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</table>
Dear Delegates, Colleagues and Friends,

It is a great pleasure to welcome you all to the 51st Annual Scientific Meeting of the International Spinal Cord Society (ISCoS) held in cooperation with our host SCI-UK, an umbrella organization, comprised of the British Association of Spinal Cord Injury Specialists, the Multidisciplinary Association of Spinal Cord Injury Professionals and the Spinal Injuries Association & Spinal Injuries Scotland. It is also comforting to be back in the country where ISCoS was founded more than fifty years ago.

All attendees can look forward to presentations of recent research within the specified themes, Long Term Outcome of SCI, Health Economics and Cost Management, and Putting Evidence into Practice, as well as Free Paper sessions. The ISCoS Scientific Committee has, together with the Local Organizing Committee, made sure that there are several workshops, including a consumer workshop, with different educational issues related to individuals with spinal cord lesions. Of particular interest, ISCoS will during the meeting launch the e-learning educational tool on the comprehensive management of spinal cord injury, which is hoped to enhance the possibility for education within the field of spinal cord injury all over the world. There are modules for the whole team, as well as for the nurses, physiotherapists, occupational therapists, psychologists, social workers and doctors – all this with consumer involvement.

The ISCoS Annual Scientific Meeting is held at the same time as the Paralympics, making it possible to enjoy the World’s best wheelchair athletics. Therefore a joint workshop has been arranged on wheelchair sport.

I am sure you also will enjoy the social events and the great city of London.

Finally on behalf of ISCoS I would like to thank you for your attendance and the sponsors for their support to the ISCoS 51st Annual Scientific Meeting.

Wishing you an enjoyable visit, both professionally and socially.

Fin Biering-Sørensen
President, ISCoS

Welcome to London!

Here in the United Kingdom we are rightly proud of our National Health Service which guarantees free health care for all at the point of need. However, political priorities mean that the distribution of resources is not always equal. In the last two decades we have seen a relative decline in service for individuals with spinal cord injury. Just over five years ago SCI-UK was created from member organisations representing all the service providers and users. This partnership has been influential in bringing about many of the current reforms to the service that you will hear about in this meeting.

It is a great honour and privilege for SCI-UK to welcome ISCoS back to the United Kingdom, its nation of birth. It is therefore appropriate that themes for the meeting should include ‘long-term outcomes’ and ‘putting evidence into practice’.

It is an exciting time to be here in London during the 30th Olympiad and we hope that, not only will you enjoy the three very full days of our Annual Scientific Meeting, but that you will also have time to take in some of the sights and events.

I would like to thank the committee of SCI-UK, the organisers of the workshops and the ISCoS scientific committee for their hard work. Our thanks also go to our generous sponsors. Lastly, I would like to thank all of you in advance for making this, what I am sure will be, a very successful meeting.

On behalf of SCI-UK, I hope you all have a great time.

Martin McClelland FRCS FRCP
Chairman of the Organising Committee of ISCoS 2012 ASM
The Officers of ISCoS

President: Prof Fin Biering-Sørensen (Denmark)
President Elect: A/Prof D J Brown (Australia)
Past President: Mr W El Masri (UK)
Honorary Secretary: Dr S Katoh (Japan)
Honorary Treasurer: Mr M McClelland (UK)
Editor of Spinal Cord: Prof J J Wyndaele (Belgium)

Non-Executive Officers

Vice Presidents
Africa: Dr E Baalbergen (South Africa)
Europe: Dr F Abel (Germany)
Latin America: Dr F Montero (Costa Rica)
North America: Dr M Sipski (North America)
Oceania: Dr R Marshall (Australia)
SE Asia: Hyun-Yoon Ko (Korea)

The Committee Chairs

Education: Dr H S Chhabra (India)
Nominations: Prof F Biering-Sorensen (Denmark)
Prevention: Dr D Brown (Australia)
Scientific: Dr S Charlifue (USA)
Membership: Dr I Lanig (USA)

Executive Administrator: M Bint (UK)

ISCoS Affiliated Societies

Affiliated Societies Representatives

AFIGAP Dr B Perrouin-Verbe (France)
APS Dr I Lanig (USA)
ASIA Dr L Vogel (USA)
ANZSCoS Dr S Urquhart (Australia)
ASCoN Dr F Hoque (Bangladesh)
CARDP-SoSCI Prof D Wang (UK)
DMGP Dr Y-B Kalke (Germany)
DUFSCoS Dr G Snoek (Netherlands)
JASCoL Dr S Katoh (Japan)
KoSCoS Dr HY Ko (Korea)
NoSCOS Dr A-K Karlsson (Sweden)
SASCA Dr F Theron (South Africa)
ReSCoS Dr G Onose (Romania)
SEP Dr J Benito (Spain)
SLAP Dr J M D’Andrea Greve (Brazil)
SoMIPAR Dr C Pilati (Italy)
Spinal Cord Society – Indian Chapter Dr H S Chhabra (India)
TrSCD Dr M Akyüz (Turkey)
### Meeting Organising Committee

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Company/Institution</th>
<th>Location</th>
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<tbody>
<tr>
<td>Mr M McClelland</td>
<td>Chairman</td>
<td></td>
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<tr>
<td></td>
<td>Consultant in Spinal Injuries</td>
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<tr>
<td></td>
<td>Honorary Senior Lecturer, University of Sheffield, UK</td>
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<tr>
<td>Ms Liz Anderson</td>
<td>Chairman</td>
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<td></td>
<td>Spinal Injuries Scotland, UK</td>
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<tr>
<td>Mr John Borthwick</td>
<td>Chairman</td>
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<td></td>
<td>Spinal Injuries Association, UK</td>
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<tr>
<td>Mr Brian Gardner</td>
<td>Consultant Spinal Cord Injury</td>
<td>Buckinghamshire Healthcare NHS Trust, UK</td>
<td></td>
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<tr>
<td>Dr Angela Gall</td>
<td>Spinal Rehabilitation</td>
<td>Royal National Orthopaedic Hospital NHS Trust, UK</td>
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<tr>
<td>Dr Alison Graham</td>
<td>Consultant Physician Spinal Injuries</td>
<td>Buckinghamshire Healthcare NHS Trust, UK</td>
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<tr>
<td>Professor Paul Kennedy</td>
<td>Professor of Clinical Psychology</td>
<td>Director (Academic and Research) University of Oxford, UK</td>
<td></td>
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<tr>
<td>Dr Fred Middleton</td>
<td>Spinal Rehabilitation Consultant</td>
<td>Spinal Research Centre, Royal National Orthopaedic Hospital, UK</td>
<td></td>
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<tr>
<td>Mr Paul Smith</td>
<td>Executive Director</td>
<td>Spinal Injuries Association, UK</td>
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### Scientific Committee

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Company/Institution</th>
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<tr>
<td>Dr S Charlifue</td>
<td>Chair</td>
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<tr>
<td>Dr M Akuyz</td>
<td>2013 Rep</td>
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<td>Dr S Aito</td>
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<tr>
<td>Prof F Biering-Sørensen</td>
<td>President</td>
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<tr>
<td>Professor D J Brown</td>
<td>Vice President Chair, Prevention Committee</td>
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<td>Prof A Catz</td>
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<tr>
<td>Dr HS Chhabra</td>
<td>Chair, Education Committee and 2010 Rep</td>
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<tr>
<td>Prof H L Frankel</td>
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<td>Dr M Haak</td>
<td>2011 Rep</td>
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SCI-UK would like to thank the following for their help in the early stages of organising the 51st ISCoS Conference:

Fletchers Solicitors, Southport
Barratt, Goff & Tomlinson Solicitor’s, Nottingham
Withy King Solicitors, London
Potter Rees Solicitors, Manchester
Outer Temple Chambers, London
Byrom Street Chambers, Manchester
Gerald McDermott QC
<table>
<thead>
<tr>
<th>Year</th>
<th>ISCoS Society Medal Holders</th>
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<th>ISCoS Society Medal Holders</th>
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<tr>
<td>1975-76</td>
<td>Sir Ludwig Guttmann (UK)</td>
<td>1999</td>
<td>Dr William Geisler (Canada)</td>
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<td></td>
<td>Dr Ernest Bors (USA)</td>
<td>2000</td>
<td>Prof John Yeo (Australia)</td>
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<td>1978</td>
<td>Dr L Michaelis (UK)</td>
<td>2001</td>
<td>Prof J J Wyndaele (Belgium)</td>
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<td>Sir George Bedbrook (Australia)</td>
<td>2002</td>
<td>Mr W EL MASRI (UK)</td>
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<td>1979</td>
<td>Dr Marc Maury (France)</td>
<td>2003</td>
<td>Prof Giles Brindley (UK)</td>
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<td>Dr J S Young (USA)</td>
<td>2004</td>
<td>Prof William Donovan (USA)</td>
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<td>Dr A G Hardy (UK)</td>
<td>2005</td>
<td>Dr Ray Shrosbree (South Africa)</td>
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<td>1982</td>
<td>Prof Fred Meinecke (Germany)</td>
<td>2006</td>
<td>Dr Lee Illis (UK)</td>
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<td>1983</td>
<td>Pror Hans Frankel (UK)</td>
<td>2007</td>
<td>Dr Fin Biering-Sorensen (Denmark)</td>
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<td>1984</td>
<td>Dr Y Nakamura (Japan)</td>
<td>2008</td>
<td>Dr J Ditunno (USA)</td>
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<td>1985</td>
<td>Dr M Weiss (Poland)</td>
<td>2009</td>
<td>A/Prof D J Brown (Australia)</td>
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<td></td>
<td>Mr Phillip Harris (UK)</td>
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<td>Dr P Meyer (USA)</td>
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<td>1986</td>
<td>Dr H Hahn (USA)</td>
<td>2010</td>
<td>A/Prof A Kovindha (Thailand)</td>
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<td></td>
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<td>Dr I Perkash (USA)</td>
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<td>1987</td>
<td>Professor Alain Rossier (Switzerland)</td>
<td>2011</td>
<td>Marianne Bint (UK)</td>
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<td>1988</td>
<td>Dr Al Jousse (Canada)</td>
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<td>Dr E Iwatsubo (Japan)</td>
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<td>1989</td>
<td>Mr J Cosbie Ross (UK)</td>
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<td>1990</td>
<td>Dr Paul Dolffus (France)</td>
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<td>1991</td>
<td>Dr Ed Carter (USA)</td>
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<td>1992</td>
<td>Dr A Key (South Africa)</td>
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<td></td>
<td>(Deceased)</td>
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<td>1993</td>
<td>Air Marshal (Rtd) Amar Chahal (India)</td>
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<td>1994</td>
<td>Mr Isaac Nuseibeh (UK)</td>
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<td>1995</td>
<td>Dr Avrom E Cornarr (USA)</td>
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<td>Dr Guido Zäch (Switzerland)</td>
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<td>Prof Helmut Madersbacher (Austria)</td>
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<tr>
<td>1998</td>
<td>Prof Takaaki Ikata (Japan)</td>
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International Spinal Cord Society

Founder and First President: 1961 – 1970
Prof Sir Ludwig Guttmann, CBE, FRS

Presidents of ISCoS

<table>
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<tr>
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<th>Country</th>
<th>Years</th>
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<tbody>
<tr>
<td>Dr H Talbot</td>
<td>USA</td>
<td>1970 - 1973</td>
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<tr>
<td>Dr A Tricot</td>
<td>Belgium</td>
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<td>Prof V Paesslack</td>
<td>Germany</td>
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<td>Sir George Bedbrook</td>
<td>Australia</td>
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<tr>
<td>Prof A Rossier</td>
<td>Switzerland</td>
<td>1984 - 1988</td>
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<tr>
<td>Dr E Carter</td>
<td>USA</td>
<td>1988 - 1992</td>
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<tr>
<td>Dr P Dollfus</td>
<td>France</td>
<td>1992 - 1996</td>
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<tr>
<td>Dr HL Frankel</td>
<td>UK</td>
<td>1996 - 2000</td>
</tr>
<tr>
<td>Prof T Ikata</td>
<td>Japan</td>
<td>2000 - 2004</td>
</tr>
<tr>
<td>Prof W Donovan</td>
<td>USA</td>
<td>2004 - 2008</td>
</tr>
<tr>
<td>Mr W S El-Masry</td>
<td>UK</td>
<td>2008 – 2010</td>
</tr>
<tr>
<td>Prof F Biering-Sorensen</td>
<td>Denmark</td>
<td>2010 – 2012</td>
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</table>

The Sir Ludwig Guttmann Lecture was established by the International Medical Society of Paraplegia, now the International Spinal Cord Society, to recognize the pioneering work and lifelong contribution of Sir Ludwig Guttmann, the originator of modern multidisciplinary spinal cord care.

He was the first President of the International Medical Society of Paraplegia at its inception in 1961 and the first Editor of the journal of the Society, Paraplegia, which is now known as Spinal Cord. Dr Guttmann was the inspiration and founder of what is currently the Paralympics. In the mid 1940’s, while treating young veterans at the Stoke Mandeville Spinal Injuries Unit in England, Dr Guttmann introduced sport and exercise as mandatory activities for the patients, thus rebelling against the widespread nihilism with which the rehabilitative potential of spinal cord injuries was regarded. From the first Stoke Mandeville Games for the paralysed that Dr Guttmann organized for 16 archers in July of 1948, the athletic movement for individuals with spinal cord injuries has grown tremendously.

He retired from clinical work in 1966 but continued his involvement with sport until he passed away in 1980, leaving his message that “spinal cord injured patients should be transferred as soon as possible to a specialized spinal injuries unit”.

Sir Ludwig Guttmann’s tireless effort and vision touched thousands of lives around the world - a legacy to be remembered and honoured by this Lectureship.

It has become a tradition at the annual conference for ISCoS to invite a leading specialist in the field to present The Guttmann lecture.

1981 Sir George Bedbrook, Australia, (President of IMSoP 1980-84)
1993 William C Degroot, USA
2002 James Fawcett, UK
2004 Prof B Kakulas, Australia
2005 Prof Helmut Madersbacher, Austria
2006 Dr Michael J DeVivo, USA
2007 Dr Kristjan T Ragnarsson, USA
2008 Ass Prof Philip Siddall, Australia
2009 Dr John F Ditunno, USA
2010 Prof W H Donovan, USA (President of ISCoS 2004-08)
2011 Dr Daniel P Lammertse, USA

The Sir Ludwig Gutmann Lecture will take place on Monday, 3rd September 2012 at 16:30 in the Churchill Auditorium and will be delivered by Dr Hans Ludwig Frankel, OBE, MB, FRCP
Dr Hans Ludwig Frankel, OBE, MB, FRCP
Guttmann Lecturer 2012

Few are more qualified to honour Sir Ludwig Guttmann than Dr Hans Ludwig Frankel, his understudy and colleague for more than 22 years, 1958-1980 (Guttmann’s death). Dr Frankel was called on frequently over the years to pay tribute to his Mentor. On the occasion of Dr Guttmann’s 70th birthday, Dr Frankel was asked and delivered his famous paper defining the Frankel Grades (Frankel 1969), the most frequently cited outcome measure for the study of spinal cord injury in the literature today (Ditunno 2010). Dr Frankel was one of the successors to Sir Ludwig at Stoke Mandeville Hospital and continued the tradition of dedicated care, learning and research at this institution so dear to its Founder. Dr Frankel has also continued Sir Ludwig’s work at the British Paraplegic Sports Society (now WheelPower), IMSoP (now ISCoS) and the journal Paraplegia (now Spinal Cord), all founded by Guttmann.

Who other than Hans Frankel could have described his Mentor with such profound respect as on the occasion of his “100th Birthday” in 1999?

“Those who never met Guttmann wonder how he achieved so much. He was a small man of immense energy and when he became animated he seemed to grow in size and almost filled the room. He was both loved and feared and inspired great loyalty in his followers.”

John F Ditunno, Jr. MD
Professor of Rehabilitation Medicine, Jefferson Medical College
Philadelphia, USA

Acknowledgements

The International Spinal Cord Society kindly acknowledges the generous support from the following companies for the ISCoS Annual Scientific Meeting 2012
Meeting Information

Date
The ISCoS 2012 Scientific Meeting takes place from Monday, 3rd September until Wednesday, 5th September 2012.

Venue
The Queen Elizabeth II Conference Centre,
Broad Sanctuary
Westminster
London SW1P 3EE
Telephone: 020 7222 5000.
Fax: 020 7798 4200.
E-mail: info@qeiicc.co.uk
http://www.qeiicc.co.uk/

Registration
On-site registration will start on Sunday, 2nd September at 16:00 hours. The registration desk and meeting secretariat is located in the foyer of the QEII Conference Centre and will remain open during the following hours:
Sunday, 2nd September 2012 16:00 - 20:00
Monday, 3rd September 2012 07:30 - 21:00
Tuesday, 4th September 2012 07:30 - 17:30
Wednesday, 5th September 2012 07:30 - 16:00

Access for Disabled Persons
The Centre has nine passenger lifts, all of which are large enough to accommodate a wheelchair. There are eight accessible toilet facilities through the Centre: These are equipped with emergency alarms and can be accessed from function rooms by using lifts where necessary.

Badges
Please wear your registration badge at all times.
All participants are required to wear identification badges when attending sessions, social events and when entering the exhibition. If you lose your badge, please go to the registration desk where a new badge will be made for you.

Accreditation & Evaluation
The Royal College of Physicians has awarded the Meeting a maximum of 18 CME credits. Attendees requesting CME credit are required to complete an online evaluation form. The details of how to complete the evaluation form will be sent to all delegates a few weeks after the Meeting by email.

Chairpersons & Speakers
Please ensure that you are available in your presentation room at least ten minutes before the start of the session. It is recommended that all speakers visit the Speaker Preview Room (East Long Room) in order to hand in presentations and confirm audiovisual requirements at least two hours prior to the start of the session.

Exhibition
An exhibition is being held in conjunction with the Meeting. The exhibition is located in the Fleming Room and the Benjamin Britten Lounge on the 3rd floor of the QEII. The official opening hours are as follows:

Exhibition Opening Hours:
Monday, 3rd September 2012 10:15-19:15
Tuesday, 4th September 2012 08:00-18:15
Wednesday, 5th September 2012 08:00-17:00

Posters
Posters will be displayed in the Pickwick Room from Monday, 3rd September 2012 until Wednesday, 5th September 2012.
All poster presenters should please ensure that they mount their poster by the correct poster number.
Poster presenters should refer to the list of poster presentations included in this final programme for their board numbers.
Delegates are encouraged to view the posters during the official tea/coffee and lunch breaks. Please note that the Organising Committee, The Queen Elizabeth II Conference Centre or Kenes UK will not be responsible for any posters that are not removed by the end of the Meeting.

Language
English is the official language of the Meeting.

Lunches and Refreshments
Coffee, tea and lunch will be served during the official breaks within the Exhibition Area.

Mail/Messages/Medical Assistance/Lost & Found
Please go to the Registration Desk.

Mobile Phones
As a courtesy to speakers and other participants, all mobile phones must be turned off before entering the scientific sessions.

Wi-Fi Lounge
A Wi-Fi lounge is located in the Fleming Room, kindly sponsored by Lofric.
To receive your access card, please visit Lofric at stand number 27
Social Programme

Welcome Reception
The Queen Elizabeth II Conference Centre- Exhibition Area
Monday, 3rd September 2012
17:15 - 19:15

This reception is kindly sponsored by:

Gala Dinner
Imperial War Museum
Tuesday, 4th September, 2012
19:30 until late

Imperial War Museum
Lamberth Road
London
SE1 6HZ
Website: www.iwm.org.uk

Coach transfers will be available from the Park Plaza hotel, the Double Tree Westminster hotel and the QEII conference centre from 19:15 hours. Please ensure you are in the lobby from 19:00 onwards in order to board the coach. Please note that coaches will depart promptly at 19:15.

Nearest Tube Stations:
Lambeth North (Bakerloo Line)
Waterloo (Bakerloo, Northern, Jubilee Line)
Southwark (Jubilee Line)
Elephant & Castle (Bakerloo, Northern Line)

Tickets for this event are now sold out but if you are interested in attending please visit the registration desk in the foyer of the QEII as there may be some last minute availability.

Liability & Insurance
The Organising Committee and The Queen Elizabeth II Conference Centre accept no liability for any for any injury or damage involving persons and property during the Meeting. Delegates are advised to take out their own personal insurance to cover travel, accommodation, cancellation and personal effects.

ISCoS headquarters:
For further information on ISCoS, please contact:

ISCoS Headquarters
National Spinal Injuries Centre
Stoke Mandeville Hospital
Aylesbury
Bucks
HP21 8AL, UK
Tel: +44 1296 315 866
Fax: +44 1296 315870
Email: admin@iscos.org.uk
Website: www.iscos.org.uk

Organising Secretariat
Kenes UK Ltd
Chesterfield House
385 Euston Road
London, NW1 3AU

Tel: +44 (0) 207 383 8030
Email: iscos@kenes.com
Website: www.kenes.com/uk
Programme at a Glance
### Monday 3rd September 2012

<table>
<thead>
<tr>
<th>Time</th>
<th>Session/Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>08:30– 09:00</td>
<td>Opening Ceremony &amp; Welcome</td>
<td>CHURCHILL AUDITORIUM</td>
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<td>09:00 – 09:30</td>
<td>Putting Evidence into Practice – the Importance of Partnerships</td>
<td>CHURCHILL AUDITORIUM</td>
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<td>09:30 – 10:15</td>
<td><strong>KEYNOTE LECTURE</strong> A new paradigm for measuring outcomes in Spinal Cord Injury medicine: Relevant outcomes for clinical trials and clinical practice</td>
<td>CHURCHILL AUDITORIUM</td>
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<tr>
<td>10:15 – 10:45</td>
<td>Tea/Coffee Break in Exhibition Area</td>
<td>CHURCHILL WHITTLE ROOM ST JAMES SUITE WESTMINSTER SUITE</td>
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<tr>
<td>10:45 – 12:45</td>
<td><strong>Award Eligible Papers (ends at 13.05)</strong></td>
<td>CHURCHILL WHITTLE ROOM ST JAMES SUITE WESTMINSTER SUITE</td>
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<tr>
<td>12:45 – 14:00</td>
<td>Lunch Break/Exhibition &amp; Poster Viewing</td>
<td>CHURCHILL AUDITORIUM</td>
</tr>
<tr>
<td>14:00 – 14:45</td>
<td><strong>Keynote Lecture</strong> Global Disparities in Income and Care</td>
<td>CHURCHILL AUDITORIUM</td>
</tr>
<tr>
<td>14:45 – 16:15</td>
<td><strong>Long-term Outcomes</strong> Free Papers (ends at 16:15)</td>
<td>CHURCHILL AUDITORIUM</td>
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<tr>
<td>16:15 – 16:30</td>
<td>Tea/Coffee Break in Exhibition Area</td>
<td>CHURCHILL AUDITORIUM</td>
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### Tuesday 4th September 2012

<table>
<thead>
<tr>
<th>Time</th>
<th>Session/Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>08:30 – 09:00</td>
<td>Plenary 4 Plenary Session E-Learning Launch</td>
<td>CHURCHILL AUDITORIUM</td>
</tr>
<tr>
<td>09:00 – 10:00</td>
<td><strong>Long-term Outcomes</strong> Free Papers (ends at 10:00)</td>
<td>CHURCHILL AUDITORIUM</td>
</tr>
<tr>
<td>10:00 – 10:30</td>
<td>Tea/Coffee Break in Exhibition Area</td>
<td>CHURCHILL AUDITORIUM</td>
</tr>
<tr>
<td>14:00 – 14:45</td>
<td><strong>Keynote Lecture</strong> Improving long-term outcomes after spinal cord injury</td>
<td>CHURCHILL AUDITORIUM</td>
</tr>
<tr>
<td>14:45 – 16:15</td>
<td><strong>Long-term Outcomes</strong> Review of current recommended treatment and management practices of children and adolescents with a spinal cord injury</td>
<td>CHURCHILL AUDITORIUM</td>
</tr>
<tr>
<td>16:15 – 16:30</td>
<td>Tea/Coffee Break in Exhibition Area</td>
<td>CHURCHILL AUDITORIUM</td>
</tr>
<tr>
<td>16:30-17:15</td>
<td><strong>Keynote Lecture</strong> Putting Evidence into Practice</td>
<td>CHURCHILL AUDITORIUM</td>
</tr>
<tr>
<td>17:15 – 18:15</td>
<td>How to get published Spinal Cord – Nature Publishing Group</td>
<td>ST JAMES SUITE</td>
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<tr>
<td>19:15 onwards</td>
<td>Gala Dinner</td>
<td>ST JAMES SUITE</td>
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<td>Imperial War Museum</td>
<td>ST JAMES SUITE</td>
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<td></td>
<td>Coach Transfers will be provided from the Park Plaza Hotel, the Double Tree Hotel and the QEII Conference Centre.</td>
<td>ST JAMES SUITE</td>
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<td>Details can be found on delegate’s invitation tickets</td>
<td>ST JAMES SUITE</td>
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### Wednesday 5th September 2012

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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</thead>
<tbody>
<tr>
<td><strong>08:15 – 09:00</strong></td>
<td><strong>Plenary 7</strong>&lt;br&gt;<strong>ISRT Lecture</strong>&lt;br&gt;<strong>Beyond the Injury, Before the Cure: Neuroprostheses for Function &amp; Health</strong>&lt;br&gt;Mike Craggs, UK&lt;br&gt;<strong>CHURCHILL AUDITORIUM</strong></td>
</tr>
<tr>
<td><strong>09:00 – 10:20</strong></td>
<td><strong>Parallel 6</strong>&lt;br&gt;<strong>Free Papers</strong>&lt;br&gt;<strong>Economics</strong>&lt;br&gt;<strong>ISRT: Advances in preclinical repair: influencing the good and the bad in neuroplasticity</strong>&lt;br&gt;<strong>Imaging of Spinal Cord Injury: Present and Future</strong>&lt;br&gt;<strong>09:00– 10:20</strong>&lt;br&gt;Tea/Coffee Break in Exhibition Area&lt;br&gt;<strong>10:20– 10:45</strong>&lt;br&gt;Tea/Coffee Break in Exhibition Area</td>
</tr>
<tr>
<td><strong>10:45 – 12:45</strong></td>
<td><strong>Parallel 7</strong>&lt;br&gt;<strong>Free Papers</strong>&lt;br&gt;<strong>Health</strong>&lt;br&gt;<strong>Economics</strong>&lt;br&gt;<strong>Quantitative neuroimaging of the spinal cord and brain following spinal trauma</strong>&lt;br&gt;<strong>Legal Symposium: How much is enough?</strong>&lt;br&gt;<strong>10:45 –12:45</strong>&lt;br&gt;<strong>12:45 – 14:15</strong>&lt;br&gt;<strong>AGM in WHITTLE ROOM</strong>&lt;br&gt;<strong>Introduction to National Care Pathways for the Management of SCI Patients – Launch Event in the WESTMINSTER SUITE</strong>&lt;br&gt;<strong>12:45 – 14:15</strong>&lt;br&gt;Lunch Break/Exhibition &amp; Poster Viewing&lt;br&gt;<strong>14:15 – 15:00</strong>&lt;br&gt;<strong>Plenary 8</strong>&lt;br&gt;<strong>Keynote Lecture</strong>&lt;br&gt;<strong>Health Economics and Cost Management</strong>&lt;br&gt;Steve Morris, UK&lt;br&gt;<strong>CHURCHILL AUDITORIUM</strong></td>
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<tr>
<td><strong>15:00 – 16:45</strong></td>
<td><strong>Parallel 8</strong>&lt;br&gt;<strong>Free Papers</strong>&lt;br&gt;<strong>Paralympics Workshop</strong>&lt;br&gt;<strong>Free Papers</strong>&lt;br&gt;<strong>Current Concepts in Management of Unstable Spine</strong>&lt;br&gt;<strong>15:00 – 16:45</strong>&lt;br&gt;Tea/Coffee Break&lt;br&gt;<strong>16:45 – 17:00</strong>&lt;br&gt;<strong>17:00 – 17:45</strong>&lt;br&gt;Closing Ceremony / Award Presentations&lt;br&gt;<strong>CHURCHILL AUDITORIUM</strong></td>
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### Venue maps

[Venue map image]

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Meetings Schedule

Monday, September 3rd:
Physio Network Meeting
Chaired by Lisa Harvey
12:45 – 14:00  Wesley Room, 4th Floor

Tuesday, September 4th:
Quality of Life Meeting
Chaired by Susan Charlifue
12:30 – 14:00  Robert Burns Room, 4th Floor

Wednesday, September 5th:
Consumer Group
Chaired by Jane Horsewell
11:00 – 13:00  Abbey Room, 4th Floor

Visit to the National Spinal Injuries Centre, Stoke Mandeville Hospital, Aylesbury, Bucks, HP21 8AL

Mr F Derry, Consultant Surgeon in Spinal Injuries is happy to welcome visitors to the NSIC on Wednesday 5th September 2012 at 12.00 where a short visitors’ programme has been arranged. Anyone wishing to attend must register their names to the ISCoS Desk beforehand. The Desk is located in the exhibition area on the 3rd Floor of the QEII conference centre.
Scientific Programme
Monday 3rd September 2012

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>08:30 – 09:00</td>
<td>Opening Ceremony and Welcome</td>
</tr>
<tr>
<td>09:00</td>
<td>Putting Evidence into Practice: The Importance of Partnerships</td>
</tr>
<tr>
<td>09:30</td>
<td>Plenary 1: Keynote Lecture: A new paradigm for measuring outcomes in Spinal Cord Injury medicine: Relevant outcomes for clinical trials and clinical practice</td>
</tr>
<tr>
<td>10:45</td>
<td>Parallel 1: Award Eligible Papers</td>
</tr>
<tr>
<td>11:45</td>
<td>Trends in age-adjusted cause-specific mortality rates after spinal cord injury</td>
</tr>
<tr>
<td>12:05</td>
<td>Impaired neurological recovery of spinal cord injured patients with infections</td>
</tr>
<tr>
<td>12:45</td>
<td>Late bladder management in persons ageing with spinal cord injury</td>
</tr>
<tr>
<td>13:05</td>
<td>LUNCH BREAK/EXHIBITION AND POSTER VIEWING</td>
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</table>

Room: Churchill Auditorium
Chairpersons: Fin Biering-Sørensen and Martin McClelland

Plenary 1: Keynote Lecture:
09:30 A new paradigm for measuring outcomes in Spinal Cord Injury medicine: Relevant outcomes for clinical trials and clinical practice
David Tulsky, USA

Parallel 1: Award Eligible Papers
Chairpersons: Gordana Savic and Susan Charlifue

10:45 Improved diagnosis of spinal cord disorders by the neurophysiological assessment of spinothalamic pathways
A Ulrich1; J Haefeli1; J Blum1; K Min1; A Curt1
1Spinal Cord Injury Centre, Balgrist University Hospital, Switzerland; 2Department of Orthopaedic Surgery, Balgrist University Hospital, Switzerland

11:05 Development and Validation of SCIM-SR (Spinal Cord Independence Measure III for self-report)
C Fekete1; I Eriks-Hoogland1; M Baumberger2; A Catz2; H Lüthi3; M Post4; E von Elm5; A Wyssb, O Brinkhof5
1Swiss Paraplegic Research, Switzerland; 2Swiss Paraplegic Center Nottwil, Switzerland; 3Loewenstein Rehabilitation Hospital, Israel; 4Swiss Paraplegic Center Rehab Basel, Switzerland; 5Rehabilitation Center De Hoogstraat and Rudolf Mag, Netherlands; 6University Hospital Lausanne, Switzerland

11:25 Neuroprotective Therapy using Granulocyte Colony Stimulating Factor for Acute Spinal Cord Injury: A Phase IIb Prospective Controlled Clinical Trial
Hiroshi Takahashi; Masashi Yamazaki; Akihiko Okawa; Tsuyoshi Sakuma; Kei Kato; Koshiro Kamiya; Masao Koda; Kazuhisa Takahashi Orthopaedic Science, Chiba University, Japan
Parallel 1: **What Factors and outcomes should be understood prior to clinical trials involving participants with an incomplete spinal cord injury?**

Chairperson: John Steeves  
Time: 10:45 – 12:45  
Room: Whittle Room

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10:45  
**Introduction**  
John Steeves  
International Collaboration On Repair Discoveries, ICORD, Canada

10:50  
**Background, overall challenges and goals of the session**  
Dan Lammertse  
Craig Hospital, Englewood, CO, USA

11:10  
**Explanation of the statistical analysis algorithm**  
Lorenzo Tanadini  
Balgrist University Hospital, Zurich, Switzerland

11:30  
**Examples of what works and does not work for early prediction, stratification and inclusion of iSCI participants in trials**  
John Steeves  
International Collaboration On Repair Discoveries, ICORD, Canada

11:50  
**Summation of ongoing challenges and necessary steps for inclusive trial approaches**  
Armin Curt  
Balgrist University Hospital, Zurich, Switzerland

12:10  
**Panel and audience discussion**  
Chair: Linda Jones  
Geron Corporation Menlo Park, CA, USA

Panel including:  
Bill Donovan, TIRR, Houston, Texas, USA  
Ed Wirth, Geron Corporation, Menlo Park, CA., USA  
James Fawcett, University of Cambridge Centre for Brain Repair, Cambridge, UK

12:45  
**LUNCH BREAK/EXHIBITION AND POSTER VIEWING**

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**Monday 3rd September 2012**

**Parallel 1:**  
**Free Papers**

Chairpersons: Dirk van Kuppervelt and Aheed Osman  
Time: 10:45 – 12:45  
Room: St James Suite

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10:45  
**Clinical usefulness of ultrasound assessment of detrusor thickness in patients with neurogenic bladder dysfunction due to spinal cord injury**  
Jürgen Pannek1; Peter Bartel1; Konrad Goecking1; Angela Frotzler2  
1Neuro-Urology, Swiss Paraplegic Center, Switzerland; 2Clinical Trial Unit, Swiss Paraplegic Center, Switzerland

11:00  
**Corticospinal plasticity of sphincter function induced by repetitive transcranial magnetic stimulation in spinal cord injury: towards a therapy**  
Natalia Vásquez1; Peter Ellaway1; Sarah Knight1; Judith Susser1; Angela Gall1; Michael Craggs1  
1London Spinal Cord Injuries Centre, Royal National Orthopaedic Hospital, United Kingdom; 2Clinical Neuroscience, Imperial College, United Kingdom

11:15  
**Are Antimuscarinics still justified in the era of Botulinum Toxin A? A review on Antimuscarinics in SCI**  
Helmut Madenschläger1; Manfred Stöhrer2  
1Neurology Department, University Hospital Innsbruck, Austria; 2Urology and Pediatric Urology, University of Essen, Germany

11:30  
**Audit of cystourethroscopic surveillance in spinal cord injured Patients with indwelling catheter at Midlands centre for spinal injuries, Oswestry**  
Siddeshwar Patil1; Prasanna Kappaganthu; Wagih El Masri  
RJAH Orthopaedic Hospital, United Kingdom

11:45  
**Trans Anal Irrigation by means of Peristeen: evidences for a motor response characterized by propagating contractions as possible mechanism of action**  
Gabriele Bazzocchi1; E Poletti; A Avogadri  
Gastroenterological Rehabilitation, Montecatone Rehabilitation Institute, Italy

12:00  
**Bowel function and quality of life after colostomy in spinal cord lesioned individuals**  
Rikke Boelling Hansen1; M Staun2; A Kalhauge2; E Langholz2; F Biering-Sørensen1  
1Clinic for Spinal Cord Injuries, Rigshospitalet, Denmark; 2Department of Gastroenterology., Rigshospitalet, Denmark; 3Department of Radiology, Rigshospitalet, Denmark

12:15  
Discussion

12:45  
**LUNCH BREAK/EXHIBITION AND POSTER VIEWING**
<table>
<thead>
<tr>
<th>Time</th>
<th>Abstract No</th>
<th>Title</th>
<th>Speaker(s)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:45</td>
<td>S2</td>
<td>The World Report on Disability – Main findings, implications for SCI and implementation progress (WRD)</td>
<td>Alana Officer, WHO, Switzerland</td>
<td>Westminster Suite</td>
</tr>
<tr>
<td>11:25</td>
<td>S3</td>
<td>The International Perspectives on Spinal Cord Injury (IPSCI): Why a specific disability report for SCI - What IPSCI has to offer</td>
<td>Jerome Bickenbach, Swiss Paraplegic Research, Switzerland</td>
<td></td>
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<tr>
<td>11:45</td>
<td>S4</td>
<td>Application and implementation of IPSCI</td>
<td>David Gray, Washington University School of Medicine, USA</td>
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<tr>
<td>12:05</td>
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<td>Questions from the audience to the podium</td>
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<tr>
<td>12:45</td>
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<td>LUNCH BREAK/EXHIBITION AND POSTER VIEWING</td>
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**Symposia Sponsored by Coloplast**

**Bladder and Beyond**

Chairperson: Professor Jean-Jacques Wyndaele

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<th>Time</th>
<th>Abstract No</th>
<th>Title</th>
<th>Speaker(s)</th>
<th>Location</th>
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<tr>
<td>12:45</td>
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<td>Arrival of delegates and seating with lunch boxes</td>
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<tr>
<td>12:55</td>
<td></td>
<td>Introduction</td>
<td>Professor Jean-Jacques Wyndaele</td>
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<tr>
<td>13:00</td>
<td></td>
<td>QoL of patients on intermittent self catheterization: Results of the SpeediCath Compact RCT</td>
<td>Dr. med. Burkhard Domurath</td>
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<tr>
<td>13:25</td>
<td></td>
<td>QoL Panel discussion:</td>
<td>Dr. Clive Glass, Dr. Marcel Post, Mrs. Winnifred de Moe, Dr. Domurath, Professor Wyndaele</td>
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<tr>
<td>13:55</td>
<td></td>
<td>Closing Remarks</td>
<td>Professor Jean-Jacques Wyndaele</td>
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### Monday 3rd September 2012

#### Parallel 2: Free Papers

**Chairpersons:** James Middleton and Bakul Soni

**Time:** 14:45 – 16:00

**Room:** Whittle Room

**Abstract No:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
<th>Institutions</th>
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<tbody>
<tr>
<td>14:45</td>
<td>Inter-rater reliability of the International Standards for Neurological Classification of Spinal Cord Injury by using electromyography</td>
<td>Zee-A Han¹; Ji Cheol Shin²; Jeehyun Yoo²; Su Jin Yu²</td>
<td>¹NHIC Ilsan Hospital, South Korea; ²Yonsei University College of Medicine, South Korea</td>
</tr>
<tr>
<td>15:00</td>
<td>ISNCSCI Calculator (International Standards for the Neurological Classification of Spinal Cord Injury)</td>
<td>William Waring¹; Eduardo Echeverria²; Steven Kirshblum³; Ronald Reeves¹</td>
<td>¹Physical Medicine and Rehabilitation, Medical College of Wisconsin, USA; ²Rick Hansen Institute, Canada; ³Physical Medicine and Rehabilitation, Kessler Institute, USA</td>
</tr>
<tr>
<td>15:15</td>
<td>Autonomic and motor recovery from cervical contusion boosted by midbrain stimulation</td>
<td>Ian Hentall; Alberto Vitores; Melissa Carballosa Gonzalez</td>
<td>The Miami Project to Cure Paralysis, University of Miami, USA</td>
</tr>
<tr>
<td>15:30</td>
<td>Intra- and interrater reliability of the Modified Ashworth Scale in individuals with Spinal Cord Injury</td>
<td>Ulla Via Nissen; Mette Skov Henriksen; Inge Bjergaard; Alec Ellenson; Fin Biering-Sørensen</td>
<td>Clinic for Spinal Cord Injuries, Glostrup hospital / Rigshospitala, Denmark</td>
</tr>
<tr>
<td>15:45</td>
<td>The reliability of SCIM III by interview</td>
<td>Malka Itzkovich¹; I Front²; T Poliack³; H Shefler³; S Schachner³; I Gelenter³; A Catz³</td>
<td>¹Loewenstein Hospital, Tel Aviv University, Israel; ²Loewenstein Hospital, Israel; ³Tel Aviv University, Israel</td>
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<tr>
<td>16:00</td>
<td>TEA/COFFEE BREAK AND POSTER VIEWING</td>
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#### Monday 3rd September 2012

#### Parallel 2: Free Papers

**Chairperson:** Angela Gall

**Time:** 14:45 – 16:00

**Room:** St James Suite

**Abstract No:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
<th>Institutions</th>
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<tbody>
<tr>
<td>14:45</td>
<td>Effects of granulocyte colony stimulating factor (G-CSF) on central neuropathic pain after spinal cord injury</td>
<td>Kei Kato¹; M Koda²; M Yamazaki³; A Okawa¹; C Manojoji¹; T Furuya¹; H Takahashi¹; T Sakuma¹; K Takahashi¹</td>
<td>¹Dept. of Orthop. Surg.,Chiba Univ., Japan; ²Dept. of Orthop. Surg., Chiba Aoba Municipal Hospital, Japan</td>
</tr>
<tr>
<td>15:00</td>
<td>Somatosensory patterns in individual with neuropathic pain after Spinal Cord</td>
<td>Mohit Arora¹; HS Chhabra²</td>
<td>¹Clinical Research, Indian Spinal Injuries Centre, India; ²Department of Spine Service, Indian Spinal Injuries Centre, India</td>
</tr>
<tr>
<td>15:15</td>
<td>Voluntary modulation of EEG rhytms reduces central neuropathic pain in patients with spinal cord injury</td>
<td>Muhammad Abul Hasan¹; A Vuckovic¹; M Fraser¹; D Allan¹</td>
<td>¹School of Engineering, University Of Glasgow, United Kingdom; ²Queen Elizabeth National Spinal Injuries Unit, Southern General Hospital, Glasgow, UK, United Kingdom</td>
</tr>
<tr>
<td>15:30</td>
<td>Trajectories in the course of shoulder pain after spinal cord injury: Identification and predictors</td>
<td>Eriks-Hoogland, Inge¹; Hoekstra, T²; de Groot, S³; Post, M²; vd Woude, L³</td>
<td>¹SwiSCI, Swiss Paraplegic research/center, Switzerland; ²Department of Health Sciences and the EMGO+ Institute for Health and Care Research, ³Department of E, VU University Medical Center, Netherlands; ³Reade, center for rehabilitation and rheumatology, Netherlands; ⁴Rudolf Magnus Institute for Neuroscience, Rehabilitation Center de Hoogstraat, Netherlands; ⁵Center for Human Movement Sciences and Center for Rehabilitation, University of Groningen, Netherlands</td>
</tr>
<tr>
<td>15:45</td>
<td>Daily nutrient intake of athletes with spinal cord injury compared to able-bodied controls and standard dietary recommendations</td>
<td>Mojtahedi, MC¹; Valentine, RJ²; Evans, EM³</td>
<td>¹University of Illinois, USA; ²Boston University, USA; ³University of Georgia, USA</td>
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<td>16:00</td>
<td>TEA/COFFEE BREAK AND POSTER VIEWING</td>
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Monday 3rd September 2012

Parallel 2: **SCI Consumer Workshop**

Chairpersons: Jane Horsewell and Paul Smith

Time: 14:45 – 16:00
Room: Westminster Suite

14:45  **Introduction to the Workshop**  S5
Jane Horsewell  
European Spinal Cord Injury Federation (ESCIF), Switzerland

14:50  **Aims & Objectives of ASCoN Consumer Network**  S6
Shivjeet Singh Raghav  
Consumer Committee of Spinal Cord Society of India, India

15:00  **What's important to Americans living with SCI?**  S7
Kim Anderson-Erisman  
University of Miami, USA

15:10  **The impact of the economic crisis on the lives of people with SCI in Europe**  S8
Pietro Vittorio Barbieri  
ESCIF, Switzerland

15:20  **Improving SCI treatment and rehabilitation facilities in Malaysian hospitals: a consumer view**  S9
Bathmavahti Krishnan  
Association of Women with Disabilities Malaysia, Malaysia

15:30  **SCI in Sri Lanka- rehabilitation, consumer organisations, awareness and prevention**  S10
Cyril Siriwardana  
Spinal Injury Association, Sri Lanka, Sri Lanka

15:40  **ESCIF statement on quality in SCI rehabilitation and management**  S11
Frans Penninx  
Member of the ESCIF working group on quality in SCI rehabilitation, Board member Dwarslaesie Organisatie Nederland, The Netherlands

15:50  **Questions and concluding remarks from the Chair**
Jane Horsewell  
European Spinal Cord Injury Federation (ESCIF), Switzerland

16:00  **TEA/COFFEE BREAK AND POSTER VIEWING**

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Monday 3rd September 2012

Plenary 3  **Sir Ludwig Guttmann Lecture:**
16:30  **The contribution of Stoke Mandeville Hospital to Spinal Cord Injuries**  
Hans Frankel, OBE

17:15  **WELCOME RECEPTION IN EXHIBITION AREA ON THE 3RD FLOOR**
Tuesday 4th September 2012

Plenary 4  Launch of elearnsci.org: a global educational initiative of ISCoS

Chairpersons:  Fin Biering-Sørensen – ISCoS
              Douglas Brown – ISCoS
              HS Chhabra – Education Committee (ISCoS) & representative ISIC
              Susan Charlifue – Scientific Committee (ISCoS)

Other Dignitaries: Lisa Harvey – Representative University of Sydney
                   Stephen Muldoon – Representative Livability
                   Dave Webber – Director of Operations/Deputy Chief Executive Livability
                   Apichana Kovindha – Representative ASCoN
                   Jane Horsewell – Coordinator Consumer Advisory Committee
                   Debbie Green – Coordinator Nursing Modules
                   David Simpson – Coordinator Occupational Therapy Module
                   Shipra Chaudhary – Coordinator elearnsci.org

Time: 08:30-09:00  Room: Churchill Auditorium

Journey of elearnsci.org
H S Chhabra

Keynote Address
Fin Biering Serensen

Launch of elearnsci.org
Fin Biering Serensen

Audio Visual on elearnsci.org

Questions from the House

Tuesday 4th September 2012

Parallel 3:  Long Term Outcomes

Chairpersons: Lawrence Vogel and Allison Graham

Time: 09:00 – 10:00  Room: Churchill Auditorium

Abstract No:

09:00  Childhood onset spinal cord injury, the relationship between hip instability and scoliosis
Kirsten Hart¹; EMK Bergstrom¹; NJ Henderson²
¹Physiotherapy, National Spinal Injury Centre, United Kingdom;
²Trauma & Orthopaedics, National Spinal Injury Centre, United Kingdom

09:20  Effect of mobility on long-term outcomes of childhood-onset tetraplegic spinal cord injury
Kathy Zebracki; Kathleen Chlan; Lawrence Vogel
Shriners Hospitals for Children, USA

09:40  Lung function in spinal cord injury up to 5 years after rehabilitation: deterioration in many individuals in spite of improvement at group level
Karin Postma¹; JH Bussmann¹; JA Haisma¹; S de Groot²;
³Erasmus MC, Netherlands; ¹Reade, centre for rehabilitation and rheumatology, Netherlands; ²Radboud University Nijmegen Medical Center, Netherlands; ³Rijndam Rehabilitation Center, Netherlands

10:00  TEA/Coffe break and poster viewing
Tuesday 4th September 2012

Parallel 3: Free Papers

Chairperson: Amiram Catz

Time: 09:00-10:00
Room: Whittle Room

Abstract No:

09:00 Early onset of morphological changes of the cord and brain following acute spinal cord injury
Patrick Freund1; S Fries2; K Wolf3; N Weiskopf4; A Thompson5; A Curt1
1Spinal Cord Injury Center Balgrist, University of Zurich, Switzerland; 2Wellcome Trust Center for Neuroimaging, UCL Institute of Neurology, United Kingdom; 3Brain Repair and Rehabilitation, UCL Institute of Neurology, United Kingdom

09:15 The Graded and Redefined Assessment of Strength, Sensibility and Prehension (GRASSP) allows for reliable prediction of hand function in acute C-SCI
IM Velstra1; M Bolliger2; L Tanadini2; M Baumberger3; S Kalsi-Ryan4; JS Rietman5; A Curt2
1Clinical Trial Unit, Swiss Paraplegic Centre, Nottwil, Switzerland; 2Spinal Cord Injury Center, Balgrist University Hospital, Zurich, Switzerland; 3Swiss Paraplegic Centre, Nottwil, Switzerland; 4Toronto Western Hospital, Krembil Neuroscience Centre, Toronto, Canada; 5Roessingh Research and Development, Lab of Biomechanical Engineering, University of Twente, Enschede, Netherlands

09:30 Whole body CT in sepsis and severe sepsis in spinal cord injured patients: findings and outcomes
Ahmed Wail; L Lopez de Heredia; M Belci; RJ Hughes; TM Meagher National Spinal Injuries Centre, Stoke Mandeville Hospital, United Kingdom

09:45 Effects of a walking training on sensory-motor fMRI patterns in spinal cord injured people
Emiliana Bizzarini1; G De Maio2; C Urgesi1; C Pinzini1; M Maioroni1; S D’Agostini1; C De Colle1; B Tomasino2; A Zampa1
1Department of Rehabilitation Medicine, IMFR Udine, Italy; 2Spinal Lab , Udine, SISSA ,Trieste, Italy; 3Department of Biomedical Sciences and Technologies and Department of Philosophy, University of Udine, Italy; 4Department of Radiologic Sciences, University General Hospital - Udine, Italy; 5Scientific Institute Eugenio Medea - Udine, Italy

10:00 TEA/COFFEE BREAK AND POSTER VIEWING

Tuesday 4th September 2012

Parallel 3: E-Learning Workshop on Comprehensive Management of SCI - Session 1

Chairpersons: Apichana Kovindha and Claire Weeks

Time: 09:00-10:00
Room: St James Suite

Abstract No:

09:00 elearnsci.org: conceptualization & implementation of the project and the way forward
Stephen Muldoon

09:08 elearnsci.org: salient features and how to optimally use the resource
Shapira Chaudhary

09:16 Overview for the whole Team Module
H S Chaabra

09:34 Physiotherapists Module
Lisa Harvey

09:52 Discussion

10:00 TEA/COFFEE BREAK AND POSTER VIEWING

Parallel 3: Prevention Symposium - Session 1

Chairpersons: Hendon Murray and Doug Brown

Time: 09:00 – 10:00
Room: Westminster Suite

Abstract No:

09:00 The Royal Society for the Prevention of Accidents (ROSPA) - 100 years of accident prevention
Sheila Merril
The Royal Society for the Prevention of Accidents, United Kingdom

09:30 Recent developments in the prevention of injury in road traffic accidents
Murray Mackay OBE
Professor Emeritus of Transport Safety, Birmingham University, United Kingdom

10:00 TEA/COFFEE BREAK AND POSTER VIEWING
## Tuesday 4th September 2012

### Parallel 4: Long Term Outcomes

**Chairpersons:** Paul Kennedy and Ralph Marino  
**Time:** 10:30-12:30  
**Room:** Churchill Auditorium  
**Abstract No:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Abstract Title</th>
<th>Authors</th>
<th>Institution(s)</th>
</tr>
</thead>
</table>
| 10:30 | Neglected traumatic spinal cord injuries: Do they affect outcome              | HS Chhabra¹; M Arora²  
¹Department of Spine Service, Indian Spinal Injuries Centre, India; ²Clinical Research, Indian Spinal Injuries Centre, India |
| 11:10 | Unintentional injuries occurring after spinal cord injury                     | L. Saunders; J. Krause  
Medical University of South Carolina, USA                                                      |
| 12:10 | Discussion                                                                    |                                                                                             |
| 12:30 | LUNCH BREAK/EXHIBITION AND POSTER VIEWING                                    |                                                                                             |

### Tuesday 4th September 2012

### Parallel 4: Free Papers

**Chairperson:** Hans Frankel  
**Time:** 10:30-12:45  
**Room:** Whittle Room  
**Abstract No:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Abstract Title</th>
<th>Authors</th>
<th>Institution(s)</th>
</tr>
</thead>
</table>
| 10:30 | Implementation of therapy recording for patients with SCI in inpatient rehabilitation in 5 specialized rehabilitation centers in the Netherlands | Sacha van Langeveld; MWM Post  
Center of Excellence for Rehabilitation Medicine Utrecht, Rehabilitation Center De Hoogstraat, Netherlands |
| 10:45 | Responsiveness and Sensitivity of a Clinical Impairment Measure Specific for Tetraplegia: An International Multi-Centre Study of the GRASSP | Sukhvinder Kalsi-Ryan¹; IM Velstra²; D Beaton³; M Bolliger⁴; A Curt⁵; MR Popovic⁶; JS Reitman⁷; MG Fehlings⁸  
¹Neurosurgery, University Health Network, Canada; ²Clinical Trial Unit, Swiss Paraplegic Centre, Switzerland; ³St. Michael’s Hospital, Canada; ⁴University Hospital Balgrist, Switzerland; ⁵Toronto Rehabilitation Institute, Canada; ⁶University of Twente, Enschede, Netherlands; ⁷University Health Network, Canada |
| 11:00 | Therapists’ ability to predict future mobility for people with spinal cord injury | J Batty¹; LA Harvey¹; J Chu²; M Ben³; A Avis⁴; R Adams⁵  
¹Spinal Unit, Prince of Wales Hospital, Australia; ²Rehabilitation Studies Unit, Sydney School of Medicine, University of Sydney, Australia; ³Moorong Spinal Unit, Royal Rehabilitation Centre Sydney, Australia; ⁴Spinal Unit, Royal North Shore Hospital, Australia; ⁵Discipline of Physiotherapy, Faculty of Health Sciences, University of Sydney, Australia |
| 11:15 | Visual biofeedback balance training improves static stability and locomotion pattern in chronic motor incomplete (AIS D) spinal cord injury subjects | Federica Tamburella; G. Scivoletto; M. Molinari  
Spinal Cord Unit, IRCCS Santa Lucia Foundation, Italy |
| 11:30 | Effectiveness of community-based occupational therapy in meeting the re-integration needs of individuals with spinal cord injury: a pilot study | Pollie Price; J Fry; L May  
Occupational Therapy, University of Utah, USA |
Effectiveness of virtual reality system TOyRA for evaluation and treatment of upper limb motor function in patients with spinal cord injury
Iris Dimbwadyo Terrer1; B Peasco-Martin1; A De los Reyes-Guzman1; A Bernal-Sahin2; B Polonio-Lopez2; A Gil-Agudo1
1Biomechanics and Technical Aids Department, National Hospital for Spinal Cord Injury, Spain; 2Senior Systems, INDRA Systems, Spain; 3Occupational Therapy, University of Castilla-La Mancha, Spain

SCIRehab: trends in practice patterns and outcomes following occupational therapy after acute SCI
Teresa Foy
Shepherd Center, USA

SCIRehab: trends in practice patterns and outcomes following physical therapy after acute SCI
Shari McDowell
Shepherd Center, USA

Effects of seated double-poling ergometer training on oxygen uptake, upper-body muscle strength and motor performance in paraplegics
A Bjerkefors1; T Lindberg2; C Norrbrink2; K Wahman2; A Arndt1
1The Swedish School of Sport and Health Sciences, Sweden; 2Department of Clinical Sciences, Danderyd Hospital, Karolinska Institute, Sweden; 3Department of Neurobiology, Care Sciences and Society, Karolinska Institute, Sweden

LUNCH BREAK/EXHIBITION AND POSTER VIEWING
### Tuesday 4th September 2012

#### Parallel 4: Prevention Symposium - Session 2

**Chairpersons:** Brian Gardner and Peter Wing  
**Time:** 10:30-12:30  
**Room:** Westminster Suite  
**Abstract No:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker(s)</th>
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</thead>
</table>
| 10:30 | The role of the voluntary sector and community campaigning in road injury prevention | Julie Townsend  
Deputy chief executive of Brake, the road safety charity |
| 11:00 | Preventing injury is about managing risk - the SMARTRISK approach to minimising the incidence of unintentional injury in teenagers | Mike Buckley, Injury Survivor Presenter.  
Kevin Moore, co-founders of the SMARTRISK UK charity. |
| 11:30 | Low velocity spinal cord injury with dislocation, the England national approach to the prevention of the secondary injury, using rugby as an example | Dennis Newton/Brian Gardner, Emeritus Consultant Surgeons in Spinal Cord Injury Stoke Mandeville  
Dr Mike England, Medical Director RFU Injured Players Foundation, Twickenham  
Mr Balraj (Raj) Singhal, Consultant Surgeon in Spinal Cord Injuries, Burwood Spinal Unit, Christchurch, New Zealand |
| 12:15 | Preventing primary spinal cord injuries in adolescents: a pilot 7th grade science education program | Brigit Metzger¹; Herndon Murray¹; Shari McDowell¹  
¹Shepherd Center, USA; |
| 12:30 | LUNCH BREAK/EXHIBITION AND POSTER VIEWING | |

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#### Plenary 5  
**Keynote Lecture**  
**Chairpersons:** Paul Kennedy and Ralph Marino  
**Time:** 14:00-14:45  
**Room:** Churchill Auditorium  

14:00 **Improving long-term outcomes after spinal cord injury**  
James Middleton  
Australia

---

**Medtronic Satellite Symposium**  
**High Function Patients & ITB therapy. A New Approach**  
**Moderator:** Indira Lanig  
**Time:** 12:45-14:00  
**Room:** Whittle Room

- Institute Guttmann experience with ITB Therapy and the case of Anna  
  Dr Benito and Anna Gilabert
- Catheter Position and targeted effect on HF ITB Patients  
  Dr Viaene Annick
- State of the art trial method at UZ Leuven  
  Dr Kiekens and Dr Roels
### Tuesday 4th September 2012

**Parallel 5: Long Term Outcomes**

**Chairpersons:** Indira Lanig and Fred Middleton  
**Time:** 14:45-16:15  
**Room:** Churchill Auditorium  
**Abstract No:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Abstract</th>
<th>Speaker</th>
<th>Institution</th>
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</thead>
<tbody>
<tr>
<td>14:45</td>
<td>Long-term urinary outcomes in chronic spinal cord injured patients with transurethral indwelling catheters</td>
<td>Apichana Kovindha</td>
<td>Rehabilitation Medicine, Faculty of Medicine, Chiang Mai University, Thailand</td>
</tr>
<tr>
<td>15:05</td>
<td>Role of external sphincterotomy on long term management of spinal cord injury patients</td>
<td>Vijay Rao Gudla; M Agarwal</td>
<td>Department of Urology, University Hospital Of Wales, United Kingdom</td>
</tr>
<tr>
<td>15:25</td>
<td>Long term ventilation of SCI patients, experiences within 25 years of treatment</td>
<td>S Hirschfeld; R Thietje</td>
<td>SCI Centre Hamburg, Trauma Hospital Hamburg, Germany</td>
</tr>
<tr>
<td>15:45</td>
<td>Discussion</td>
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</tbody>
</table>

**16:15** TEA/COFFEE BREAK AND POSTER VIEWING

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### Tuesday 4th September 2012

**Parallel 5: Review of current recommended treatment and management practices of children and adolescents with a spinal cord injury**

**Chairperson:** Lawrence Vogel  
**Time:** 14:45-16:15  
**Room:** Whittle Room  
**Abstract No:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Abstract</th>
<th>Speaker</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>114:45</td>
<td>Introduction/ Overview of Pediatric SCI</td>
<td>Lawrence Vogel</td>
<td>Rush Medical College, Chicago, USA</td>
</tr>
<tr>
<td>14:55</td>
<td>Presentation of Case #1- Early childhood</td>
<td>Lawrence Vogel</td>
<td>Rush Medical College, Chicago, USA</td>
</tr>
<tr>
<td>15:00</td>
<td>Acute treatment</td>
<td>Randal Betz</td>
<td>Shriners Hospitals for Children, USA</td>
</tr>
<tr>
<td>15:05</td>
<td>Neurological classification</td>
<td>MJ Mulcahey</td>
<td>Shriners Hospitals for Children, USA</td>
</tr>
<tr>
<td>15:10</td>
<td>Medical complications and management</td>
<td>Allison Graham</td>
<td>National Spinal Injuries Centre, United Kingdom</td>
</tr>
<tr>
<td>15:15</td>
<td>Discussion</td>
<td></td>
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</tr>
<tr>
<td>15:20</td>
<td>Presentation of Case #2- Middle childhood</td>
<td>MJ Mulcahey</td>
<td>Shriners Hospitals for Children, USA</td>
</tr>
<tr>
<td>15:25</td>
<td>Orthopaedics (hip subluxation, scoliosis)</td>
<td>Randal Betz</td>
<td>Shriners Hospitals for Children, USA</td>
</tr>
<tr>
<td>15:30</td>
<td>Bladder/ bowel management</td>
<td>Lawrence Vogel</td>
<td>Shriners Hospitals for Children, USA</td>
</tr>
<tr>
<td>15:35</td>
<td>Rehabilitation technology and natural transitions</td>
<td>Allison Graham</td>
<td>National Spinal Injuries Centre, United Kingdom</td>
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<td>15:40</td>
<td>Education/ vocational planning</td>
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<tr>
<td>15:45</td>
<td>Discussion</td>
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</tbody>
</table>
### Tuesday 4th September 2012

**Parallel 5: Free Papers**

**Chairpersons:** Giorgio Scivoletto and Alan McLean

**Time:** 14:45-16:15

**Room:** St James Suite

<table>
<thead>
<tr>
<th>Abstract No.</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>O54</td>
<td>Prediction of functional prognosis after contusive spinal cord injury in common marmosets by novel in vivo MR imaging technique: Myelin map</td>
<td>Tsunehiko Konomi1; K Fujiyoshi; K Hikishima; O Tsuji; A Iwanami1; Y Kobayashi1; M Takano; S Nori1; A Yasuda1; H Okano1; Y Toyama1; M Nakamura1</td>
</tr>
<tr>
<td></td>
<td>Department of Orthopaedic Surgery, Keio University, Japan; 2Department of Orthopaedic Surgery, Murayama Medical Center, NHO, Japan; 3Department of Physiology, Keio University School of Medicine, Japan</td>
<td></td>
</tr>
<tr>
<td>O55</td>
<td>A dual role for sclerostin after SCI: therapeutic target in the acute phase and biomarker of osteoporosis severity in the chronic phase</td>
<td>Ricardo Battaglino1; S Sudhakar2; A Lazzari3; E Garshick4; LR Morse5</td>
</tr>
<tr>
<td></td>
<td>1Skeletal Biology, The Forsyth Institute, USA; 2Spaulding-Harvard SCI Model System, Spaulding Rehabilitation Hospital, USA; 3Primary Care Section, VA Boston Healthcare System, USA; 4Pulmonary and Critical Care Medicine Section, VA Boston Healthcare System, USA; 5Department of Physical Medicine and Rehabilitation, Harvard Medical School, USA</td>
<td></td>
</tr>
<tr>
<td>O56</td>
<td>The effect of injury level on circulating inflammatory cytokine responses to wheelchair propulsive exercise.</td>
<td>TAW Paulson; VL Goosey-Tolfrey; JP Lenton; CA Leicht; NC Bishop School of Sport Exercise and Health Sciences, Loughborough University, United Kingdom</td>
</tr>
<tr>
<td>O57</td>
<td>Improved assessment of contact heat evoked potentials in spinal cord injured subjects</td>
<td>J Haefeli; JLK Kramer; A Curt</td>
</tr>
<tr>
<td></td>
<td>SCI research, Switzerland</td>
<td></td>
</tr>
<tr>
<td>O58</td>
<td>A pilot study to the altered skin temperature circadian rhythm in spinal cord-injured individuals</td>
<td>Jean Nyakayiru; R.J.H.M Verheggen; H Jones; G Atkinson; M.T.E. Hopman; D.H.J Thijssen</td>
</tr>
<tr>
<td></td>
<td>1Physiology, Radboud University Nijmegen Medical Centre (RUNMC, Netherlands; 2Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, United Kingdom</td>
<td></td>
</tr>
<tr>
<td>O59</td>
<td>Complete absence of evening melatonin increase in tetraplegic individuals</td>
<td>JT Groothuis1; R.J.HM Verheggen; H Jones; JD Nyakayiru; A Thompson; G Atkinson; MTE Hopman; DHJ Thijssen</td>
</tr>
<tr>
<td></td>
<td>1Department of Rehabilitation, Radboud University Nijmegen Medical Centre, Netherlands; 2Department of Physiology, Radboud university Nijmegen Medical Centre, Netherlands; 3Research Institute for Sports and Exercise Science, Liverpool John Moores University, United Kingdom</td>
<td></td>
</tr>
</tbody>
</table>

**Discussion**

**16:15** TEA/COFFEE BREAK AND POSTER VIEWING
**Parallel 5:** Spinal Cord Injury in the Majority World: Action and Direction for the International Community

**Chairperson:** Colleen O’Connell  
**Time:** 14:45-16:15  
**Room:** Westminster Suite

<table>
<thead>
<tr>
<th>Abstract No.</th>
<th>Title</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>S20</td>
<td>Introduction: SCI in Majority World</td>
<td>Colleen O’Connell, Dalhousie University, Stan Cassidy Centre for Rehabilitation, Canada</td>
</tr>
<tr>
<td>S21</td>
<td>Challenges in establishing SCI Units in Africa</td>
<td>Claes Hultling, Karolinska Institute, Stockholm, Sweden</td>
</tr>
<tr>
<td>S22</td>
<td>Challenges in Physician training- Nepal Experience</td>
<td>Claire Weeks, University of British Columbia, Canada</td>
</tr>
<tr>
<td>S23</td>
<td>SCI-related Disaster Preparedness</td>
<td>Peter Wing, University of British Columbia, Canada</td>
</tr>
<tr>
<td>S24</td>
<td>Early Markers and Post-Disaster interventions</td>
<td>Eric Weertzn, Handicap International Vietnam – Bach Mai hospital Hanoi SCI Care extension project – Post Earthquake support program – PR China</td>
</tr>
<tr>
<td>S25</td>
<td>Collaborations of SCI and Disaster Organizations</td>
<td>Geraldine Jaquemin, Physical Medecine &amp; Rehab Université de Montréal, Institut de Réadaptation Gingras-Lindsay de Montréal, Canada</td>
</tr>
<tr>
<td>S26</td>
<td>Proposed Recommendations for International Community</td>
<td>Anthony Burns, Brain &amp; Spinal Cord Rehabilitation Program, Toronto Rehabilitation Institute – University Health Network, Toronto Canada</td>
</tr>
</tbody>
</table>

16:15 TEA/COFFEE BREAK AND POSTER VIEWING

**Plenary 6**  
**Chairperson:** John Ditunno  
**Time:** 16:30-17:15  
**Room:** Churchill Auditorium

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>16:30</td>
<td>Putting Evidence into Practice</td>
<td>Catherine Craven, Canada</td>
</tr>
</tbody>
</table>

**Tuesday 4th September 2012**

**How to get published**  
**Spinal Cord-Nature Publishing Group**

**Chairpersons:** JJ Wyndaele and Rebecca Vickerstaff  
**Time:** 17:15-18:15  
**Room:** St James Suite

This session is presented by Professor J-J Wyndaele and Rebecca Vickerstaff from Nature Publishing Group. They will explain how best to draft and then finalise your manuscript intended for publication, how exactly the editorial review process works and how to interpret an editor’s response.

19:15 onwards **Gala Dinner at Imperial War Museum**

Coach Transfers will be provided from the Park Plaza Hotel, the Double Tree Hotel and the QEI1 Conference Centre. Details can be found on delegate’s invitation tickets.

Please note this event is now sold out.
### Wednesday 5th September 2012

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Abstract No</th>
<th>Authors</th>
<th>Institutions</th>
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<tbody>
<tr>
<td>08:15</td>
<td>Plenary 7: ISRT Lecture</td>
<td></td>
<td>Mike Craggs, UK</td>
<td></td>
</tr>
<tr>
<td>09:00</td>
<td>Parallel 6: Free Papers</td>
<td>O60</td>
<td>JM Clark¹; D Sharkey²; R Marshall³</td>
<td>South Australian Spinal Cord Injury Research Centre, Hampstead Rehabilitation Centre, Australia; Robinson Institute, University of Adelaide, Australia; South Australian Spinal Cord Injury Service, Hampstead Rehabilitation Centre, Australia</td>
</tr>
<tr>
<td>09:15</td>
<td>Pre-clinical validation of adult olfactory bulb ensheathing glia for the treatment of patients with spinal injuries</td>
<td>O61</td>
<td>Almudena Ramon-Cueto¹; C Munoz-Quiles²</td>
<td>Neural Regeneration Unit, Institute of Biomedicine Valencia, CSIC, Spain; Fundacion Investigacion Regeneracion Sist Nervioso, Spain</td>
</tr>
<tr>
<td>09:30</td>
<td>Effect of hind-limb cycling on severity of orthostatic hypotension and autonomic dysreflexia in rats with SCI</td>
<td>O62</td>
<td>Christopher West; JA Inskip; LM Ramer; JJ Cragg; AV Krassioukov</td>
<td>ICORD, UBC, Canada</td>
</tr>
<tr>
<td>09:45</td>
<td>The allogeneic transplantation of neural stem/progenitor cells into injured spinal cord in adult common marmosets</td>
<td>O63</td>
<td>H Iwai¹; H Shimada¹; S Nishimura¹; Y Kobayashi¹; T Konomi¹; O Tsuji¹; Y Toyama¹; H Okano¹; M Nakamura¹</td>
<td>Orthopaedic Surgery, Keio University, Japan; Physiology, Keio University, Japan</td>
</tr>
<tr>
<td>10:30</td>
<td>Comparative study of neural stem cell transplantation for spinal cord injury in between young and aged mice</td>
<td>O64</td>
<td>Takano Morito¹; Yuichiro Takahashi¹; Akimasa Yasuda¹; Satoshi Nori¹; Soraya Nishimura¹; Hiroki Iwai¹; Osahiko Tsuji¹; Yoshiaki Toyama¹; Hideyuki Okano³; Masaya Nakamura¹</td>
<td>Orthopaedics Surgery, Keio University, Japan; Physiology, Keio University, Japan</td>
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<tbody>
<tr>
<td>09:00</td>
<td>Parallel 6: Health Economics</td>
<td>O65</td>
<td>Carly Rivers¹; V Noonan²; L Trenaman³; P Joshi¹; M Dvorak¹; H Krueger²</td>
<td>Rick Hansen Institute, Canada; Rick Hansen Institute; UBC, Canada; H. Krueger &amp; Associates Inc., Canada; Rick Hansen Institute; VGH, Canada</td>
</tr>
<tr>
<td>09:20</td>
<td>Spinal cord injury and durable employment: Potential interventions to prevent post-injury job loss</td>
<td>O66</td>
<td>Gregory Murphy³; Mary Alice O’Hare²</td>
<td>Public Health, LaTrobe University, Australia; Public Health, LaTrobe University, Australia</td>
</tr>
<tr>
<td>09:40</td>
<td>From evidence to policy to practice? Implementation of a World Health Organization (WHO) report</td>
<td>O67</td>
<td>Per von Groote³; JE Bickenbach²</td>
<td>Swiss Paraplegic Research (SPF), Switzerland; Swiss Paraplegic Research (SPF), Switzerland</td>
</tr>
<tr>
<td>10:00</td>
<td>Reasons for Extending Length of Stay in Inpatient Spinal Cord Rehabilitation</td>
<td>O68</td>
<td>Heather Flett; JA Yee; K Guy; N Cournoyeva; J Zee; AS Burns</td>
<td>Spinal Cord Rehab Program, Toronto Rehab - University Health Network, Canada</td>
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**Wednesday 5th September 2012**

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<tr>
<td>10:15</td>
<td>Discussion Time</td>
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<tr>
<td>10:20</td>
<td>TEA/COFFEE BREAK AND POSTER VIEWING</td>
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<td>Comparative study of neural stem cell transplantation for spinal cord injury in between young and aged mice</td>
<td>O64</td>
<td>Takano Morito¹; Yuichiro Takahashi¹; Akimasa Yasuda¹; Satoshi Nori¹; Soraya Nishimura¹; Hiroki Iwai¹; Osahiko Tsuji¹; Yoshiaki Toyama¹; Hideyuki Okano³; Masaya Nakamura¹</td>
<td>Orthopaedics Surgery, Keio University, Japan; Physiology, Keio University, Japan</td>
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**Wednesday 5th September 2012**

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<td>TEA/COFFEE BREAK AND POSTER VIEWING</td>
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### ISRT Workshop: Advances in preclinical repair: influencing the good and the bad in neuroplasticity

**Chairperson:** Armin Curt  
**Time:** 09:00-10:20  
**Room:** St James Suite

<table>
<thead>
<tr>
<th>Time</th>
<th>Abstract No:</th>
<th>Title</th>
<th>Author</th>
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<tbody>
<tr>
<td>09:00</td>
<td>S27</td>
<td>Beyond the glial scar: using chondroitinase as a therapy to promote repair following spinal cord injury</td>
<td>Elizabeth Bradbury</td>
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<tr>
<td>09:20</td>
<td>S28</td>
<td>Peripheral plasticity in spinal cord injury: the capsaicin receptor and autonomic dysreflexia.</td>
<td>Matt Ramer</td>
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<tr>
<td>09:40</td>
<td>S29</td>
<td>Inspiring new thinking to restore motor function after spinal cord injury</td>
<td>Gregoire Courtine</td>
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### Imaging of Spinal Cord Injury: Present and Future

**Chairperson:** Richard Hughes  
**Time:** 09:00-10:20  
**Room:** Westminster Suite

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<th>Time</th>
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<tbody>
<tr>
<td>09:00</td>
<td>S30</td>
<td>Imaging of Bony Spinal Trauma / Concepts of Radiological Stability</td>
<td>Bernhardt Tins; Robert Jones; Agnes Hunt</td>
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<td>09:15</td>
<td>S30</td>
<td>The post-operative spine</td>
<td>Paul O'Donnell</td>
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<tr>
<td>09:30</td>
<td>S30</td>
<td>Clinical Imaging of acute and subacute cord injury</td>
<td>Gregoire Courtine, Fin Sheerin</td>
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<tr>
<td>09:45</td>
<td>S30</td>
<td>Clinical Imaging of chronic cord injury</td>
<td>Tom Meagher</td>
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<td>09:55</td>
<td>S30</td>
<td>Advanced cord imaging techniques and future developments</td>
<td>Jon Brookes</td>
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### Closing remarks

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<th>Time</th>
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<tr>
<td>10:10</td>
<td>Imaging Research in Spinal Cord Injury</td>
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<tr>
<td>10:20</td>
<td>TEA/COFFEE BREAK AND POSTER VIEWING</td>
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</table>
### Parallel 7: Free Papers

**Chairperson:** Marcel Post  
**Time:** 10:45-12:45  
**Room:** Churchill Auditorium

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
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</table>
| 10:45 | Cardiac Arrhythmias the First Month After Acute Traumatic Spinal Cord Injury | K Bartholdy1; TB Sorensen2; L Malmqvist3; M Ballegaard4; A Krassioukov5; JH Svendsen6; A Kruse7; KL Welling8; B Hansen9; FB Sorensen1  
1 Clinic for Spinal Cord Injuries, Rigshospitalet/Glostrup Hospital, Copenhagen, Denmark; 2 Clinic for Spinal Cord Injuries and Dept. of Cardiology, Rigshospitalet/Gentofte University Hospital, Denmark; 3 Clinic for Spinal Cord Injuries and Dept. of Clinical Neurophysiology, Rigshospitalet, Copenhagen, Denmark; 4 Department of Clinical Neurophysiology, Rigshospitalet, Copenhagen, Denmark; 5 Department of Medicine, Div. Phys. Med. & Rehab., ICORD, Vancouver and Spinal Cord Program, GF Stron, University of British Columbia, Canada; 6 Department of Cardiology, Rigshospitalet, Faculty of Health Sciences, University of Copenhagen, Denmark; 7 Spine Section, Department of Orthopedic Surgery, Rigshospitalet, Copenhagen, Denmark; 8 Department of Neuroanaesthesiology, Rigshospitalet, Copenhagen, Denmark |
| 11:00 | Body mass index do not predict cardiovascular disease risk after spinal cord injury | Wahman Kerstin1; P Flank2; R Levi2; M Fahlstrom3  
1 Karolinska Institutet/Neurobiology, Care Sciences and Society, Rehab Station Stockholm/Spinalis R&D Unit, Sweden; 2 Umea University/Department of Community Medicine and Rehabilitation, Rehabilitation Medicine, Sweden |
| 11:15 | Body composition determined by bioimpedance analysis in patients with spinal cord injury: a comparison of two devices | C Perret; I Flury; C Zangger; M Baumberger  
Swiss Paraplegic Centre, Switzerland |
| 11:30 | Putting evidence into practice; guidelines for neurogenic bowel management in the United Kingdom | Maureen Coggrave  
National Spinal Injuries Centre, Stoke Mandeville Hospital, United Kingdom |
| 11:45 | Validation of the Screening Tool for the Assessment of Malnutrition (STAMP) in patients with Spinal Cord Injuries (SCI). | Samford Wong1; Allison Graham2; Shashi Harini3; George Grimble4; Alastair Forbes5  
1 National Spinal Injuries Centre, Stoke Mandeville Hospital, Buckinghamshire Healthcare NHS Trust / UCL, United Kingdom; 2 National Spinal Injuries Centre, Stoke Mandeville Hospital, Buckinghamshire Healthcare NHS Trust, United Kingdom; 3 School of Health Science, City University, London, United Kingdom; 4 Centre for Gastroenterology and Clinical Nutrition, University College London, United Kingdom |
Parallel 7: Health Economics

Chairpersons: Ruth Marshall and Lisa Harvey

Time: 11:00-13:00
Room: Whittle Room

Abstract No:

11:00
Provision of Care for Traumatic Spinal Cord Injury in Canada: Are There Differences?
Vanessa Noonan1; D Atkins2; A Santos1; R Lewis1; L Soril1; MG Fehlings1; A Singh1; A Townson1; MF Dvorak2
1Rick Hansen Institute, Canada; 2University of British Columbia, Canada;
3University of Toronto, Canada

11:20
Cost effectiveness, length of stay and outcome of inpatient rehabilitation for traumatic spinal cord injured patients.
P Eelmae; M Pakkanen; K Englas
Haapsalu Neurological Rehabilitation Centre, Estonia

11:40
Epidemiology of traumatic Spinal Cord Injury(SCI) due to falls; Data from 2003-2011 from Midlands-Centre-for-Spinal-Injuries (MCSI); demographic trends
Poornashree Ramamurthy; N Kumar; I Zobina; A Osman
Midlands Centre for Spinal Injuries, Oswestry, UK, United Kingdom

12:00
The global map for traumatic spinal cord injury epidemiology: Update 2011, global incidence rate
Bonsan Bonne Lee1; RA Cripps2; Fitzharris Michael3; Wing Peter4
1Spinal Medicine department, Prince of Wales Hospital/ University of NSW, Australia; 2Flinders University, Australia; 3Monash University, Australia; 4University of British Columbia/ Rick Hansen Inst., Canada

12:20
Prevalence of non-traumatic spinal cord injury in Victoria, Australia
Peter New1; A Farry1; D Baxter2; VK Noonan2
1Spinal Rehabilitation Unit, Caulfield Hospital, Alfred Health, Australia; 2Rick Hansen Institute, Canada; 3Urban Futures Institute, Canada

12:40
Discussion

13:00
LUNCH BREAK/EXHIBITION AND POSTER VIEWING

Wednesday 5th September 2012

Parallel 7: Quantitative neuroimaging of the spinal cord and brain following spinal trauma

Chairperson: Patrick Freund

Time: 10:45-12:45
Room: St James Suite

Abstract No:

10:45
Introduction to quantitative methods: DTI, MTR, spettro, fMRI and clinical applications
Claudia Wheeler Kingshott1; Armin Curt2
1UCL Institute of Neurology, United Kingdom; 2Universitat Zurich, Switzerland

10:55
Quantitative MRI of macroscopic anatomy and tissue microstructure
Nikolaus Weiskopf
UCL Institute of Neurology, United Kingdom

11:10
Imaging microstructure in the spinal cord with diffusion MRI
Julien Cohen-Adad
Harvard Medical School, USA

11:25
Artefacts reduction in human spinal cord diffusion MRI
Siaawosh Mohammadi
Wellcome Trust Centre for Neuroimaging, UCL Institute of Neurology, University College London, UK

11:40
MR spectroscopy of the spinal cord in patients with spinal cord injury
Olga Ciccarelli
UCL Institute of Neurology, United Kingdom

12:00
Quantitative studies of myelopathy using DTI: experience from chronic SCI and MS
Spyros Kollias
Universitat Zurich, Switzerland

12:20
Spinal cord fMRI in patients with cervical spinal cord injury
Michael Fehlings
University of Toronto, Canada

12:40
ISRT/WfL initiative in advancing spinal cord imaging
IM Bacon1; J Schwab2
1International Spinal Research Trust; 2Wings for Life

12:45
LUNCH BREAK/EXHIBITION AND POSTER VIEWING
Wednesday 5th September 2012

Parallel 7: **Legal Symposium: How much is enough?**

Chairperson: Gerard McDermott

Time: 10:45-12:45
Room: Westminster Suite

**How much is enough?**
A session for all Personal Injury Lawyers and Doctors in the Field of Spinal Cord Injuries
Tim Tomasik and Mike Krzak, Clifford Law Offices, Chicago.
Gerard McDermott QC, Leading Barrister (trial lawyer) specialising in SCI Outer Temple Chambers, London
Paul Paxton, Solicitor Head of Personal Injury, Stewarts Law, London
Julian Chamberlayne, Head of the Travel Law Team, Stewarts Law, London
Brian Gardener FRCS, FRCP Stoke Mandeville
Gary Yarkony MD Elgin, Illinois

12:45 LUNCH BREAK/EXHIBITION AND POSTER VIEWING

**ISCoS Annual General Meeting**

Time: 12:45 - 14:15
Room: Whittle Room

All members of ISCoS are invited to attend the AGM.

Wednesday 5th September 2012

Plenary 8: **Keynote Lecture**

Chairperson: William Donovan

Time: 14:15-15:00
Room: Churchill Auditorium

14:15 **Health Economics and Cost Management**
Steve Morris
UK

Parallel 8: **Free Papers**

Chairperson: William Donovan

Time: 14:45-16:45
Room: Churchill Auditorium

**Trajectories and predictors of the course of mental health in persons with spinal cord injury**
Christel MC van Leeuwen 1; Trynke Hoekstra 2; Casper F van Koppenhagen 3; Sonja de Groot 4; Marcel WM Post 1
1Swiss Paraplegic Research, Switzerland; 2Department of Epidemiology and Biostatistics and the EMGO Institute for Health and Care Research, VU University Medical Center Amsterdam, Netherlands; 3Rudolf Magnus Institute of Neurosciences and Center of Excellence for Rehabilitation Medicine, University Medical Center Utrecht, Netherlands; 4Reade, centre for rehabilitation and rheumatology, Netherlands

15:00 **Venlafaxine XR for major depression after spinal cord injury: a multi-site randomized controlled trial**
Jesse Fann 1; CH Bombardier 2; D Tate 3; JS Richards 4; AW Heinemann 5; C Wilson 6; AM Warren 7; D Cardenas 8; L Brooks 9; T Bushnik 10; N Temkin 11
1Psychiatry and Behavioral Sciences, University of Washington, USA; 2Rehabilitation Medicine, University of Washington, USA; 3Physical Medicine and Rehabilitation, University of Michigan, USA; 4Physical Medicine and Rehabilitation, Rehabilitation Institute of Chicago, USA; 5Rehabilitation Psychology, James A. Haley Veterans Hospital, USA; 6Division of Trauma, Baylor University Medical Center, USA; 7Rehabilitation Medicine, University of Miami, USA; 8Rehabilitation Medicine, Rusk Institute for Rehabilitation, USA; 9Neurological Surgery, University of Washington, USA

15:15 **Self-efficacy and self-esteem explain participation of people with spinal cord injury**
Szilvia Geyh 1; E Nick 2; D Stirnimann 3; S Ehrlat 4; F Michel 5; P Lude 6
1Swiss Paraplegic Research, Switzerland; 2Zurich University of Applied Sciences, Switzerland; 3University Hospital Balgrist, Paraplegic Center, Z, Switzerland; 4Swiss Paraplegic Center, REHAB Basel, Switzerland; 5Swiss Paraplegic Center, Nottwil, Switzerland; 6Private practice for psychotherapy, Bad Zurzach, Switzerland
Wednesday 5th September 2012

15:30  Secondary Conditions and Life Satisfaction in Adults Aging with Traumatic Spinal Cord Injury in the USA
Denise Tate; SJ McLaughlin; M Forchheimer
Physical Medicine and Rehabilitation, University of Michigan, USA

15:45  Social Networks and Secondary Health Conditions: The critical secondary team for individuals with a spinal cord injury
Sara Guilcher1; T Casciaro2; L Lemieux-Charles1; BC Craven1; MA McColl1; SB Jaglal1
1Institute of Health Policy, Management and Evaluation, University of Toronto, Canada; 2Rotman School of Management, University of Toronto, Canada; 3Toronto Rehabilitation Institute, Canada; 4Department of Community Health and Epidemiology and School of Rehabilitation Therapy, Queen’s University, Canada; 5Department of Physical Therapy, University of Toronto, Canada

16:00  Do Risk Perceptions Explain Gender Differences in Community Integration and Participation after Spinal Cord Injury?
HE Dillaway; SW Neufeld; CL Lysack
Wayne State University, USA

16:15  Discussion

16:45  TEA/COFFEE BREAK AND POSTER VIEWING

Wednesday 5th September 2012

Parallel 8:  Paralympics Workshop

Chairpersons:  Joseph Oriol Martinez
Andrei Krassioukov

Time:  14:45-16:45
Room:  Whittle Room
Abstract No:

14:45  Adapted Physical Activity as part of Multi Disciplinary Treatment of Hospital Functional Rehabilitation
Josep Oriol Martinez Ferrer
Ramon Llull University, Spain

15:00  Preparing Athletes for the Paralympic Games
Vicky Tolfrey
Loughborough University, United Kingdom

15:15  Autonomic Dysreflexia and Boosting in Paralympic Athletes - Policies, procedures and Preliminary Findings
Cheri Blauwet
Harvard Medical School, USA

15:30  Is there a relationship between Paralympic classification, autonomic symptoms and altered cardiovascular control among elite wheelchair athletes?
A Krassioukov1; SC Wong2; P Mills3; D Krassioukov-Enns4; D Mikhail5
1Physical Medicine and Rehabilitation, University of British Columbia, Canada; 2Experimental Medicine, University of British Columbia, Canada; 3Medicine, University of Manitoba, Canada; 4Schulich School of Medicine and Dentistry, University of Windsor, Canada

15:45  Heart rate variability reveals differences in autonomic control among wheelchair rugby athletes with cervical spinal cord injury
SC Wong1; P Mills2; A Krassioukov2
1Experimental Medicine, University of British Columbia, Canada; 2Physical Medicine and Rehabilitation, University of British Columbia, Canada

16:00  Exercise Induced Bronchoconstriction in Paralympic Athletes - the Role of Eucapnic voluntary Hyperpnea
Claudio Perret
Institute of Sports Medicine, Switzerland

16:15  Evaluation of the Effect of Abdominal Binder and Improvement of Cardiorespiratory Fitness of Wheelchair Athletes
West Christopher
University British Columbia, Canada, Canada

16:45  TEA/COFFEE BREAK AND POSTER VIEWING
Wednesday 5th September 2012

Parallel 8: Free Papers

Chairpersons: Pradeep Thumbikat and Claire Weeks

Time: 14:45-16:45
Room: St James Suite

14:45 A clinically meaningful motor outcome for an acute clinical trial utilizing individuals with sensorimotor complete cervical spinal cord injury
John Steeves1; JLK Kramer2; A Curt3; M Schubert4; DP Lammertse6
1UBC and Vancouver Coastal Health, Canada; 2Balgrist Hospital, Switzerland; 3Craig Hospital, USA

15:00 The Spinal Cord Independence Measure. How Much Change is Clinically Significant for Spinal Cord Injury Subjects
Giorgio Scivoletto; F Tamburella; L Laurenza; M Molinari
Spinal Cord Unit, IRCCS Fondazione S. Lucia, Italy

15:15 International retrospective comparison of non-traumatic spinal cord injury rehabilitation outcomes
Peter New1; RK Reeves2; E Smith3; MWM Post4; A Townson5; A Gupta6; G Scivoletto7; I Eriks-Hoogland8; ZA Gill9
1Spinal Rehabilitation Unit, Caulfield Hospital, Alfred Health, Australia; 2Department of Physical Medicine &Rehabilitation, Mayo Clinic College of Medicine, USA; 3National Rehabilitation & Mater Misericordiae Univ, Ireland; 4Center of Excellence in Rehabilitation Medicine, Rehabilitation Center De Hoogstraat, Utrecht, Netherlands; 5GF Strong Rehab Centre, University of British Colu, Canada; 6National Institute of Mental Health & Neurological, India; 7IRCCS, Italy; 8on behalf of the SwiSCI study group, Swiss Paraplegic Center, Switzerland; 9Armed Forces Institute of Rehabilitation Medicine, Pakistan

15:30 UAB Index of Motor Recovery (UABIMR): A new validated outcome measure to verify significant neurological return after spinal cord injury (SCI)
Amie Jackson1; Anthony Chiodo1; Ralph Marino2; Daniel Graves3
1Physical Medicine and Rehabilitation, University of Alabama at Birmingham, School of Med, USA; 2Department of PM&R, University of Michigan, USA; 3Department of PM&R, Thomas Jefferson University, USA

15:45 Clinical significance of diffusion tensor tractography as a prognostic predictor of functional recovery in cervical myelopathy after laminoplasty
Masaya Nakamura1; Kanehiro Fujiyoshi1; Osahiko Tsuji1; Tsunehiko Konomi1; Naobumi Hosogane1; Kota Watanabe2; Takashi Tsuji1; Ken Ishii1; Yoshikazu Toyama1; Morio Matsumoto1
1Orthopaedic Surgery, Keio University, Japan; 2Orthopaedic Surgery, Murayama Medical Center, National Hospital Organiz, Japan; 3Department of Advanced Therapy for Spine and Spinal Cord Disorders, Keio University, Japan

Wednesday 5th September 2012

Parallel 8: Surgery Symposium Current Concepts in Management of Unstable Spine

Chairpersons: Sreedhar Kolli and Sashin Ahuja

Time: 15:00-16:45
Room: Whittle Room

15:00 Management of Unstable Traumatic Spine
Sashin Ahuja
University Hospital of Wales, United Kingdom

15:20 Current concepts in the management of Metastatic spinal tumours followed by interactive case based discussions
Casey Adrian1; Jacinta Abraham2
1Royal National Orthopaedic Hospital, United Kingdom; 2Velindre Cancer Centre, United Kingdom

15:50 Current concepts in management of Osteoporotic fractures followed by interactive case based discussions
Sashin Ahuja
University Hospital of Wales, United Kingdom

16:20 Debate on mobilization of post surgical stabilization of unstable spine
W S El Masri1; Charles Greenough2
1Midlands Centre for spinal Injuries (MCSI), United Kingdom; 2The James Cook University Hospital, Middlesbrough, United Kingdom

16:45 TEA/COFFEE BREAK AND POSTER VIEWING

Closing Ceremony/Award Presentations

Time: 17:00-17:45
Room: Churchill Auditorium
Keynote Speakers

Cathy Craven, 
Canada

Dr. Craven is a Physiatrist with a Clinician Scientist role at Toronto Rehabilitation Institute – University Health Network in Ontario, Canada. She is currently an Assistant Professor in the Departments of Medicine & Health Policy Management and Evaluation at the University of Toronto. Dr. Craven earned her BA cum laude in Kinesiology at York University in North York, Ontario, and her MD and residency in physical medicine and rehabilitation at McMaster University in Hamilton, Ontario. After graduating, she completed a SCI fellowship and obtained a Master’s in Clinical Epidemiology from the University of Toronto.

Dr Craven’s clinical and research expertise is in the prevention and treatment of secondary health conditions among people with spinal cord injury, with a particular focus on sublesional osteoporosis and health service provision. She has authored or coauthored over 60 articles on these and related topics. Dr Craven is the Ontario lead for the SCI-IMPACT team, an interprovincial group of 26 clinicians and scientists from Ontario and Quebec focused on ameliorating secondary health conditions after spinal cord injury. She has been the Scientific Co-chair of the 1-5th Canadian National SCI Conference. Dr Craven is leading production of the Rick Hansen Institute sponsored E-scan atlas “Capturing Capacity in Canadian SCI Rehabilitation”. Dr. Craven has been the recipient of 15 honors and awards; she was the 2011 recipient of the University of Toronto, Department of Medicine, Division of Physiatry, Innovator of the Year Award”.

James Middleton, 
Australia

Associate Professor Middleton is a Consultant in Rehabilitation Medicine with 20 years clinical experience and research interest in the field of spinal cord injury medicine and rehabilitation. He is Director of the NSW State Spinal Cord Injury Service, Agency for Clinical Innovation and Senior Medical Specialist for the Spinal Outreach Service, having previously worked as a Staff Specialist in the Spinal Cord Injuries Unit at Royal North Shore Hospital and Medical Director of the Moorong Spinal Unit at the Royal Rehabilitation Centre in Sydney for 10 years between 1996 and 2006. Combining clinical, service planning and academic roles affords James an opportunity to translate research evidence into practice, service development and quality health system improvements.

James undertakes collaborative interdisciplinary research broadly focused on areas including functional, psychological, health and participation outcomes, pain management, health service delivery and utilization, quality of life, life expectancy and use of assistive technologies, such as functional electrical stimulation, to enhance mobility, bladder and bowel control after SCI. He has received over $8.5M funding support for research over his career, authored or co-authored more than 60 peer-reviewed publications and 5 book chapters, given over 120 presentations at national and international conferences (25 as invited speaker).

James is President of the Youthsafe Organisation (formerly Spinesafe Education Program), a NGO focused on multi-strategic approaches to Youth Injury Prevention. He was the inaugural Chair of the Clinical Trials Committee of the Australian and New Zealand Spinal Cord Injury Network (SCIN), which he helped to establish as the Steering Committee Chair in 2006. He is also a past President of the Australian and New Zealand Spinal Cord Society.
Steve Morris,  
UK

Steve Morris is Professor of Health Economics at UCL. He is a member of the Health Care Evaluation Group and is affiliated with the UCLH/UCL Comprehensive Biomedical Research Centre and the Division of Research Strategy. Prior to coming to UCL Steve worked at the Health Economics Research Group at Brunel University, the Imperial College Business School, and the Department of Economics at City University.

He has an MSc in Health Economics from the University of York, and a PhD in Economics from City University. Steve's main research interests are in the economic evaluation of health care programmes and in the determinants of health service use, including health care resource allocation formulae and inequality in health service use. He has a specific interest in the economics of obesity and has undertaken economic evaluations in a broad range of disease areas, including: HIV/AIDS; depression; cholesterol-lowering drugs; antipsychotic drugs; contraception; infant crying and sleeping problems; acute exacerbations of chronic bronchitis; systemic fungal infections; trauma; intensive care; cardiac surgery; obesity; small cell lung cancer; and, screening for Chlamydia.

Hans Rosling,  
Sweden

Hans Rosling is professor of International Health at Karolinska Institutet, the medical university in Stockholm, Sweden. When working as a young doctor in Mozambique

He discovered a previously unrecognised paralytic disease that his research team named Konzo. His 20 years of research on global health concerned the character of the links between economy and health in Africa, Asia and Latin America.

He has been adviser to WHO and UNICEF, co-founded Médecines sans Frontiers in Sweden and started new courses and published a textbook on Global Health. He is a member of the International Group of the Swedish Academy of Science and of the Global Agenda Network of the World Economic Forum in Switzerland.

He co-founded Gapminder Foundation (www.gapminder.org) with son and daughter-in-law. Gapminder promotes a fact based world view by converting the international statistics into moving, interactive, understandable and enjoyable graphics. This was first done by developing the Trendalyzer software that Google acquired in 2007. Using animations of global trends, Hans Rosling lectures about past and contemporary economic, social and environmental changes in the world and he produces thematic videos using the same technique. His award-winning lectures on global trends have been labeled “humorous, yet deadly serious” and many in the audience realize their own world view is lagging many decades.

Hans Rosling’s 5 points on global trends are:
• There are no longer two types of countries in the world, the old division into industrialized and developing countries has been replaced by 192 countries on a continuum of socio-economic development.
• Many Asian countries are now improving twice as fast as Europe ever did.
• A new gap may form between 5 billion people moving towards healthy lives with education, cell phones, electricity, washing machines and health service and more than 1 billion people stuck in the vicious circle of absolute poverty and disease.
• So far all progress towards health and wealth has been achieved at the price of increased CO2 emission that drives the imminent climate crisis.
• There are reasons for optimism regarding the future of the world because the world is so poorly governed at present. Hence we have enormous opportunities to improve the life of all humans by turning our already converging world into an equal, secure, sustainable and free place to live in.
David Tulsky, USA

David S. Tulsky, Ph.D. is the Director of Research for the Department of Physical Medicine and Rehabilitation (PM&R) at the University of Michigan (UM) Medical School. In addition, he directs the Center for Rehabilitation Outcomes and Assessment Research. Dr. Tulsky has significant experience leading large-scale, federally funded, multicenter studies of rehabilitation outcomes. Dr. Tulsky received his M.A. and Ph.D. degrees from the University of Illinois at Chicago with specializations in Clinical Psychology, Psychometrics, Research Methods, and Statistics. He also completed a post-doctoral fellowship in Health Psychology at Rush-Presbyterian St. Luke’s Medical Center in Illinois.

Dr. Tulsky also has extensive experience developing patient reported outcomes measures. He has co-authored more than 10 peer-reviewed articles and book chapters related to the measurement of quality of life. He has also served as the editor of two journal supplements of the Archives of Physical Medicine and Rehabilitation devoted to the improvement of Quality of Life in Rehabilitation Medicine as well as organizing and chairing a special international conference on the topic. Currently, Dr. Tulsky is involved in six federally funded, multi-site projects related to the development of Quality of Life instruments for a rehabilitation population.
Information For Presenters

Oral Presentations
The Speakers’ Preview Room is located in the East Long Room and this will be clearly signposted.

There will always be a technician available to assist you with any queries you may have in the Speakers’ Preview Room.

Monday, 3rd September 2012  07:30 - 21:00
Tuesday, 4th September 2012  07:30 - 17:30
Wednesday, 5th September 2012  07:30 - 16:00

If using a PowerPoint (or any other computer) presentation, please note you need to bring it on a CD, a DVD or on a “disk on key” Memory stick (using the USB port in the computer) and load it on one of the conference’s computers in the Speakers’ Ready Room, at least 2 hours before the start of the session. You may supply your own laptop computer as a back-up.

You may review your PowerPoint presentation in the Speakers Preview Room: Please pass your presentation CD/DVD or memory stick to the dedicated technician who will then upload the presentation and check for viruses. (Please note that the conference’s computers in the Session Halls are being supplied with Windows XP and Office 2007). Any embedded movies or sound files should also be included on the disc or stick as separate files, for back-up purposes. Please;

Assemble in your session room at least 10 minutes before the beginning of the session.
Ensure that you sit near the front of the room with easy access to the right hand side of the stage. Ensure that you keep to the time allocated to you, as it will cause disruption to sessions if you run over your allotted time.

If combining video films with PowerPoint, please make sure to check it in the Session Hall where your lecture is taking place, during a coffee or lunch break prior to your session, at least 30 minutes before the start of the session – even after checking it in the Speakers’ Ready Room.

We are keen to ensure smooth transition between presenters and wish to avoid presenters using their own laptops at the lectern as this sometimes causes delays between presentations.

IMPORTANT NOTE FOR MACINTOSH USERS
In order to use MAC presentations on a PC compatible computer please note that you need to prepare it according to the instructions below, before bringing it to the Speakers’ Preview Room:
Use a common font, such as Arial, Times New Roman, Verdana, etc (special fonts might be changed to a default font on a PowerPoint based PC).
Insert pictures as JPG files (and not TIF, PNG or PICT – these images will not be visible on a PowerPoint based PC).
Use a common movie format, such as AVI, MPG and WMV (MOV files from Quick Time will not be visible on a PowerPoint based PC).

You may use your own Macintosh laptop computer as a backup. In such a case please confirm that it has a VGA socket for external signal and come to check it first in the Speakers’ Preview Room as soon as you arrive and later on in the Session Hall where your lecture is taking place during the coffee or lunch break prior to your session, at least 30 minutes before the start of the session.

Please note that VHS Video Projection, 35 mm slide projection and overhead projection (projection of transparencies) will NOT be available.

Poster Presentations
Posters will be displayed in the Pickwick Room from 07:30 hrs on Monday, 3rd September until 17:00 hrs on Wednesday, 5th September.
Poster presenters should refer to the list of poster presentations contained within the programme for their board numbers.
Poster presenters are requested to be present at their designated poster board(s) during all official breaks to answer questions.
Your poster can be mounted from 07:30 on Monday, 3rd September: all materials to mount your poster can be found at a designated desk in the Poster room.

Please remove your poster on Wednesday 5th September, by 18:00 hours. Please note that the Organising Committee, The Queen Elizabeth II Conference Centre, or Kenes UK will not be responsible for any posters that are not removed at the end of the Meeting.
What factors and outcomes should be understood prior to clinical trials involving participants with an incomplete SCI?

**Background**

Because there is some preserved tissue connectivity and spared function, it has been suggested that individuals with incomplete SCI (iSCI) might show a better response to a therapeutic over subjects with sensorimotor complete SCI (AIS-A). If we could be more inclusive in our enrolment strategies (complete + incomplete SCI), it could:

1) speed completion of trials as enrolment rate would be more rapid.

2) exclude participants who will show substantial spontaneous recovery (e.g. AIS-D), which might mask any therapeutic benefit.

3) reveal therapeutic benefits not realized in sensorimotor complete SCI.

However, compared with neurologically complete SCI (AIS-A), the degree of spontaneous recovery after iSCI is variable and extensive.

**Goal**

For trials involving iSCI subjects, we require a more refined and rigorous SCI classification system than AIS grades. For acute and sub-acute studies, we need to identify and stratify relatively homogeneous study cohorts soon after SCI (e.g. within 1-2 weeks) while being able to reliably predict what their spontaneous (untreated) functional outcome will be 6 months later!

**Results**

Using the EMSCI database, we have employed multivariate analysis (specifically recursive partitioning) to data collected within first 2 weeks after SCI to predict outcomes (neurological and/or functional) at 6 months.

**Conclusion**

Preliminary data suggests we can be inclusive for clinical trial enrolment. We can include specific iSCI cohorts and complete study comparisons with reasonable power.
Monday 3rd September 2012

SCI Consumer Workshop 14:45-16:00
Westminster Suite

S5 14:45
Introduction to the workshop
Horsewell, Jane
Switzerland

The purpose of the workshop is to give SCI consumers from around the world the opportunity to present and discuss current, significant and pressing issues – as they define and identify them – and for SCI professionals to gain firsthand knowledge about the priorities of the community they serve. The SCI agenda differs in its priorities from world region to world region: but recent collaboration has indicated that, in fact, core issues are similar. The workshop will give a unique insight into the issues that SCI consumers prioritise. It will provide a platform where SCI consumers, professionals and policy makers can meet and exchange experience and ideas – with a view to future collaboration on how to resolve these issues.

S6 14:50
Aims & Objectives of ASCoN Consumer Network
Raghav, Shivjeet Singh
India

The ASCoN SCI consumer network was formed in 2010 to look at ways in which people with spinal injury across Asia may have a better chance of survival and a good quality life after injury. The network has identified specific challenges and problems across Asia which include: § Lack of official statistics on incidence and prevalence of SCI § Inadequate dedicated SCI treatment and rehabilitation facilities and comprehensive SCI management services to respond to high numbers of injuries § Little or no follow-up care/monitoring of people living with SCI (recent research indicates that 30% die of complications within three years of discharge) § Assistive/mobility devices not easily available/not affordable § Access to accessible accommodation and to the physical environment following discharge from rehabilitation unit can be problematic, especially for poor families § Access to vocational training and return to work severely restricted § Lack of peer support and access to sports and recreation The aims and objectives of the ASCoN SCI network is to promote the welfare of people with SCI in Asian countries so as to further their independence and participation in the community.

S7 15:00
What’s important to Americans living with SCI?
Anderson-Erisman, Kim
USA

The complexity encompassing SCI medicine and research mirrors the complexity of living with SCI. In the United States, the SCI community is heterogeneous on many levels and quite fractured. Topics that are important to a large proportion of the SCI community will be discussed, including functional recovery priorities, access to specialized healthcare and equipment, research/clinical trial interests, and improved quality of life.

Monday 3rd September 2012

S8 15:10
The impact of the economic crisis on the lives of people with SCI in Europe
Barbieri, Pietro Vittorio
Switzerland

The provisional results of a 2012 study carried out in collaboration with ESCIF, FAIP (the umbrella organisation for SCI consumer organisations in Italy) and the research institute Instud. The presentation will include the input of ESCIF member organisations gathered through discussions at the ESCIF congress in Italy in May 2012.

S9 15:20
Improving SCI treatment and rehabilitation facilities in Malaysian hospitals: a consumer view
Krishnan, Bathmavahti
Malaysia

The presentation will consider the following issues: 1) There appears to be a gap between the level of research involvement by medical and clinical staff and the actual delivery of its outcomes to SCI consumers. Possible reasons why such a gap exists – i) too much emphasis on meeting qualification criteria for career advancement (i.e. focusing on publishing research papers) especially in teaching hospitals. ii) the current lack of a formal channel/platform for communication between medical staff and SCI consumer groups to share information or give input to improve medical and rehabilitation services. 2) The need for a benchmark for the treatment, rehabilitation and care of SCI in hospitals.

S10 15:30
SCI in Sri Lanka – rehabilitation, consumer organisations, awareness and prevention
Siriwardana, Cyril
Sri Lanka

The presentation will consider the current situation of SCI consumers and consumer groups in Sri Lanka. This can be summarised as follows: a. Around 1000 people sustain SCI annually. Only about 30 percent of them receive rehabilitation at the two hospitals for SCI rehabilitation. Most patients are discharged from hospitals without any sort of rehabilitation and their life expectancy is very short. The Health ministry is planning to open a few more rehabilitation hospitals. Training of medical staff on SCI is important. b. There are two consumer groups, one formed in the north of the country after the ASCoN conference in Sri Lanka. The biggest problem for persons with SCI to attend meetings is the high cost of transport as the public transport system is not accessible. Peer group training in the past has helped many people with SCI to improve the quality of their life, Iso peer counselling is another area which needs development.

S11 15:40
ES CIF statement on quality in SCI rehabilitation and management
Penninx, Frans
Netherlands

The theme of the annual ESCIF Congress in 2011 was: (Proven) Quality of SCI rehabilitation. The congress addressed such topics as how to measure and evaluate quality in healthcare, the specific requirements of people with SCI, the knowledge and skills of SCI professionals, and the accreditation of SCI facilities. The words ‘and management’ were added to the title of the statement to emphasise that it is not only about quality during SCI rehabilitation but also about life-long quality when living with SC’. The statement was endorsed at the ESCIF Assembly of Delegates in May 2012.
A four per cent reduction in fractured neck or femur resulted in a saving of approximately £3 million.

Following a public meeting in Caxton Hall in 1916 it was decided to elect a London “Safety First” Council to tackle the “alarming increase in traffic accidents, and the direct connection therewith of the restricted street lighting which had been necessitated by the War conditions”. So began the organisation which was to become the Royal Society for the Prevention of Accidents. Accidents are responsible for 11,438 deaths and millions of injuries across the UK each year, costing the country an estimated £150 billion. Yet, prevention is fairly easy to implement and inexpensive to deliver. That’s why it is one of RoSPA’s key campaigns to make accident prevention a public health priority. Accidents are untimely, often violent, events that can devastate families and whole communities. Following a lot of hard work in recent decades, big strides have been made in bringing down the number of people accidentally killed or injured on the road and at work. Yet, despite these significant gains, mortality statistics show that the overall trend for accidental death in the UK has been generally upwards in the last few years. Of the 11,438 deaths 59% were deaths to people aged 65 and over, of which 45% were due to falls. In 13 years, the number of over-60s needing inpatient care for falls-related injuries has more than doubled, standing at more than 357,000 in 2010-11 in NHS hospitals in England alone. With an ageing population and an emphasis on enabling older people to live as independently as possible, falls (especially in the home) is an issue that cannot be ignored. The cause of a fall is often multi-factorial, involving both environmental hazards and an underlying medical condition. Strength, balance and gait, decline in vision, mental health problems and deficiencies in the diet are all contributory risk factors. Although prescription medicines are seldom the cause of falls, they may also be a major risk factor. RoSPA has been actively involved in developing falls prevention strategies and delivers accredited falls prevention training, providing resources, advice and information. We also have a strong input into National Policy. Falls prevention services tackle falls in older people, particularly in areas where there is a concentration of over-60s, focusing on preventative strategies that assess and address risks in the home using simple pieces of equipment and improving physical stability through exercise. Falls prevention services work with a range of partners to identify at-risk members of the community. Referrals can be made by GPs, hospital staff, social care professionals, Age Concern, as well as direct referrals from older people themselves. The structure of the service is flexible but can include a manager, postural stability programme co-ordinator, falls advisers, a handy-person and an administrative assistant. Since the introduction of the Dudley Falls Service in 2003, there has been a 38 per cent reduction in the number of over-60s attending A&E as result of a fall and a four per cent reduction in fractured neck or femur resulted in a saving of approximately £3 million. The quality of life improvements are immeasurable.

Dr Mackay’s presentation focuses on the mechanisms of spinal cord injuries in traffic crashes, especially rollover accidents. Data are presented which show that although most spinal cord injuries occur in frontal crashes, which constitute 50% of all serious and fatal accidents, rollover events, although only around 12% of all serious injury accidents, are much more likely to generate serious cervical cord injuries.

On the mechanism of the injuries, there are two schools of thought; one side emphasises the role of roof deformation, whilst the other side considers that the main mechanism of the injury is a diving action by the occupants when a car makes an inverted landing.

For unbelted occupants sitting on the outside seat in a rollover, the diving mechanism is usually predominant. The severity of the injury and the extent of the roof deformation are both outcomes of the severity of the landing; one is not causally related to the other.

For occupants using seat belts the issue is somewhat more complicated. Initial head clearance, the seat belt design, the occupant’s characteristics and the nature of the injury mechanism become more important.

Lumbar spine injuries in frontal crashes are often related to poor seat belt positioning across the abdomen. This is especially important for rear seat passengers because there is no instrument panel in front of the knees. This can lead to submarining, where the pelvis rotates out from under the seat section of the seat belt, resulting in flexion distraction injuries to the lumbar spine. Some of the seat and seat belt design issues are illustrated.

New designs of seat belts and side and roof airbags are illustrated, and the difficulties of sensing when a rollover is about to occur are discussed.

Electronic stability control systems have reduced the number of fatal crashes by 14% for cars and 28% for SUVs. For police reported rollovers, there has been a 64% reduction in cars fitted with ESC systems and for SUV rollovers the reduction has been 85%. ESC systems therefore have proven to be one of the most successful technical advances in automotive safety.
Road crashes are the single biggest killer of young people in the UK and worldwide, and the biggest cause of major bodily trauma admissions to hospital. Work to prevent road crashes and casualties, particularly to improve the safety of people on foot and bicycle, can deliver significant benefits to our ability to lead active life-styles, reduce car dependency, and create healthier, greener communities. Despite this, road safety is not usually regarded as a public health issue.

Brake is charity campaigning to change this, through top-down and bottom-up activities to shift attitudes and behaviour around road use and promote the benefits that safer roads can deliver to society. We are working to get the message across that road crashes are not accidents: they are devastating, violent, man-made events that are fully preventable. We believe that worldwide, NGOs like Brake can play a critical role in convincing the public and policy makers on this point, tackling road casualties and making streets and communities safer.

Brake takes the approach of providing information, resources, events and opportunities to help communities and organisations take action on road safety issues and bring about results. We help schools to teach road safety and campaign for local drivers to slow down to protect children. We inspire young people to engage with road safety in colleges and youth clubs, and run their own road safety campaigns promoting safe and sustainable road use. We advise companies on ensuring the safety of at-work drivers, and recognise those with exemplary fleet safety practices. And we support communities and organisations take action on road safety issues and bring about results. We help NGOs combining national campaigning with community engagement can have a support within these communities for safer roads.

At the same time as encouraging grassroots action, we lobby national and devolved government for policy change, and carry out national media campaigns, in line with international evidence on what’s most effective in improving road safety. We work with bereaved and injured volunteers to draw attention to the terrible aftermath of road crashes, and to persuade policy makers and the public that these tragedies can be prevented. We draw on our own and desk-based research to underpin all these activities, and encourage communities everywhere to campaign for change and spread the word, by providing guidance, publicising local campaigns, and running national Road Safety Week as a focal point for everyone and anyone to shout loud and proud about road safety.

We believe NGOs combining national campaigning with community engagement can have a big influence on preventing road casualties, and help to bring about cultural shift, in the UK and elsewhere in the world. We are actively engaging in the UN’s global Decade of Action on Road Safety and working to extend our services and reach to international level, including sharing our expertise, including 15 years of running the UK’s Road Safety Week, with those working to improve road safety in other countries.
risk is what makes life worth living for many people. Unlike the negative messaging of traditional “safety” approaches to injury prevention, SMARTRISK programs emphasize the positive choices that can be made to reduce the risk of injury while continuing to enjoy life. We recognize that injuries are not “accidents” or unavoidable acts of fate but predictable and preventable events. SMARTRISK’s core programs focus on reaching youth – the age group at highest risk for injury. Many teenagers feel invincible and may take risks without thinking. They often do not understand that they have the power to choose a smart risk, rather than taking a risk without first thinking it through. SMARTRISK programs are centred on five simple, positive choices that can be applied to all areas of life, including driving, playing sports, even just crossing the street:

- Buckle Up
- Look First
- Wear the Gear
- Get Trained
- Drive Sober

Since we founded SMARTRISK here in the UK in 2003 one of these programs ‘Heroes’ has been seen by over 350,000 young people. This road show travels all over the UK visiting schools explaining to teenagers how they are able to avoid injury and death by taking smart risks. Our show features a live presenter who we call an injury survivor presenter (ISP) and they describe to the audience the day they didn’t take a smart risk and ended up seriously injured. You can hear a pin drop when the presenter is on stage sharing their story and explaining to the teenagers attending the show how to recognise smart risks and stupid risks and not cross your stupid line. The questions they ask are very insightful and reflect the connection they feel with the presenter.

Our Symposium presentation will share with you our experiences at SMARTRISK in staging Heroes and our plans for the future. As we strive to ensure that our kids don’t stop taking risks we simply want them to take smart risk and take risk after risk time and time again.
S16 11:30

Low velocity cervical spinal cord injury (SCI) with dislocation - the England national approach to the prevention of the secondary injury, using rugby as an example

Dennis Newton/Brian Gardner, Emeritus Consultant Surgeons in Spinal Cord Injury Stoke Mandeville
Dr Mike England, Medical Director RFU Injured Players Foundation, Twickenham
Mr Balraj (Raj) Singhal, Consultant Surgeon in Spinal Injuries, Burwood Spinal Unit, Christchurch, New Zealand

Of 113 Rugby SCI cases treated in Cape Town from 1988-2000, 57 had facet dislocations that were reduced. 32 were motor and sensory complete at the time of reduction. 8 of these 32 were reduced within 4 hours of injury. 5 of these 8 made a full recovery. None of the 24 reduced after 4 hours made a full recovery and only 1 made a useful recovery (Newton et al J Bone Joint Surg. Br: 2011;93-B:1646–52).

This evidence was considered by the England National Spinal Cord Injury Strategy Board (NSCISB) in December 2011. It was concluded that this evidence for the importance of the 4-hour post-injury window of opportunity for recovery in low velocity cervical spinal cord injury with dislocation merited a clinical care pathway for such cases.

The two main features that led the NSCISB to believe that this care pathway might be practicable at this stage were first the creation of the England Major Trauma Network in 2012, and second the development of the new cervical spinal reduction system in New Zealand in 2011.

Appropriate care at the scene of injury in these cases is well established. The RFU has prepared a DVD that will guide those at the scene of the accident.

In England all new traumatic spinal cord injured patients will be transported to the nearest major trauma centre (MTC). There are 26 in England. It is anticipated that around one acute low-velocity traumatic cervical spinal cord injured patient with dislocation will be treated in each MTC each year.

This low volume of such cases mandates a simple system for diagnosis and reduction. It is believed that the Burwood reduction system, supplemented by a web-based video on the use of this system and advice from the linked spinal cord injury centre, will enable clinicians in the MTCs to carry out reductions effectively and safely. The Burwood reduction system does not require any hanging weights. Traction is achieved by a gear box with a mechanical load cell as a torque measuring device. The Traction bed used is a modified Howard Wright Bed. The latter is an important component of the device. In the 22 cases that have been reduced the average weight used was 13.5 kg and the reduction time 29 min. Complications were one pin cut out and one re-dislocation needing further reduction.

The authors emphasise that the key goal of the care pathway is the reduction of the facet dislocation within 4 hours of injury.

The authors are aware of the controversies surrounding the place and timing of MRI scanning and the route and timing of surgery, and whether surgery should be done at all. The authors believe that these issues on MRI scanning and surgery are for the patient and not for the surgeon to decide, within the context of an appropriate consent system. A low velocity cervical SCI patient is fully conscious. The surgeon must explain matters fully to his patient. This would take at most a few minutes, as MTC’s have modern electronic imaging. If MRI scanning or surgery prevents reduction within the 4 hour window of opportunity then the patient must be aware of the effect this might have on his neurological outcome. The MTC surgeon is encouraged within the protocol to discuss the case with the SCI centre that is linked to the MTC so that the patient has available to him all appropriate advice to assist him in coming to his decision.

Tuesday 4th September 2012

S17 11:55

SCI in the UK - a 10 year analysis of causes from 2000-2009 - how does this help prevention?

In 1999, through the British Association of Spinal Cord Injury Specialists (BASCIS), all the Spinal Cord Centres in the UK and Ireland agreed to collect data on all the new patients admitted to the Centres. This was collected over the next 10 years (2000-2009).

Cardiff, Oswestry and Stoke Mandeville (Group A) supplied the full 10 years of data; Middlesbrough, Southport and Wakefield (Group B) 9 years; Sheffield 7 years; Belfast and Stanmore 5 years; Glasgow and Salisbury 4 years; and Dublin 2 years of data.

This presentation will look at epidemiological trends in the spinal cord centres as a whole over the ten year period. It will compare trends in group A, which covers all of Wales, the West Midlands and some of the south east of England (“the Mid West”), with those in group B, which covers all of the north of England(“the North”). Only patients with some neurological deficit will be included, even if that is only some bladder dysfunction.

This analysis will show those causes and other demographical changes that appear to be occurring in Wales and parts of England during the first decade of this century. This in turn will help to identify the areas where attention needs to be focussed in preventing such injuries in the future.
Preventing primary spinal cord injuries in adolescents: a pilot 7th grade science education program
Bridget Metzger; Herndon Murray; Shari McDowell; Shepherd Center, USA

Background:
A group of clinicians, educators and administrators designed, implemented and assessed a pilot education program addressing the impact of a spinal cord or brain injury and injury prevention efforts for 140 middle school students.

Methods:
A prospective design was used to assess knowledge of the outcomes of a brain or spinal cord injury and attitudes toward risky behavior. Students enrolled in a single middle school received a three week educational series about brain and spinal cord anatomy and function, expected changes following injury, and injury prevention. The curriculum was interactive, including video case studies and school visitation with current and former patients who have a brain and/or spinal cord injury. Students were tested for knowledge of the effects of these injuries and a 0-10 visual analogue scale (VAS) was used for a pre- and post-course attitude assessment of the students’ perceptions of risk for 20 behaviors, such as diving into a pool.

Results:
140 students (82 female, 60 male) were surveyed. Mean scores for knowledge based questions pre- and post-intervention were 10.62 and 13.40 respectively (min 0 and max 17). 89% of students improved their assessment score. For the VAS behavior risk assessment, 84% of all students noted an increase in perceived risk on their post assessment. The greatest risk perception attitude change in both males and females was noted for diving into a pool with respective pre- and post-test mean scores of 4.2 (SD = 3.1) and 7(SD = 2.6).

Conclusion:
Education sessions can improve a student’s knowledge of the impact of a brain or spinal cord injury and change perceived attitudes about the risk of common behaviors. Follow up is needed to understand the impact on their personal behavior. Expansion of this program would provide an opportunity to better understand other demographic populations and enhance curriculum development.

Future steps:
In May, 2012, the program will be expanded to include 350 adolescent students. The addition of behavior contracts between the students and guardians will be used to augment personal responsibility. The outcomes tool will be revised based on pilot data and the program will be reassessed. Data for the second year will be reported by July, 2012.
Spinal Cord Injury in the Majority World: Action and Direction for the International Community  

Westminster Suite

S20

Spinal Cord Injury in the Majority World: Action and Direction for the International Community
Colleen O'Connell, MD FRCPC, Dalhousie University, Stan Cassidy Centre for Rehabilitation, Canada

The World Health Organization estimates that of the 20 million people with spinal cord injury (SCI), the majority live in the developing world. Furthermore, over the past decade there has been an increasing global awareness of the aftermath of natural disasters, including provision of care to those with catastrophic injuries. International response efforts to such events has resulted in a greater recognition of disaster related SCI and the state of SCI care in general in low-resource regions. There now exists tremendous opportunity for the international SCI community to collaboratively work towards identifying the challenges and critical successes in delivery of SCI care in low resource areas, including disaster preparedness and response, capacity building within acute and rehabilitation care settings, and establishment of sustainable training programs in SCI care.

Drawing on personal and organizational experiences and research, this symposium will review the state of SCI care in low resourced countries, highlighting both the paucity of resources and data, and the current opportunities as a result of increased global attention. Innovative programs in a number of developing regions will be explored, including Nepal, Botswana, China and Haiti, identifying successes and potential models that could be adapted in a more global context. Disaster preparedness recommendations, including the IS COS Disaster Committee collaborations, will be presented. Suggestions for IS COS and the international SCI community for next steps for action will conclude with an opportunity for symposium participants to engage in discussion.

Challenges in Establishing SCI Units in Africa
Claes Hultling, MD PhD, Associate Professor, Karolinska Institute, Stockholm, Sweden

Background:
Spinal cord injury rehabilitation (SCI rehab) is almost non-existing in most developing countries. In 2008 the Spinalis Foundation of Sweden (Spinalis) met with the Ministry of Health in Botswana (MoH) (incidence ≈100/year) to discuss potential for a SCI unit. SCI patients were normally admitted to small countryside hospitals, with resulting high mortality. Patients in Botswana’s primary referral hospital (PMH) had slightly better survival. Lack of rehabilitation made it impossible for most patients to return to active meaningful life.

Methods:
Spinalis and MoH created a joint project, with application to the Swedish International Development Cooperation Agency (Sida) for three-year grant to establish a SCI unit at PMH. The goal was a small, independent unit with 12-16 beds for inpatients, with capacity for out-patients from throughout Botswana. PMH would supply staff and hospital facilities and Spinalis providing key project leads and medical professionals.

Result:
The first patient was admitted in May 2010. The centre is now fully staffed by local professionals, (1 full time MD, 1 part time MD, 2 RPTs, 1 OT, and 15 nurses/auxiliary nurses) and the Swedish team concentrating on support, lecturing and documentation of protocols and routines. Since 2010 there have been 97 SCI in-patients 1357 out-patient consultations. Challenges have included time consuming bureaucracy, cultural differences, and lack of relevant technical aids, medicines and consumables.

Conclusion
It is extremely rewarding to introduce comprehensive SCI units in countries where most people suffering spinal cord injuries die. Doing this requires dedicated local decision making partners, preferably both on ministry and hospital levels and dedicated, patient and highly professional team members, with an ability to create solutions rather than argue problems. The Spinalis Foundation of Sweden will continue to support Spinalis Botswana throughout 2012 and 2013 when the centre is expected to become an independent unit within the Botswana public health care services.
Challenges in Physician Training: Nepal experience
Claire Weeks PhD MD FRCP(C), University of British Columbia, Canada

Background:
People who sustain a spinal cord injury in Nepal face greatly exaggerated problems compared with their peers in the developed world. All health care costs must be borne by individuals, as there is no universal health care, health insurance is not available, and, with an average annual income of about $650, there is little available for anything but the most basic necessities of life. As in many under-resourced countries, Nepal is short on SCI-related knowledge and skills. In addition, attitudes towards people with disabilities are not generally supportive, and resources (financial, social, vocational, psychological, etc) are insufficient. One of the greatest problems in providing SCI care in developing economies is the lack of physicians trained in SCI medicine.

Methods:
We sought the best training path and credentialing option for a young physician working in SCI rehabilitation through conversations with others with similar experience and over the course of four visits to Nepal. Canadian options for training were also researched using data from the annual Canadian Postgraduate Education Report and from the Canadian Resident Matching Service.

Results:
PM&R training in Canada is prohibitively expensive and admission is very difficult for Nepali trainees. Alternative routes to expertise in SCI medicine are not currently available.

Conclusion:
There is a need for other routes to SCI medical education appropriate to the needs of countries like Nepal. The role of ISCoS in this endeavour should be further explored.

SCI-related disaster preparedness
Peter C Wing MB ChB MSc FRCS(C), University of British Columbia, Canada

Background:
All of the faculty on this symposium have worked in a developing country, some following natural disasters, triaging those with SCI and assisting with acute care and rehabilitation. Others have worked as advisors to health care organisations preparing for the event that a disaster may stretch care capacity beyond an already marginal ability to cope with SCI. We have learned through our literature about the impact of recent major earthquakes. Deaths number in the tens or hundreds of thousands, there are matching numbers of major injuries and large cohorts with spinal cord injuries. These often occur in countries lacking full SCI rehabilitation facilities at the best of times, let alone at the time of civil collapse following a natural disaster.

Methods:
Nepal is in a highly active seismic area and earthquakes can be frequent and severe. Landslides occur in the absence of earthquake activity. In spring 2012, two disaster preparedness workshops were held in Kathmandu, Nepal, organised by the Nepalese Spinal Injury Rehabilitation Centre (SIRC). The first was a higher-level workshop in which representatives of a number of NGOs and INGOs explored planning issues relating to earthquakes in Nepal. The second, a few days later, was held at the SIRC and involved all staff and some of the patients in an extended briefing session and subsequent drill.

Results:
Drawing on this experience, the talk will present the recommendations from the workshop and the drill and describe the ongoing process of preparation.

Conclusion:
Especially in earthquake prone regions, providers of acute and rehabilitation services for people with SCI should be able to accept surges of patients with independent stocks of supplies pending restoration communications and of transportation following a natural disaster.
Consideration SCI early markers and observations in post disaster for preparing long term management of SCI subjects
Eric Weertz, Handicap International Vietnam – Bach Mai hospital Hanoi SCI Care extension project – Post Earthquake support program – PR China

Introduction:
The term “early marker” refers to information (direct observation, measure scales, assessments) obtained in the immediate aftermath of a disaster on site. Such markers can be used to predict highly probable outcomes for suspected SCI persons, including prevention of complications, early functional recovery as well as making contingencies to prepare long term follow-up and intervention for SCI care and management in general. This can decrease care burden and allow resource planning in the long term to facilitate social and economic integration of persons living with SCI.

Methods:
Early markers including clinical data, assessment tools and observations during early responses to presumed SCI victims after major disasters were evaluated from earthquake events in China; Sichuan province (2008) and QingHai province (2010). Data from follow-up of minimum 2 years post disaster was reviewed, including published papers, presentations, letters to editors, internal assessment reports, on site visits by the speaker and client satisfaction surveys.

Results:
Analysis of spinal fractures and dermatome sensation was a clear indicator for triage towards specialized care and monitoring. Simple examinations (functional measure, mobility scores and bowel and bladder diaries) in non-neuro trauma wards could help identify SCI, and direct basic specialized patient care and teaching of staff. Continuous follow-up of suspected SCI patients resulted in better case management. Outcome information facilitated longer term planning. SCI Patients identified later post earthquake had more complications and longer recovery process.

Conclusion:
The use of consistent examinations and indicators on suspected SCI cases in the first weeks after injury allow an early start of comprehensive management and facilitates a swifter integration process in time and space for the SCI person. More research is needed to add further early markers and to reduce time to determining functional outcomes.

Collaborations of SCI and Disaster Organizations
Géraldine Jacquierin, MD, FRCP, FAAPMR, MPH
Assistant professor, Physical Medecine & Rehab Université de Montréal, Institut de Réadaptation Gingras-Lindsay de Montréal, CANADA

Background:
Recent disasters have caused a high number of spinal cord injuries. Many deficiencies have been noted in the initial management of those affected persons. Following the Haiti earthquake, a disaster committee was formed within ISCoS. Our aim was to improve our participation in the medical efforts in the care of spinal cord injured persons. To facilitate this, we initiated linkages with international organizations involved in disaster situations.

Objectives:
The objective of this presentation is to share the initial steps of the collaborations between ISCoS and disaster response non-government organizations (NGOs).

Methods:
The decision was made to create links with NGOs involved with disaster management and emergency situations.

Results:
The committee members communicated with several organizations in order to get an idea of existing protocols and explore potential collaborations. Discussions on protocols and resources are currently under way. Additional topics include whether ISCoS could be a provider of human resources during a disaster. This is being looked at and this will be presented in the session.

Conclusion:
Through this process, we are creating a great opportunity to merge operational facilities (emergency NGOs) with technical knowledge (ISCoS members). We are therefore creating a possibility to improve the outcomes of people with SCI acquired before, during, and after a disaster.
S26

Recommendations & Planning for Future Disasters
Anthony S. Burns MD MSc, (1) Associate Professor, Division of Physiatry, Dept. of Medicine, University of Toronto; (2) Brain & Spinal Cord Rehabilitation Program, Toronto Rehabilitation Institute – University Health Network, Toronto Canada

Background: or Objectives:
It is a certainty that future disasters will occur. Due to improved disaster response, survival rates have increased as well as the number of injuries in relation to deaths (injury to death ratio). Sudden onset disasters can lead to unprecedented numbers of spinal cord injuries (SCI), often in low resource environments.

Methods:
An attempt was made to examine and synthesize the collective experience of the field of SCI medicine in the setting of sudden onset disaster using literature review, correspondence with colleagues, personal experience, and access to other information sources as available.

Results:
Measures are proposed that target challenges identified in prior sudden onset disaster including: coordination and mobilization; identification and procurement of required expertise; initial survey and assessment; health care delivery; community reintegration and health maintenance; and sustainability and capacity building.

Conclusion:
In the context of future disasters, improved rapid response will lead to the increasing survival of individuals with catastrophic injuries (including SCI) and accompanying long-term needs and impairments. Fortunately, the fields of SCI medicine and disaster planning can learn from prior experience when looking to the future. The international community should proactively address how these needs will be met when the need once again arises.

S27

Beyond the glial scar: using chondroitinase as a therapy to promote repair following spinal cord injury
Elizabeth J. Bradbury, King’s College London, Regeneration Group, The Wolfson Centre for Age-Related Diseases, London SE1 1UL

One of the many reactive events that occurs following spinal cord injury (SCI) is the formation of a glial scar that surrounds the injury site. The glial scar is thought to be an inhibitory barrier to the regrowth of injured spinal axons due to the presence of growth inhibitory molecules. Chondroitin sulphate proteoglycans (CSPGs) are one of the main classes of inhibitory molecules that are present in the extracellular matrix of the glial scar, and are dramatically up-regulated after SCI. The bacterial enzyme chondroitinase ABC (ChABC) removes CSPG glycosaminoglycans, rendering the SCI environment more permissive to growth, and is a promising treatment option for SCI. However, despite the reported beneficial effects of ChABC treatment, the potential for achieving long term efficacy in traumatic injuries that mimic a human SCI has not yet been realised. Recently, a bacterial chondroitinase cDNA has been engineered that allows the expression and secretion of active chondroitinase enzyme by mammalian cells. Gene delivery of ChABC may have a number of advantages compared to previous treatment paradigms, including sustained delivery by spinal cord cells at the site of injury. We have assessed the efficacy of gene delivery of ChABC in a clinically relevant animal model of spinal contusion injury, which represents the most common form of SCI in humans. We delivered genetically modified ChABC via a lentiviral vector (LV-ChABC) to adult rats following T10 spinal contusion and have examined changes in spinal injury pathology and functional outcome. LV-ChABC resulted in sustained and widespread CSPG degradation in the contused rat spinal cord and this was associated with significantly reduced cavitation, enhanced neuronal survival, sparing of spinal axons, increased vascularisation throughout the injury site and a marked change in the nature of reactive gliosis and the inflammatory response around the injury epicenter and cavity borders. Importantly, LV-ChABC treatment also resulted in improved spinal conduction and behavioural function, which was sustained into chronic stages of injury. These findings identify gene delivery targeting glial scar extracellular matrix as a promising strategy for repair following spinal injury. Supported by: The Medical Research Council and the International Spinal Research Trust
**Peripheral plasticity in spinal cord injury: the capsaicin receptor and autonomic dysreflexia.**

Matthew Ramer, ICORD, Canada

Spinal cord injury (SCI) triggers profound changes in visceral and somatic targets of sensory neurons below the level of injury. Despite this, little is known about the influence of injury to the spinal cord on sensory ganglia. One of the defining characteristics of sensory neurons is the size of their cell body: for example, nociceptors are smaller in size than mechanoreceptors or proprioceptors. In these experiments, we first used a comprehensive immunohistochemical approach to characterize the size distribution of sensory neurons after high- and low-thoracic SCI. Male Wistar rats (300 g) received a spinal cord transection (T3 or T10) or sham-injury. At 30 days post-injury, dorsal root ganglia (DRGs) and spinal cords were harvested and analyzed immunohistochemically. In a wide survey of primary afferents, only those expressing the capsaicin receptor (TRPV1) exhibited somal hypertrophy after T3 SCI. Hypertrophy only occurred caudal to SCI and was pronounced in ganglia far distal to SCI (i.e., in L4-S1 DRGs). Injury-induced hypertrophy was accompanied by a small expansion of central territory in the lumbar spinal dorsal horn and by evidence of TRPV1 upregulation. Importantly, hypertrophy of TRPV1-positive neurons was modest after T10 SCI. Given the specific effects of T3 SCI on TRPV1-positive afferents, we hypothesized that these afferents contribute to autonomic dysreflexia (AD). Rats with T3 SCI received vehicle or capsaicin via intrathecal injection at 2 or 28 days post-SCI; at 30 days, AD was assessed by recording intra-arterial blood pressure during colo-rectal distension (CRD). In both groups of capsaicin-treated animals, the severity of AD was dramatically reduced. We have also found that passive cycling exercise not only reduces the severity of AD, but also reverses hypertrophy of TRPV1-positive DRG neurons. While AD is multi-factorial in origin, TRPV1-positive afferents are clearly involved in AD elicited by CRD. These findings implicate TRPV1-positive afferents in the initiation of AD and suggest that TRPV1 may be a therapeutic target for amelioration or prevention of AD after high SCI.

**References**


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**Inspiring new thinking to restore motor function after spinal cord injury**

Courtine, Gregoire

International Paraplegic Foundation, Switzerland

Functional restoration after spinal cord injury (SCI) has been interpreted as the need to promote long-distance regeneration of severed fibers to their original targets. A radically new and more immediate approach may instead capitalize on the intrinsic capacity of spared neuronal systems to produce locomotion, and to reorganize through use-dependent mechanisms. Indeed, the neuronal machinery sufficient to produce standing and stepping is located below the majority of SCI. A combination of electrical spinal cord stimulation and monoamine agonists is capable of transforming this circuitry from dormant to highly functional states, promoting coordinated locomotion in otherwise paralyzed rats. Training enabled by this electrochemical neuroprosthesis restores full weight-bearing locomotion in rats with complete SCI (1). This impressive recovery relies on the ability of the spinal brain to utilize multisensory information as a source of control and learning after the complete loss of brain input. Due to the interruption of supraspinal information, electrochemically-enabled locomotion remains involuntary, and restricted to automated stepping on a treadmill. However, spinal cord injuries in humans are rarely complete, and instead spare tissue bridges that may support recovery. We developed a new experimental model of SCI that reproduces the key anatomical and functional outcomes of severe SCI (2). Despite the complete interruption of direct supraspinal input, I will show that a training program combining an electrochemical neuroprosthesis and a novel robotic interface (3) restores voluntary control over refined locomotion. This recovery relies on what may be the most extensive remodeling of axonal projections after CNS injury observed to date (4). These findings may inspire new thinking in the future design of strategies to return function after SCI in humans (5).

**References**

Imaging of Spinal Cord Injury - Present and Future 09:00 – 10:20
Westminster Suite

S30
O’Donnell, Paul1; Hughes, Richard2; Meagher, Tom2; Lopez de Heredia, Luis2; Tins, Bernhard3; Brooks, Jonathan4
1Royal National Orthopaedic Hospital London; 2Stoke Mandeville Hospital; 3Robert Jones and Agnes Hunt Hospital, Oswestry; 4FMRIB centre

The role of imaging in evaluating the acutely injured spine has become well established over the last 25 years. Cross-sectional imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI) play a key role in the assessment of spinal bony and soft tissue injury, cord imaging and in conjunction with clinical features help to guide appropriate surgical/non-surgical management strategies. Such imaging techniques and strategies continue to evolve with technological advances and increasing clinical experience.

This symposium will review 3 key areas focussing on the clinically important aspects of imaging in spinal cord injury:

1. Spinal Orthopaedic Imaging: Early imaging of acute spinal injury and its role in guiding surgical decision making will be reviewed. Imaging strategies and imaging concepts of ‘spinal stability’ will be considered. Imaging of the post-operative spine and its challenges will be reviewed.

2. Imaging the injured spinal cord. The role of clinical MRI imaging in acute/subacute and chronic spinal cord injury will be reviewed. Discussion will include protocols and imaging appearances of complications such as ascending myelopathy, syrinx and epidural adhesion. Advanced cord imaging techniques such as diffusion tensor/tractography and functional cord imaging will be discussed with a view to future clinical applications.

3. Imaging the complications of spinal cord injury. The role of a modern imaging service in managing ongoing complications will be discussed with particular emphasis on imaging strategies for sepsis and thromboembolic disease in spinal injured patients. The role of interventional radiology in managing spinal injury will also be discussed.

Quantitative Neuroimaging of the Spinal Cord and Brain 10:45-12:45
Following Spinal Trauma
St James Suite

S31
Quantitative MRI of macroscopic anatomy and tissue microstructure
Nikolaus Weiskopf
Wellcome Trust Centre for Neuroimaging
UCL Institute of Neurology
University College London

Background:
Intensity values in standard images are not quantitative and thus cannot be compared across time points or imaging sites, limiting longitudinal multi-center studies and standardized diagnosis. Moreover, contrast in clinical MRI results from a mix of different types of MR relaxation mechanisms and tissue characteristics, hindering the interpretation of signal changes. We aim at developing quantitative MRI that yields absolute measures of MR parameters, which are universally comparable and provide different views on the local microanatomy.

Methods:
We developed a multi-parameter mapping (MPM) approach based on a fast low angle shot (FLASH) acquisition combined with advanced correction and parameter estimation methods. MPM yields accurate and precise measures of four major contrast parameters in a clinically feasible scan time of 20 mins at 1mm isotropic resolution: longitudinal relaxation rate (R1), apparent transverse relaxation rate (R2*), proton density (PD) and magnetization transfer saturation (MT). Each quantitative parameter reflects a single contrast mechanism that predominantly depends on a specific tissue property, e.g., MT and R1 are highly correlated with myelination. Recently, MPM was extended to 800μm resolution, which allows for in-vivo mapping of cortical myelination in ~30 mins.

Results:
Several applications and results of MPM will be presented, which include: effects of ageing on myelination and iron concentration 1; in-vivo mapping of cortical myelination allowed for delineating different areas in the visual and auditory cortex as a first step towards mapping of myeloarchitecture 2. Delineation and segmentation of subcortical areas was improved when based on MT maps 3.

Conclusion:
Quantitative MPM offers new possibilities for accurately mapping macroscopic anatomy and tissue microstructure. The resolution, coverage and speed makes it feasible for neuroscience and clinical applications. The quantification simplifies comparisons across sites and time points, facilitating multi-center studies.

2. Sereno et al. Cerebral Cortex (in press).
Prognosis after spinal cord injury strongly depends on the extent of the lesion, as well as on the type and number of spinal pathways that have been damaged. This assessment can potentially be performed using non-invasive biomarkers obtained with multi-parametric MRI, which combines various quantitative techniques such as diffusion tensor imaging, magnetization transfer and atrophy measurements. However, multi-parametric MRI is hampered by the difficulty in obtaining robust and sensitive measurements in the spinal cord. Ultra-high field MRI (7 tesla and beyond) has the potential to alleviate these difficulties thanks to an increase in signal and image contrast. In this talk we will briefly review the pros/cons of 7T MRI and present some of the latest applications in the healthy and pathological spinal cord.

Diffusion MRI (dMRI) can be exploited to provide markers for the characterisation of the microscopic environment within biological tissue. It's most common implementation - Diffusion Tensor Imaging (DTI) - has been used successfully to study white matter (WM) in the healthy and diseased human CNS. However, DTI is hampered by its simplistic underlying mathematical model, which makes it difficult to relate it's parameters to individual tissue changes such as axon diameter or density. While simple dMRI techniques are very useful in detecting regions of injury, extracting meaningful quantitative microstructural information and changes is more challenging. Here, we review alternative methods to DTI in the spinal cord, including non-parametric methods such as Q-space imaging and complex parametric multi-compartment models. We provide evidence that those method can indeed provide better insight into the microstructural organisation of the spinal cord and thus have great potential, e.g., to provide more specific outcome markers for novel SCI therapies.

Diffusion tensor imaging (DTI) provides information about the microstructure in the brain and spinal cord. While new technology has significantly advanced the accuracy and sensitivity of DTI of the brain, the quality of spinal cord DTI has improved less. This is in part due to the small size of the spinal cord (ca. 1 cm diameter) and more pronounced instrumental (e.g. eddy current) and physiological (e.g. cardiac pulsation) artefacts present in spinal cord DTI. A clear and reliable distinction between grey matter (GM) and white matter (WM) of DTI-index maps holds promise to improve clinical diagnosis in the spinal cord. So far, the improvements in image quality and resolution have resulted from cardiac gating and new acquisition approaches (e.g. reduced field-of-view techniques). The use of retrospective correction methods is not well established for spinal cord DTI. The aim of this paper is to develop and optimise a post-processing pipeline tailored for robust DTI in the spinal cord. We found that the combination of slice-wise motion correction, eddy current correction, and robust fitting increased the contrast-to-noise ratio (CNR) in FA maps by about 30% and reduced inter-individual variation in FA by a factor of up to 3. The higher quality of FA maps allows for a better distinction between GM and WM without costs in terms of scan-time and is comparable with any multi-directional DTI acquisition scheme.

MR Spectroscopy (MRS) allows the in vivo quantification of metabolites, which reflect specific pathological processes. Recent developments and advances in imaging acquisition and the increased use of high field scanners have made it possible to apply MRS to the spinal cord of patients with spinal cord injury. Clinical applications of spinal cord MRS have been scarce and limited to a few studies that were carried out in patients with cervical spondylotic myelopathy, chronic whiplash, cord tumours, multiple sclerosis, and brachial plexus injury. In this talk I will review recent studies that use MRS of the spinal cord in patients with spinal cord injury and discuss their main results. These studies have demonstrated that MRS of the spinal cord can provide information on the underlying mechanisms of the disease by reflecting pathological changes that are not detectable with conventional MRI techniques. Although most of the studies published so far are limited by small cohort sizes and technical limitations, they have shown the potential of MRS of the spinal cord in patients with spinal cord injury. Larger, prospective, longitudinal studies are now needed to corroborate the findings to date and assess how long term outcomes relate to changes in MRS metabolite concentrations at the time of acute injury. A key question that needs to be answered is whether MRS of the spinal cord provide biomarkers which are sensitive to change and responsive to treatments.
Quantitative studies of myelopathy using DTI: experience from chronic SCI and MS
Kollias, Spyros
Universitat Zurich, Switzerland

Background and Objectives:
Diffusion Tensor Imaging (DTI) enables the visualization and quantification of intrinsic damage within the central nervous system. In order to assess a possible association between intrinsic structural damage and clinical disability, DTI data of the spinal cord were correlated with electrophysiological parameters in patients diagnosed with Multiple Sclerosis (MS), and patients with spinal cord injury (SCI).

Methods:
DTI data of the spinal cord were acquired with a Philips Achieva 3 T MR scanner using an outer volume suppressed, reduced field of view (FOV) acquisition with oblique slice excitation and a single-shot EPI readout. Neurological and electrophysiological measures, American Spinal Injury Association (ASIA) impairment scale scores, and motor (MEP) and somatosensory evoked potentials (SSEP) were assessed in SCI subjects. For the MS study, DTI, T1- and T2 weighted images of the spinal cord were acquired in 28 healthy volunteers and 41 MS patients. Fractional anisotropy (FA) and apparent diffusion coefficient (ADC) were evaluated in NAWM and grey matter at the cervical level. The obtained values were correlated MEP. The “Asymmetry Index” (AI) was calculated for FA values of corresponding left and right ROIs in the lateral funiculi. Results: FA values were decreased in the SCI subjects compared to normals. In upper cervical segments, the decrease in FA was significant for the evaluation of the entire cross-sectional area of the spinal cord, and for corticospinal and sensory tracts. A decreasing trend was also found at the thoracic level for the corticospinal tracts. The decrease of DTI values correlated with the clinical completeness of SCI, and with SSEP amplitudes. In MS patients structural abnormalities were reflected by asymmetric decrease of FA. Subgroup-analysis revealed highly significant correlations of functional (electrophysiological) and structural (DTI) asymmetries in the cervical lateral funiculi, which comprise the crossed pyramidal tract.

Conclusion:
In both patient groups, the correspondence of asymmetric anatomical changes in the spinal cord and asymmetric electrophysiological deficits for both arms and legs appears to reflect a specific structure-function relationship in the human spinal cord in vivo. The reduction of FA in regions remote from the SC injury site suggests their involvement with wallerian axonal degeneration. DTI can be used for the quantitative evaluation of the extent of SC damage, and eventually to monitor the effects of future regeneration-inducing treatments.

Michael G. Fehlings,1 David Cadotte,1 David Mikulis, Patrick Stroman
Neuroscience Program and Divisions of Neurosurgery and Neuroradiology, University of Toronto Neuroscience Program Queen’s University

Introduction
While numerous studies have documented evidence for plasticity of the human brain there is little evidence that the human spinal cord in capable of change after injury. In this work, we employ a novel spinal fMRI design where we stimulate normal and abnormal sensory dermatomes in persons who have suffered traumatic spinal cord injury and perform a connectivity analysis to understand how spinal networks process information.

Methods
Spinal fMRI data was collected at 3 Tesla at two institutions from a total of 38 individuals using the standard SEEP functional MR imaging techniques. Thermal stimulation was applied to four dermatomes in an interleaved timing pattern during each fMRI acquisition. SCI patients were stimulated in dermatomes both above (normal sensation) and below the level of their injury.

Results
Patients with chronic incomplete SCI, when stimulated in a dermatome of normal sensation, showed an increased number of active voxels relative to controls (p=0.025). There was an inverse relationship between the degree of sensory impairment and the number of active voxels in the region of the spinal cord corresponding to that dermatome of abnormal sensation (R2 = 0.93, p < 0.001). Lastly, a connectivity analysis demonstrated a significantly increased number of intraspinal connections in incomplete SCI patients relative to controls suggesting altered processing of afferent sensory signals.

Conclusions
In this work we demonstrate how spinal fMRI can be used to investigate changes to spinal processing of somatosensory information in the human spinal cord. We provide evidence for plasticity of the human spinal cord after traumatic injury based on an increase in the average number of active voxels in dermatomes of normal sensation in chronic SCI patients and an increased number of intraspinal connections in incomplete SCI patients relative to healthy controls.
Legal Symposium 10:45-12:45
Westminster Suite

S38
“How much is enough?” A session for all Personal Injury Lawyers and Doctors in the Field of Spinal Cord Injuries
Tim Tomasik and Mike Krzak, Clifford Law Offices, Chicago
Gerard McDermott QC, Leading Barrister (trial lawyer) specialising in SCI Outer Temple Chambers, London
Paul Paxton, Solicitor Head of Personal Injury, Stewarts Law, London
Julian Chamberlayne, Head of the Travel Law Team, Stewarts Law, London
Brian Gardner FRCS, FRCP Stoke Mandeville
Gary Yarkony MD Elgin, Illinois

“How much is enough?”
Scenario: A UK Claimant suffers an SCI injury as a result of a third party, whilst travelling abroad in the US. The availability of his compensation will have a significant impact on his rehabilitation and future wellbeing, particularly later in life. But how will his compensation be assessed, what insurance coverage issues will there be, how will he be dealt with clinically in the early stages, and later? What about a US citizen injured in the UK or EU – how will his claim be dealt with? In a world where people routinely travel and work abroad, important questions arise as to the impact that different legal systems apply in relation to liability and quantum and how this may impact on the wellbeing of individual patients throughout their life. This session will feature prominent trial lawyers and clinicians from the US and from UK. It will seek to inform clinicians about the different compensation systems in the US, UK and the EU and the impact that this may have on clinical practice. It will also be of real interest to lawyers in the field dealing with both domestic and cross border claims.

Paralympics Workshop 15:00-16:45
Whittle Room

S39
Adapted Physical Activity as part of Multi Disciplinary Treatment of Hospital Functional Rehabilitation
Prof. J. Oriol Martinez Ferrer, M.D, professor to Blanquerna Faculty – Ramon Llull University, Barcelona (Spain), Chairperson IPC Medical Committee – International Paralympic Committee
Ex-director to the “Hospi Sport Programme” (Spain), Spain

Background and Objectives:
After the two world wars of the twentieth century, it’s when people with disabilities start in sport freely. Your driver is the neurosurgeon Sir L. Guttmann, Stoke Mandeville Centre (UK) director, which revolutionized rehabilitation techniques by introducing the sport practices. Sports and physical activities promote global health, and those for people with disabilities are important in a comprehensive health plan specific. They are part of functional rehabilitation protocols acting on: - Conservation and improvement of their physical capacity. Restored by medical rehabilitation or preserved by appropriate health prevention. - Strengthen self-esteem, confidence in their abilities and skills. - Encourage the process of socialization and normalization.

Methods:
The introduction of adapted physical activity in multidisciplinary functional rehabilitation protocols using a model based on: - Plan activities for people with impaired motor learning. - Define the objectives to be: rehabilitation, training, prevention and develop physically. - Adapt in order to promote the full participation of people with different disabilities. - Design them to improve their motor skills high, especially recoverable anatomical areas. - Led by multidisciplinary teams in order to prepare the person for integration with autonomy to sport practices.

Results:
The European Union has developed programs for standardization and integration of people with disabilities. In the Helios II program (1993-1996) established a working group that defined protocol intervention levels for physical activities and sport in the process of functional rehabilitation and curricular profiles of professionals should be involved. This work is set in the White Paper Helios II Programme (1997), taking example of “Best Practice” “Hospi Sport Programme”, developed by Catalan Sports Federation of Physical Disabled (Spain) since 1993, honoured with Bronze Medal Awards Helios II 1996 for their efficient performance and exemplary.

Conclusion:
The application of physical and sports activities started in the twentieth century by Sir L. Guttmann, are now indispensable in functional rehabilitation for people with disabilities. These activities are developed with the international concept of “Adapted Physical Activity” (AFA), defined by C. Sherrill (1996).
Preparing Athletes for the Paralympic Games

Dr Vicky Goosey-Tolfrey
The Peter Harrison Centre for Disability Sport, School of Sport, Exercise and Health Sciences, Loughborough University.

Background or Objectives
Following the success of ParalympicsGB in Beijing 2008 (42 Gold, 29 Silver and 21 Bronze medals), there continues to be marked influx of coaches seeking to develop their knowledge of Paralympic sport. However, the coach to the Paralympic athlete faces an extremely complex challenge with the implementation of effective physical and technical training programmes. In order to develop and implement safe and effective training programmes an understanding of the physical disability is essential. Focusing on the wheelchair athlete, this presentation will describe how sport scientists have worked with coaches and practitioners to help optimise training leading to a major competition through evidence base practise.

Methods/Results
The starting point for this programme of sport science support was to review the risk categories of the sporting environment (based upon the nature of the disability, indoor/ outdoor activity and the physical efforts). Interestingly, whilst this ‘needs analysis’ has allowed the team to prioritise areas of support, preliminary data from wheelchair rugby placed this sport at a ‘high risk’ with on-court core temperatures reaching almost 40ºC. There remains a lot to be learnt about wheelchair sports and it is important to understand the sport and the implications for training. With the London preparations our priority the key has been to explore ‘Smart Training’ tools and to simply begin to quantify training in a more simplistic fashion. The use of heart rate (HR), rating of perceived exertion (RPE) has been re-examined.

Conclusion
It is difficult to appreciate the extent to which this work has had on overall performance, although we feel that the sport science knowledge and its application to coaching within each sport involved has improved. Coaches working with this cohort of athletes need to ensure that they are familiar with knowledge surrounding the physiological consequences of a spinal cord injury.

Autonomic Dysreflexia and Boosting in Paralympic Athletes - Policies, procedures and Preliminary Findings

Cheri Blauwet, MD
Chief Resident, Physical Medicine and Rehabilitation Spaulding Rehabilitation Hospital/Harvard Medical School
Member, International Paralympic Committee (IPC) Medical Commitee

Background:
“Boosting” is defined as the intentional induction of autonomic dysreflexia for the purpose of improving sports performance, occurring among athletes with spinal cord injury (SCI) typically at the neurologic level of T6 or above. Boosting has been shown to confer up to a 10% improvement in race time, and may also result in catastrophic health consequences to the athlete. The International Paralympic Committee (IPC) strictly bans this practice and has developed a protocol for in-competition testing.

Methods:
Testing for boosting was carried out at the 2008 Beijing Paralympic and 2010 Guadalajara Parapan American Games. Testing was performed according to IPC protocol through the measurement of blood pressure (BP) no less than 10 minutes prior to the start of competition. If an athlete was found to have a systolic BP greater than 180 mmHg, he/she underwent repeat testing in 10 minutes. If the BP remained greater than 180 mmHg, the athlete was disqualified from the event. Failure to comply with testing resulted in disqualification.

Results:
No athletes tested positive for boosting according to the parameters defined by the IPC. A total of 34 men and 3 women were tested. The breakdown of testing per classification is as follows: 23 in Athletics T52, 9 in Athletics T53, and 5 in Handcycling A. Of those tested, the average systolic BP and diastolic BP were 129 and 80, respectively. All athletes were compliant.

Conclusion:
Testing for boosting has been carried out at the 2008 Beijing Paralympic and 2010 Guadalajara Parapan American Games. There have been no positive tests. This may be due to a decrease in the prevalence of boosting. However, consideration must also be given to whether the current IPC protocol is insufficient to detect this prohibited method. Testing will be continued.
Is there a relationship between Paralympic classification, autonomic symptoms and altered cardiovascular control among elite wheelchair athletes?

Krassioukov, A1; Wong, SC2; Mills, P2; Krassioukov-Enns, D3; Mikhail, D4
1Physical Medicine and Rehabilitation, Canada; 2Experimental Medicine, Canada; 3Medicine, Canada; 4Schulich School of Medicine and Dentistry, Canada

Background:
Low resting blood pressure, episodic hypertension (autonomic dysreflexia, AD), or episodes of orthostatic hypotension (OH) are common among individuals with spinal cord injury (SCI). Paralympic athletes are exposed to tremendous physical and emotional stress during their training and competition. Specifically, athletes with SCI have unique disadvantages during competition due to the nature of their injury, one of which is unstable blood pressure control.

Methods:
A prospective evaluation of cardiovascular parameters and their correlation with responses to an autonomic questionnaire of 22 Paralympic wheelchair rugby athletes was performed. Data on demographics, neurological injury, and Paralympic classification were also collected.

Results:
We examined two groups of individuals with complete (AIS A&B, n=11) and incomplete (AIS C&D, n=11) SCI who had similar Paralympic wheelchair rugby classification (1.80 and 1.88 respectively). Individuals with complete SCI very frequently experienced episodes of sweating and headaches (88% and 75% respectively). During training, there was also a significantly high frequency of lightheadedness (63%), fatigue (75%) and blurred vision (38%) among of individuals with complete SCI. Interestingly, both groups of athletes demonstrated presence of OH during evaluation.

Conclusion:
These data showed that, despite continuous training, symptomatic OH is still common among Paralympians. The presence of OH could interfere with athletic performance and exacerbate fatigue in a subpopulation of athletes. These conditions may explain why wheelchair athletes use ‘boosting’ to increase their blood pressure in order to improve their athletic performance. Research into new ways of classifying athletes of similar impairments and activity or sport limitations gets to the very heart of fair play. A possible addition of autonomic assessment to the athlete evaluations could add a purely technical improvement in the fairness of the class system, team grouping and possibly judging of the results. (Endorsed by IPC Research Committee).

Heart rate variability reveals differences in autonomic control among wheelchair rugby athletes with cervical spinal cord injury

Wong, SC1; Mills, P2; Krassioukov, A2
1Experimental Medicine, Canada; 2Physical Medicine and Rehabilitation, Canada

Objective:
We assessed cardiovascular autonomic function in Paralympic wheelchair rugby athletes with spinal cord injury (SCI). We aim to highlight the importance of incorporating an assessment of autonomic function into the current International Paralympic Committee (IPC) classification system, which classifies athletes based on motor function only.

Design:
Cross-sectional.

Participants/methods:
17 male Paralympic athletes with cervical SCI (9 complete (CC) and 8 incomplete (CI)), mean age 32.0 ± 4.8 years. We assessed cardiovascular autonomic function from frequency analysis of heart rate variability (from R-R interval, by electrocardiogram) in both the supine and seated positions.

Results:
In CC, normalized low frequency (LF) power (normalized unit, nu) (reflects cardiac sympathetic innervation and/or baroreflex function) increased in from the supine to the seated position (63 ± 16 to 119 ± 54 nu, respectively). High frequency (HF) power (reflects cardiac vagal control) was greater in the supine position in both CC and CI (28 ± 8 vs. 12 ± 9 and 22 ± 11 vs. 13 ± 7 %, for supine vs. seated, respectively). HF, measured in Hz, was lower in CI than CC when seated (0.172 ± 0.03 vs. 0.266 ± 0.09 Hz, respectively).

Conclusion:
Cervical SCI may result in partial or complete loss of supraspinal control of autonomic function below the lesion. Recognition and acknowledgement of this is very important for athletes with SCI, since their neurological level of injury does not necessarily reflect their autonomic control. We found that CC and CI have different autonomic control, which may have implications for sport performance since cardiovascular function may be impaired. Further research is required to evaluate whether or not sole assessment of motor function is sufficient to classify athletes’ abilities and the critical role that the inclusion of autonomic assessment could have on promoting fair play and safety for Paralympic athletes. (Endorsed by IPC Research Committee).
Exercise Induced Bronchoconstriction in Paralympic Athletes - the Role of Eucapnic voluntary Hyperpnea
Claudio Perret and Matthias Strupler
Institute of Sports Medicine, Swiss Paraplegic Centre, CH-6207 Nottwil, Switzerland

Background:
Asthma and/or airway hyperresponsiveness (AHR) is the most common medical condition encountered in Olympic athletes with an overall prevalence of about 8%. However, in endurance sports much higher values were found ranging from 17% up to 60% for triathlon, cycling, cross country skiing or swimming. For the assessment of AHR and exercise induced bronchoconstriction (EIB) different methods such as the mannitol challenge test (MCT) or eucapnic voluntary hyperventilation (EVH) are common. Thereby, EVH was recommended as gold standard to diagnose EIB in elite athletes. However, whether this method can be used to assess athletes with a disability, in particular athletes with spinal cord injury (SCI), is unknown. Therefore, the aim of our study was to compare different challenge tests with clinical diagnosed asthma/AHR.

Methods:
44 disabled athletes of the Swiss Paralympic Team for Beijing 2008 participated in the study. 30 athletes were para- or tetraplegic (group 1) and 14 had other disabilities such as blindness and limb amputation (group 2). The athletes answered questions about asthma, underwent spirometry and were subsequently challenged with EVH and MCT on separate days.

Results:
In total, 21% of the athletes were tested positive to EVH and 18% to MCT. All these athletes were from group 1. A positive EVH challenge was significantly more frequent in athletes with diagnosed asthma than without. However only 3 athletes had a positive response to both challenges. The positive and negative predictive value to diagnose asthma was 89% and 91% for EVH and 62% and 83% for MCT, respectively.

Conclusion:
EVH and MCT were found to be feasible, safe and useful in excluding EIB in Paralympic athletes, especially in athletes with SCI. Our study supports the hypothesis that the EVH screening of athletes results in the detection of those who may benefit from the use of appropriate medication for EIB treatment.

Effect of abdominal binding on cardiorespiratory function at rest and during exercise in Paralympic wheelchair rugby players
Christopher R. West
1International Collaboration on Repair Discoveries, Dept. of Medicine, University British Columbia, BC, Canada

Background:
Spinal cord injury (SCI) causes a lesion-dependent impairment in cardiorespiratory function that may limit exercise capacity. Abdominal binding may alter cardiorespiratory function at rest and during exercise by optimising operating lung volumes and improving haemodynamics.

Objective:
To determine whether abdominal binding enhances cardiorespiratory function at rest and during exercise in highly-trained athletes with cervical SCI.

Methods:
Ten GB Paralympic wheelchair rugby players with cervical SCI (C5-C7) completed four experimental trials in two randomised conditions (bound and unbound). During trial one, participants were assessed for respiratory muscle function (gastric [Pga], esophageal [Pes], and transdiaphragmatic [Pdi] pressure), lung function (vital capacity [VC]), and cardiac function (cardiac output [CO]) at rest. During trial two, participants were assessed for respiratory muscle function, operating lung volumes (end-expiratory lung volume [EELV] and end-inspiratory lung volume [EILV]), and cardiorespiratory responses to incremental sub-maximal treadmill propulsion (5 W every 4 min). In trials two and three, peak cardiorespiratory responses were obtained from a maximal incremental treadmill protocol (0.2% gradient every 40 s) and a maximal 4-min push in the field, respectively.

Results:
In trial one, binding increased VC, Pdi and CO (all p<0.05). In trial two, binding increased end-expiratory Psa and Pao (p<0.01), and reduced EELV (p=0.017) and EILV (p=0.035). In trials two and three, peak cardiorespiratory responses were obtained from a maximal incremental treadmill protocol (0.2% gradient every 40 s) and a maximal 4-min push in the field, respectively.

Results:
In trial one, binding increased VC, Psa and CO (all p<0.05). In trial two, binding increased end-expiratory Psa and Pao (p<0.01), and reduced EELV (p=0.017) and EILV (p=0.035). In trials two and three, binding increased peak oxygen uptake (p<0.001), increased maximal 4-min push distance (p<0.01), and reduced peak blood lactate concentration (p=0.01). Peak oxygen uptake in the laboratory correlated with the distance covered during the maximal 4-min push (r=0.57, p=0.034), suggesting that the improvement in field-based performance with binding was underpinned by an improvement in aerobic capacity.

Conclusion:
Abdominal binding provides a simple, easy-to-use tool that can be used to enhance cardiorespiratory function at rest and during exercise in highly-trained athletes with cervical SCI.
Management of Unstable Traumatic Spine
Mr. Sashin Ahuja,
Consultant Spinal Surgeon, Cardiff, United Kingdom

Spinal trauma is the commonest cause leading to spinal instability which thereby can lead to mechanical and neurological problems. Most unstable spinal fractures are treated surgically. These injuries are usually caused by high velocity road accidents. The injury pattern could be variable i.e. purely ligamentous or purely bony fractures leading to segmental instability of the spine. In about 10% of these patients there could be another non-contiguous spinal fracture.

The neurological patterns could be variable as well i.e. from normal neurology to complete neurological deficit. There are various cord syndromes described with regards incomplete spinal cord injuries. A detailed neurological assessment is required to diagnose these neurological syndromes and monitor progress throughout the management of the patient. These injuries are investigated radiologically i.e. using X-rays initially.

Further radiological tests i.e. CT scan is used to assess the bony aspects of the injury and MRI scan helps to assess the soft tissues i.e. ligaments and neural structures better.

The acute management for these injuries is to stabilise the patient as they may have associated life threatening injuries i.e. head, thoracic or abdomino-pelvic injuries which may need to be dealt with as an emergency to save life. There might also be other associated fractures which would need treatment as well which would need to be prioritised as per their severity etc. The use of steroids for patients with spinal cord injury is controversial but in the UK steroids aren’t usually used for traumatic spinal cord injury.

The evidence with regards timing of surgery following the accident is variable and the current data seems to support relatively urgent stabilisation i.e. in 24 hours or so. There are various techniques used to stabilise the spinal column surgically i.e. anterior, posterior or combined. Associated decompression of the spinal cord may or may not be performed depending on the neurological pattern and the level of the injury. Controversy still exists with regards post-operative mobilisation for patients with spinal cord injury i.e. to mobilise straight away or bed rest for about 6 weeks following stabilisation. Following spinal stabilisation these patients need to go through a rehabilitation programme so as to return to their normal activities of daily living as much as possible.

Contemporary Surgical Management of Spinal Tumours
Adrian TH Casey, Consultant Spinal Neurosurgeon, The Royal National Orthopaedic Hospital, United Kingdom

Background or Objectives
The purpose of this presentation is to highlight to a non-surgical audience the various strategies available for tumour resection and give insights into what is potentially achievable in this rapidly developing field. The management of metastatic spinal tumours has undergone a revolution since the Patchell study (Lancet 2005) showed that surgery combined with radiotherapy was superior to radiotherapy alone. This trial has been the main driver in a renaissance of interest in surgical treatment for this relatively common condition. NICE guidelines have now formalised the patient pathways, across the U.K.

Coupled with this there have been fairly major strides in instrumentation development which facilitate the safe reconstruction of the destabilised spine. Similarly there have been major developments in dealing with primary spine tumours with radical en bloc resections performed with an ever improving safety margin. These resections have been popularised by Tomita and colleagues from Japan. Microsurgical techniques for intradural tumours will also be presented.

Methods:
Review of case series from the National Hospital for Neurosurgery, Queen Square & Royal National Orthopaedic Hospital, Stanmore. Surgical techniques with case examples and literature review will be used.

Conclusion:
Centralisation of the surgical management of spinal tumours in major centres which involves collaboration with other surgical specialities has hopefully improved the scope and safety of major resections and reconstructions.
Malignant Spinal Cord Compression (MSCC) remains a serious and challenging condition often presenting itself as an oncological emergency. The most likely tumour sites to be affected are breast, prostate and lung, each accounting for 15-20% of cases, while lymphoma, myeloma each may account for up to 5-10% of cases overall. MSCC can also present as a cancer of unknown primary and this lack of an identified primary tumour site can lead to delays in oncology input and subsequent treatment.

The outcome of MSCC is variable and dependent on a number of factors. Early detection, age and performance status have been shown to be independent predictors of outcome in terms of ambulatory function after treatment. Clearly the disease burden in terms of extent of metastatic disease is relevant but perhaps more critical in determining overall survival, is the site of the primary tumour. Sites which are radiosensitive such as myeloma, lymphoma, breast and small cell cancer of the lung are likely to respond well to radiotherapy in the acute setting. With the advent of newer oncological therapies such as targeted treatments, use of bisphosphonates and bone modifying agents, these patient groups are surviving longer and the prompt appropriate management of MSCC is now more relevant than ever.

Radiotherapy remains an important treatment for MSCC. There is a lack of randomised evidence on the ideal dose and fractionation of radiotherapy. This question is the subject of an ongoing randomised clinical trial called SCORAD III: A randomised phase III trial of single fraction radiotherapy compared to multifraction radiotherapy in patients with metastatic spinal cord compression. In the acute MSCC setting, bedrest, pain relief and the use of high dose steroids at 16mg in 24hrs should be initiated. Patients should have a whole spine MRI and be discussed early with an oncologist. The option of spinal surgery should also be considered at diagnosis particularly where there is a single level of compression in a reasonably fit patient without extensive visceral disease. There is a lack of clinical trial data to guide the optimal management of MSCC but NICE guidelines recommend a pragmatic individualised multidisciplinary approach.

The Velindre Cancer Centre is part of the South Wales Cancer Network and has invested in a number of initiatives to address problems identified locally in the management of MSCC. A taskforce have developed a workbook which is being rolled out to educate junior doctors, GP’s, nurses and allied health professionals in the cancer network. Use of a patient information letter outlining the signs and symptoms of MSCC for every patient diagnosed with spinal metastases is currently being distributed and piloted. These patients at risk are also being given a smartcard summarising the main signs and symptoms of MSCC and necessary action needed.

The management of MSCC is evolving with emphasis on earlier detection being the key. A coordinated, evidence based, treatment approach between oncologists and spinal surgeons will help the treatment decision process and ultimately lead to more standardised and optimal care.

References:
Debate on mobilization of post surgical stabilization of unstable spine

W S El Masri FRCS Ed, FRCP, Professor of Spinal Injuries Keele University Consultant Surgeon in Spinal Injuries, RJ & AH Orthopaedic Hospital, Oswestry UK

Traumatic spinal cord injuries (TSCI) are life changing events with medical, physical, psychological, social, financial, vocational, environmental and relationship effects to the individual affected.

The combination of consequent general physiological impairment, multi-system malfunction and non medical effects impose challenges no only to patients but also to the carers, and the treating clinicians. Almost every system malfunction becomes a source of multiple disabilities and a potential source of a wide range of complications. The combination of multi system impairment physiological impairment , malfunction and loss of sensation below the injury increases both the diagnostic and management challenges to the treating clinicians and the risks to patients. (Trauma 2006).

In their Classical largest published series of 682 consecutive patients treated in one Centre, Frankel et al in 1969 demonstrated that with expert conservative management of the TSCI patient, ambulation is resumed in about 5-9% of Frankel A patients, in the majority of FB patients and the great majority of FC & FD patients who present within two weeks of injury. These results were subsequently confirmed by many other European groups .

Guttmann, Bedbrook, Frankel and the first generation of dedicated spinal cord injury specialists believed that the damage to the spinal cord occurs at the time of the accident and that in the majority of cases surgical intervention has no added value but may cause further damage in some patients. They account for the recovery that occurs in patients presenting with complete sensory and motor paralysis (FA) being due to recovery of function in preserved long motor and sensory tracts which were dormant during the stage of spinal shock. Such neurological recovery is unlikely to occur if further insult to the spinal cord is delivered by non mechanical and/or further mechanical damage. In other words adequate conservative containment of both the physiological instability of the various systems of the body including the spinal cord as well as adequate containment of the biomechanical instability of the spinal column will result in recovery without direct intervention of the spine or neural tissues.

Freeman & Wright in 1953 put forward the hypothesis that the cellular, chemical ,vascular, enzymatic and other changes that occur in the cord tissues following injury can result in further damage to those tissues hence the hypothesis of “Secondary Injury”. Basic scientists and clinicians have since tried to pursue the “Secondary Injury”. Although some basic Scientists demonstrated the ability to manipulate the post traumatic secondary changes in the spinal cord with a variety of interventions including surgical decompression and some have claimed benefit to the laboratory animal; Tator and colleagues observed that beyond a threshold magnitude of impact on the spinal cord, early decompression in the laboratory animal does not improve neurology. Their experiments and those of Bohlm an et al suggest that at the very best surgical decompression in the laboratory animal may just expedite recovery in the incomplete laboratory animal (rats and dogs) but there is no evidence that it increases the magnitude of recovery.

Considering the many differences between the laboratory animal (rat cat and dog) and humans that have evolved over the last 20-60 million years which amongst many include: the differences in period of spinal shock, the difficulty in differentiating between the normal and abnormal gait of quadrupeds and ease of detecting gait abnormalities in humans, the differences in the requirements from the autonomic system between quadrupeds and bipeds, the effects of posture on Blood pressure and cord perfusion etc.. one should extrapolate from the laboratory animal to humans with great caution.

Assuming these differences between the laboratory animal and humans do not matter, clinicians have in the last six decades repeatedly failed to demonstrate any convincing evidence (class 1 or class 2 ) that surgical decompression expedites or improves neurological outcome in humans. Various surgical approaches, instrumentation, times of decompression since injury have been attempted without success. Other almost equally important outcomes to patients are sadly hardly discussed.

Considering the number of mechanisms that can further damage the spinal cord of patients undergoing surgery including a reduction of the spinal cord perfusion pressure during and following decompression, the lack of proof of superiority of surgical management over active physiological conservative management and considering the general agreement by the proponents of surgery that for decompression to be effective it should be carried out in the first 4 hours following injury (which is hardly achievable due to practical reasons) it is ironic that the great majority of patients with TSCI are currently surgically managed and that active physiological conservative management has been abandoned in almost all Institutions who take care of these patients.

The timing of decompression has been debated and redefined throughout the last 4 decades. Fehlings et al in 2012 demonstrated that the results of decompression in the first 24 hours are better than the results of decompression after the first 24 hours of injury. While despite the limitations of their study they may have demonstrated an advantage of early surgery compared to late surgery they have not demonstrated however that decompression in the first 24 hours from injury yields equal or better neurological outcome than Conservative management . At best the results can be interpreted that surgery within the first 24 hours from injury is safer than surgery carried out later.

Indeed comparing Fehling et al’s outcomes of surgical decompression within 24 hours of cervical spine injury with the Frankel et al’s outcomes of Conservative management; twice as many patients treated Conservatively recover from Frankel A & B to Frankel D & E and walk .

Furthermore Fehling’s et al used the ASIA classification with the following differences from the Frankel Classification :

Some AIS A would had have long tracts sensory sparing and would be classified as Frankel B with better prospects of recovery. The number of these patients is not known. However small would the number one would have expected a skew the Fehling’s cohort towards better recovery than the conservatively treated cohort but the opposite has occurred.

The definition of AIS D is that 50% of the tested muscle groups or more have power grade 3 or more according to the ASIA classification. Therefore not all ASI D will be walkers while patients in Frankel D are defined as those who have achieved a motor power that would enable them to walk. AIS E patients may not have regained sphincter functions while Frankel E patients would be expected to have normal sphincter functions.

The differences between the Frankel and ASIA classification can therefore easily further demonstrate the lack of added value of surgical decompression within 24 hours of injury over active physiological conservative management.

The prognostic indicators of recovery have been further refined over the last quarter of a century.
In 1989 Folman and El Masry studied the neurological prognostic indicators of natural spontaneous recovery (without surgical intervention) in patients with TSCI between C4 & D10 admitted within the first 72 hours of injury to the Midland Centre for Spinal Injuries. Distal motor sparing however useless (Frankel C) in the first 72 hours of injury resulted in 86% of patients recovering useful motor power to ambulate. 71% of patients with complete distal motor paralysis but with pin prick sensory sparing recovered ambulation. They speculated that the nearness of the spino-thalamic tract to the corticospinal tract may be explain the good prognostic value of pin prick sensory sparing.

Katoh & El Masri evaluated further the differential prognostic value of different sensory modalities as perceived by patients with cervical TSCI admitted within 48 hours of injury. Sharp pin sensation in response to testing with a pin prick (group 1), dull pressure sensation in response to testing with a pin prick (group 2) and rectal sensation of pressure only on rectal examination (group 3). There was a significant difference in the outcome between group 1 & 2 and between group 1 and 3; 75% of group 1, 20% of group 2 and 12.5% of group 3 recovered to community ambulation. The value of pin prick sensation as a predictor of neurological recovery was confirmed by Crozier, Poynton and others.

Katoh & El Masri evaluated pin prick sensory sparing in patients with complete motor and sensory loss. Pin sensory appreciation as pin prick in the zone of partial sensory preservation with absence of myotomal function is a good prognostic indicator of recovery of myotomal functions in the same zone i.e in the muscles that were paralysed will recover.

Neurological recovery and it various degrees is not the only outcome that requires close scrutiny and comparison between methods of management. Functional outcome which also depends on the residual flexibility of the spine, level of pain, incidence and severity of complications, total hospitalisation within five years of injury to include readmission during this period are all outcomes that have not been considered for comparison between various methods of management.

To date Active Physiological Conservative Management of the patient and injured spine remains unchallenged in its outcomes. It is yet to be challenged by surgical decompression and/or stabilisation in achieving: maximum neurological recovery, the shortest spinal fusion that preserves the flexiblity of the spine, a painless almost full range of movement which is essential for the mobility of the patient, and re-engagement of the patient in various aspects of life.

Bibliography
Mobilisation Following Acute Spinal Cord Injury
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Background
The timing of mobilisation following spinal cord injury is controversial and few comparative studies have been undertaken. Concerns revolve around potential further injury to damaged cord tissue, by postural hypotension in particular. However, early mobilisation can only take place in the stabilised spine and, therefore, the results of early surgery will include any advantage or disadvantage of early mobilisation.

Systematic review by Bagnell (2003) concluded that it was unclear whether surgery improved neurological recovery but it was demonstrated that surgery was not associated with neurological deterioration. Surgically treated patients demonstrated lower mortality, improved walking, less instability and better psychological outcome. Surgically treated patients were mobilised some four or five weeks earlier.

A later systematic review by Furlan et al (2011) again demonstrated no deterioration of neurological outcome with surgery and that early surgery at less than 24 hours appeared better than surgery after 24 hours. Early surgery reduced mortality, reduced length of stay and was not associated with increased complications.

The preliminary results of the STASCIS trial indicate that surgery at less than 24 hours may be associated with improved neurological outcome but full results are awaited.

Methods
A survey of 11 Centres in the U.K. was undertake.

Results
Nine centres mobilised within the first week and two at six weeks or more. No centre reported any neurological deterioration or failure of expected improvement associated with early mobilisation.

Conclusions
Potential benefits of early mobilisation are earlier home leave, earlier discharge, reduced social isolation, better psychological adjustment and potentially better integration. It is concluded that early mobilisation with appropriate precautions is safe and beneficial.
O1: 10:45-11:05
Improved diagnosis of spinal cord disorders by the neurophysiological assessment of spinothalamic pathways
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Background:
The segmental electrophysiological assessment of sensory pathways in spinal cord injury has gained increasing interest over the recent years. A segmental approach yields the potential advantage of providing objective information about the spinal integrity and pathway function of single spinal segments above, at and below the lesion site. The objective of this study was to evaluate the clinical feasibility and sensitivity of dermatomal contact heat evoked potentials (dCHEPs) in the segmental assessment of spinal cord disorders (SCD).

Methods:
In a prospective cohort study dCHEPs and dermatomal somatosensory evoked potential (dSSEPs) testing was performed in patients suffering from SCD with defined pathological MRI findings. Spinal cord damage was distinguished into three categories: a) complete, b) incomplete-diffuse and c) central or anterior cord damage according to spinal MRI.

Results:
74 patients were included. In total 426 dCHEPs and 339 dSSEPs were tested close to the level of cord damage. In complete and incomplete-diffuse cord damage both dCHEPs and dSSEPs were comparably sensitive to detect segmental sensory impairment with a sensitivity of 100% for dCHEPs and dSSEPs in complete cord damage while slightly reduced in incomplete-diffuse cord damage (91.7% for dCHEPs and 84.8% for dSSEPs, p=0.466). In central/anterior cord damage dCHEPs showed a significantly higher sensitivity compared to dSSEPs (96.9% compared to 26.9%, p<0.001).

Despite an overall positive correlation between dCHEPs and pinprick (PP) sensation, dCHEPs were significantly more sensitive than PP testing to reveal spinothalamic tract dysfunction in patients with anterior/central cord lesions (p<0.001).

Conclusion:
The assessment of spinothalamic pathways by applying dCHEPs is clinically feasible and of high sensitivity in SCD. It significantly complements the clinical examination within the segments close to the level of cord damage. In central and anterior cord damage dCHEPs are significantly distinct from dSSEPs and most sensitive in the diagnosis of these clinically frequent SCD.

O2: 11:05-11:20
Development and Validation of SCIM-SR (Spinal Cord Independence Measure III for self-report)
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Background:
The Spinal Cord Independence Measure in its third revision (SCIM III) is the principal measurement tool to assess independence of persons with SCI. Yet, SCIM III was designed and validated for use by health professionals, which complicates its application in community settings. The aim of this study was to develop and validate a self-report version of the SCIM III (SCIM-SR).

Methods:
SCIM III comprises 19 questions on daily tasks adding up to a total score between 0-100 points. Subscales ‘self-care’, ‘respiration & sphincter management’, and ‘mobility’ account for maximal 20, 40 and 40 points, respectively. Based on SCIM III, a German version of SCIM-SR was developed by expert discussions and pre-tests in individuals with SCI. A convenience sample of 100 in-patients with SCI completed the SCIM-SR, while the SCIM III was independently completed by health professionals within 3 days. We statistically evaluated content validity of SCIM-SR by Pearson correlation, Intraclass Correlation (ICC) and Bland-Altman plot.

Results:
High correlations between SCIM III and SCIM-SR were observed. Pearson’s r for the total score was 0.92 (95% confidence interval CI=0.88-0.94), for the subscales self-care 0.88 (0.82-0.92); respiration & sphincter management 0.84 (0.77-0.89); and mobility 0.88 (0.83-0.92). Intra-class correlations were also high: total score ICC 0.81 (95% CI 0.70-0.92); self-care 0.85 (0.74-0.96); respiration & sphincter management 0.72 (0.57-0.88); mobility 0.78 (0.65-0.92). Bland-Altman plots showed that patients rated their functioning somewhat higher than professionals, in particular for mobility: mean difference total score 4.96 (95% CI 2.82-7.10); self-care 1.02 (0.35-1.69); respiration & sphincter management 0.63 (-0.55-1.81); mobility 3.38 (2.36-4.40). Post-hoc analysis showed that in particular patients re-admitted because of pressure sores rated their mobility higher than professionals.

Conclusion:
Results support the criterion validity of the SCIM-SR. SCIM-SR may facilitate long-term evaluation of functioning in people with SCI through self-report in their home situation.
Neuroprotective Therapy using Granulocyte Colony-Stimulating Factor for Acute Spinal Cord Injury: A Phase Iib Prospective Controlled Clinical Trial

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Background:
Granulocyte colony-stimulating factor (G-CSF) is an important cytokine that is commonly used to treat neutropenia. G-CSF also has non-hematopoietic functions including neuroprotective property. We previously reported that G-CSF promotes functional recovery after compression-induced SCI in rodents. Based on those results, we have started a clinical trial using G-CSF for acute spinal cord injury (SCI) patient.

Methods:
The study design was open-label/non-randomized prospective multicenter trial to evaluate therapeutic effects of G-CSF for SCI. From August 2009 to March 2011, a total of 45 SCI patients within 48 hours of onset were subjected to the trial. Informed consent was obtained from all patients. After agreement, G-CSF (10 μg/kg/day) was intravenously administered for five consecutive days and control patients were similarly treated except for the G-CSF administration (26 patients). We evaluated motor and sensory functional recovery using the American Spinal Cord Injury Association (ASIA) score and ASIA impairment scale (AIS) three months after onset.

Results:
The AIS improved at least one step in 11 of 19 (57.9%) patients in the G-CSF group and in 9 of 26 (34.6%) in the control group. The increased ASIA motor score was significantly higher in the G-CSF group (26.1 ± 18.9) than in the control group (12.2 ± 14.7) (P < 0.01). In cases of incomplete paralysis (18 patients in the G-CSF group and 19 patients in the control group), the increase of motor score was also significantly higher (P < 0.05) in the G-CSF group (27.1 ± 18.9) than in the control group (15.1 ± 15.9).

Conclusions:
The present results showed that G-CSF administration potentially had beneficial effects on neurological recovery in patients with acute SCI. Randomized/blinded trial is needed to prove efficacy of G-CSF for acute SCI.

Pre-evaluated safe human iPS clone derived neural stem cells promoted functional recovery after spinal cord injury in adult common marmosets

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Background:
Recently, we have reported the effectiveness of transplantation of mouse as well as human iPS derived neural stem cells (iPS-NSs) for spinal cord injury (SCI) in rodents. From the viewpoint of a clinical trial, it is critical to determine the effectiveness of human iPS-NSs transplantation in non-human SCI model. The purpose of this study is to validate the effectiveness and safeness of transplantation of human iPS-NSs into the injured spinal cord of non-human primates as a pre-clinical trial.

Methods:
A pre-evaluated safe human iPS clone (hiPSCs) was used in this study, and neural differentiation of hiPSCs were induced through embryoid body using original protocol. A moderate contusive SCI was induced at the C5 level in adult common marmosets using a weight-drop device as described previously. Nine days after the injury, human iPS-NSs at a density of 100000 cells/5 μl without growth factors were transplanted into the injured spinal cord. Behavioral analyses were performed according to previous reports (original open field scoring scale, bar grip test, cage climbing test) until 12 weeks after SCI. Axial sections of spinal cords were subjected to histological analyses to determine the effects of transplantation.

Results:
Grafted human iPS-NSs that were survived and differentiated into NeuN positive neurons, GFAP positive astrocytes and Olig1 positive oligodendrocyte progenitor cells. It was noteworthy there was no tumor formation at least for 12 weeks after transplantation. Luxol fast blue staining showed a significant decrease in demyelinated areas at the epicenter in the transplanted group compared to the vehicle-control group. Furthermore, quantitative analysis revealed that there was a significant difference in CaMK-IIβ positive areas at the lesion epicenter between the transplanted and vehicle control group. Quantitative RT-PCR revealed that mRNA expression levels of human neurotrophic factors were significantly higher in hiPSCs-NSs than human dermal fibroblasts. There were more PECAM-1+ blood vessels at the lesion epicenter in the transplanted group. All of the examined behavioral tests also showed that human iPS-NSs promoted the functional recovery after SCI in adult common marmosets.

Conclusions:
Grafted human iPS-NSCs survived and safely differentiated into neurons, astrocytes, and oligodendrocyte progenitor cells without any tumorigenicity. Pre-evaluated safe hiPSC-NSs could be a potential cell source for SCI in clinic.
Impaired neurological recovery of spinal cord injured patients with infections

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Objective:
Infections are a frequent complication after spinal cord injury (SCI). As a source of peripheral inflammation, infections might propagate neuronal death and consequently contribute to the restriction of neurological recovery. We investigated the association of incident infections i.e., pneumonia and/or postoperative wound infections (Pn/Wi) with functional neurological outcome after traumatic SCI.

Methods:
We screened datasets of 24762 patients enrolled in a prospective cohort study (National Spinal Cord Injury Database). ASIA impairment scale (AIS) classified A and B patients, recruited within 24h post-trauma (n=1436) were followed up over one year. Patients with documented Pn/Wi (n=581) were compared with controls (non-documented Pn/Wi, n=855). According to the American Spinal Injury Association (ASIA) classifications AIS conversions, ASIA motor scores, and motor and sensory levels were assessed.

Results:
The Pn/Wi group revealed less AIS upward conversions after one year compared to controls (AIS A: 17.2% vs. 23.9%, p=0.03; AIS B: 57.1% vs. 74.7%, p=0.009). ASIA motor score gain [median [interquartile range]] was lower in patients with infections (AIS A: 8 [4-12] vs. 10 [5-17], p=0.01; AIS B: 19.5 [8-53.5] vs. 42 [20.5-64], p=0.03). Analysis of acquired motor/sensory levels supported these findings. Multiple regression analysis identified Pn/Wi as independent risk factor for impaired AIS upward conversion (odds ratio 1.89, [95% CI, 1.36-2.63], p<0.0005) or lower gain in ASIA motor score (regression coefficient -8.21 [95% CI, -12.29--4.14]), p<0.0005).

Interpretation Infections were associated with impaired neurological outcome after motor complete SCI. Pn/Wi constitutes a clinically relevant target in order to protect the limited endogenous functional regeneration capacity.

Trends in age-adjusted cause-specific mortality rates after spinal cord injury

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1Physical Medicine and Rehabilitation, USA; 2USA

Background:
Determine why life expectancy following spinal cord injury (SCI) has not improved among one year survivors over the past 25 years by examining trends in causes of death.

Methods:
This inception cohort study included 45,516 persons with traumatic SCI injured since 1936 (99.5% injured since 1970) who were treated at a model system or Shriners hospital. Current survival status was determined by routine follow-up, searches of the Social Security Death Index and National Death Index (NDI), on-line state vital statistics files, and newspaper obituary files. Causes of death were determined from a search of the NDI, death certificates, hospital discharge summaries, or autopsy reports. Trends in annual age-adjusted cause-specific mortality rates were calculated by decade.

Results:
10,025 deaths occurred among 543,348 person-years of follow-up. Since 2005, the highest age-adjusted mortality rates were for respiratory diseases, followed by septicemia, cancer, ischemic heart disease, other heart disease, and accidents. Age-adjusted mortality rates have declined over time for cardiovascular diseases, cancer, pulmonary embolus, and urinary system diseases, remained constant for septicemia, and increased for endocrine, nutritional and metabolic disorders, accidents, mental disorders, and homicides.

Conclusion:
Gains in life expectancy after SCI are being impeded primarily by increases in diabetes and accidental deaths as well as failure to reduce the incidence of septicemia.
Late bladder management in persons ageing with spinal cord injury

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Aim:
To analyse methods of bladder management in persons with long standing spinal cord injury (SCI) over a twenty year period (1990-2010).

Method:
293 persons injured more than 20 years previously were enrolled in the British Ageing with SCI Study (282 in 1990 and additional 11 in 1993). 85 survivors participated in the 2010 follow-up.

Results:
In 2010, the sample was 80% male, mean age was 67.8 and mean duration of injury 46.3 years, 35% had tetraplegia (Frankel grade A, B or C), 44% paraplegia (Frankel A, B or C) and 21% an incomplete lesion (Frankel D). In 2010, 17% reported having changed their bladder method in the last three years, and 38% since they enrolled in the study. Out of all the original study participants, 47% changed their method during the study, mainly due to voiding difficulties, incomplete emptying and/or frequent urinary tract infections. Condom drainage was the most frequently used method throughout the study, but its use decreased from 47% in 1990 to 30% in 2010. Percentage of persons using straining/expressing went down from 47% to 32% in 2010. Percentage of persons using straining/expressing went down from 18% to 7%, and indwelling urethral catheters from 16% to 10%. The use of suprapubic catheters increased from 1% to 16% and intermittent catheters from 3% to 17%. Normal/near normal bladder control was reported by 11% in 1990 and 15% in 2010.

Conclusions:
Almost half of the original study participants changed their bladder emptying method during the study. Condom drainage remained the most frequent method. The use of intermittent and suprapubic catheters increased, while straining/expressing and indwelling urethral catheter use decreased.

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Clinical usefulness of ultrasound assessment of detrusor thickness in patients with neurogenic bladder dysfunction due to spinal cord injury

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Background:
Urodynamic testing is the gold standard for the assessment of neurogenic lower urinary tract dysfunction (NLUTD) in patients with spinal cord injury (SCI). However, the technique is expensive, time consuming and associated with a significant morbidity.

Objective:
To evaluate the clinical usefulness of sonographic measurement of detrusor wall thickness (DWT) to replace urodynamic testing for the prediction of risk factors in patients with NLUTD due to SCI.

Design, setting, and participants:
In a prospective study, 60 consecutive patients with NLUTD due to SCI presenting for routine urodynamic assessment at a specialized SCI center.

Intervention:
All patients underwent measurement of DWT during urodynamic testing. DWT was measured at varying bladder volumes. Results of urodynamic testing were classified into favorable and unfavorable. DWT at maximum capacity was used to calculate a possible cut-off value for favorable urodynamic results.

Results:
Urodynamic results were favorable in 48 patients and unfavorable in 12 patients. A DWT of 0.97 mm or less can safely (sensitivity 91.7%) be used as a cut-off point for the absence of risk factors for renal damage. In our study, urodynamic testing could have been avoided in 53.3% of the participants by the use of this value.

Conclusions:
Although DWT cannot replace urodynamic testing, DWT as a screening parameter may well aid in reducing the number of urodynamic evaluations in a substantial number of patients.
Corticospinal plasticity of sphincter function induced by repetitive transcranial magnetic stimulation in spinal cord injury: towards a therapy
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1London Spinal Cord Injuries Centre, United Kingdom; 2Clinical Neuroscience, United Kingdom

Background:
In stable incomplete male spinal cord injury (iSCI) subjects with severely compromised voluntary control of the sphincters the aberrant “guarding reflexes” can be monitored by recording the pudendo-anal reflex (PAR). We find this reflex to be facilitated in control and iSCI subjects by single pulses of transcranial magnetic stimulation (TMS) optimally 30ms prior to reflex stimulation. We are currently investigating whether known neuro-plasticity inducing protocols of repetitive TMS elicit long term facilitation of sphincter responses for achieving continence.

Methods:
Male control and iSCI subjects have been assessed using dorsal penile nerve (DPN) stimulation to elicit a PAR, single pulse TMS to elicit an anal sphincter motor evoked potential (MEP) and single pulse TMS to condition the PAR. The effect on these responses of two different regimes of excitatory repetitive TMS has been assessed: (1) 5Hz repetitive TMS of the motor cortex, and (2) paired associative stimulation (PAS), employing DPN coupled with TMS with an interval of 35-40ms at 0.5Hz.

Results:
5Hz repetitive TMS has enhanced the facilitation of the PAR by conditioning TMS in control subjects. However, the higher thresholds in iSCI and technical limitations has precluded application of 5 Hz rTMS in iSCI subjects. PAS at lower frequencies appears technically feasible in iSCI. So far, in a control subject PAS has facilitated the sphincter MEP and increased the TMS facilitation of the PAR.

Conclusions:
PAS may be a more practical protocol than 5Hz repetitive TMS to examine plasticity of sphincter function in iSCI.
Supported by INSPIRE & The RNOH Charity.

O11:
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Background:
In the era of botulinum toxin A it is appropriate to answer the question, which role antimuscarinics still have in the treatment of NDO due to SCI.

Methods:
Our review of antimuscarinics in NDO is restricted to orally administered formulations, and based on a search of all major literature bases.

Results:
Dose-finding studies in NDO were conducted with propiverine, trospium chloride, and tolterodine, recommending 15 mg t.i.d. for propiverine, and 20 mg b.i.d. for trospium chloride. For tolterodine 1 or 2 mg b.i.d. was recommended. However, superiority of tolterodine over placebo was not demonstrated.
Placebo-controlled studies in NDO demonstrated the superior efficacy of oxybutynin 5 mg t.i.d., trospium chloride 20 mg b.i.d., and propiverine 15 mg t.i.d. compared to placebo. Comparative studies of different antimuscarinics or of different galenic formulations of the same antimuscarinic have been conducted: Self-selected dosing of either tolterodine or oxybutynin improved efficacy. Equieffectivity of trospium chloride 20 mg b.i.d. compared to oxybutynin 5 mg t.i.d. was shown as well as equieffectivity of propiverine 15 mg t.i.d. and oxybutynin 5 mg t.i.d. Furthermore, the immediate (15 mg t.i.d.) and the extended (45 mg s.i.d.) release formulations of propiverine showed a comparable efficacy with respect to key urodynamic parameters.

Conclusions:
Contrary to IDO no remarkable placebo effects were demonstrated in NDO, as most of the studies enrolled SCI patients. Only oxybutynin, propiverine and trospium chloride were evaluated in placebo- and active-controlled studies. Solifenacin, tolterodine, and darifenacin were evaluated only to a limited extent, and not in large-scale studies. Fesoterodine and imidafenacin were not investigated in NDO at all. Antimuscarinics demonstrated a decrease of maximum detrusor pressure by 30%-40%, paralleled by an increase in bladder capacity. The available data indicate, that antimuscarinics are still justified as first-line treatment of NDO despite the advent of botulinum toxin A.
Audit of cystourethroscopic surveillance in spinal cord injured patients with indwelling catheter at Midlands centre for spinal injuries, Oswestry
Patil, Siddeshwar; Kappaganthu, Prasanna; El Masri, Wagih
United Kingdom

Introduction:
Controversy continues over safe bladder management in neurogenic bladders following Spinal Cord Injury (SCI). It is generally agreed that clean intermittent catheters and/or reflex voiding is associated with less complications compared to indwelling catheters (Suprapubic and Urethral). Despite this, there is no clear agreement regarding cystourethroscopic surveillance in this group of patients. At Midlands Centre for Spinal Injuries (MCSI) we routinely offer 12-18 monthly interval cystourethroscopy for all patients with indwelling catheter.

Aim of our study:
To investigate common complications and cystoscopy findings in patients with indwelling catheter.

Materials & Methods:
We collected the list of cystourethroscopies performed between 2003 and 2008 from the theatre management system. From this list we included only patients with indwelling catheter who underwent most part of their rehabilitation at MCSI. We then reviewed the electronic patient records for demographic details, injury details, cystourethroscopy indication and findings. We used MS Excel for collating and analysing the data.

Results:
There were a total of 419 cystoscopies (Suprapubic catheter – 264, Urethral catheter – 155) performed on 252 patients. There was a definitive indication in 84% (352/419) of cystoscopies performed. The cystoscopy findings included debris (48%), vesical calculi (22%) and mucosal changes (17%). There were a total of 162 biopsies (38.6%) with 44 (27%) being reported as metaplastic changes. Squamous metaplasia was reported in histopathology reports for 25 patients. By performing cystoscopy only when indicated, we would have missed 16% vesical calculi, 49% debris and 100% metaplastic changes.

Conclusion:
Neurogenic bladders in SCI patients are vulnerable to complications. The presence of indwelling catheter can expose them to further risk of developing complications. From our experience this group of patients benefits from cystourethroscopic surveillance and also aids in improving pick up rates of common complications including metaplastic changes. This also shows that there is scope for further studies.
Bowel function and quality of life after colostomy in spinal cord lesioned individuals
Hansen, Rikke Boelling1; Staun, M; Kalhauge, A; Langholz, E; Biering-Sørensen, F
1Clinic for Spinal Cord Injuries, Denmark; 2Department of Gastroenterology, Denmark; 3Department of Radiology, Denmark

Study Design:
Cross-sectional descriptive study
Objectives: To evaluate the effect of colostomy on bowel function and quality of life in individuals with spinal cord lesion (SCL).

Setting:
Clinic for Spinal Cord Injuries and Departments of Gastroenterology and Radiology, Rigshospitalet.

Methods:
Eighteen individuals with SCL and a colostomy performed post injury, 12 males and 6 females, 8 tetraplegic and 10 paraplegic. The median age at the time of the study was 49.9 years (range 37 - 72), years since the lesion was 3 - 56 years (mean 20.9) and time since the colostomy was performed ranged from 0.5 to 20 years (mean 6.9). We used retrospective data collection from patient records, a questionnaire designed to collect data on bowel management pre and post the procedure with colostomy. Quality of life was evaluated with SF-36 and measurement of colon transit time was performed using radiopaque markers.

Results:
Of the population studied 61% percent had the colostomy performed due to constipation and/or fecal incontinence. All participants reported they were content with the colostomy and 94% of the participants did not want the colostomy reversed. The time used on bowel management was significantly reduced after the procedure with colostomy. 75% of the participants had a gastrointestinal transit time within the normal range.

Conclusion:
Our results indicate that a colostomy procedure is a favourable option for individuals with SCL, who either uses a lot of time on bowel management or suffer from faecal incontinence. Colostomy is not related to low QoL in SCL persons.

ICF Core Sets for Vocational Rehabilitation validation in SCI patients: preliminary results from the Italian project
Cremascoli, Sonia; Aiachini, B; Pistarini, C; Fizzotti, G
Spinal Unit, Italy

Background:
The International Classification of Functioning (ICF) contains more than 1400 categories and is usable as a reference system, but is not usable in clinical practice. It is therefore necessary to develop the Core Sets, which is a collection of descriptions of the major issues related to the disease. Recently, through the project “Developing a Core Set to describe Functioning in Vocational Rehabilitation”, the categories to be included in the first version of ICF Core Sets for vocational rehabilitation were produced. This study is part of the validation phase and takes into account the problems of re-employment in the SCI. The project was designed in collaboration with the ICF Research Branch, WHO - DIMDI at Swiss Paraplegic Research (SPF) Notwill, Switzerland.

Methods:
We interviewed SCI patients according to the methodology of the Focus Group (FG). The FG is a discussion led by a conductor, starting from standardized questions, aimed at a group of patients with the same disease, that express their point of view. In this study we used six questions about their health condition, with reference to work, exploring the various components of the ICF. We included SCI patients one year after their discharge from our Spinal Unit. Were conducted seven FG since has been reached “saturation” of the data. The processing data provided the full transcript of the debate and the “linking” with ICF categories of the content expressed by all members of the group.

Results:
A list of ICF categories that identify the most frequent issues for inclusion in the work reported by SCI patients will be presented and, through a study about the overlapping, i.e. the percentage of these categories and/or absent, the validation will be evaluated of the ICF core set for vocational rehabilitation in SCI.
Spinal Community Integration Service - Connecting Community and Fostering Participation
Rickard, Belinda; Hilton, G; New, P; Olver, J
1Spinal Community Integration Service, Australia; 2Spinal Unit, Australia; 3Department of Psychiatry, Australia

Background and Aims:
A 2007 review of Victorian spinal cord injury (SCI) services found that these “lacked a strong, consistent focus on community reintegration outcomes for SCI people and their families... the system lacked an effective transitional rehabilitation program and appropriate vocational services” (Leggat, S, 2007, Latrobe Uni p.3). An inter-disciplinary team was formed with funding from the Transport Accident Commission (TAC) and Department of Health (DH) to pilot a biopsychosocial model of care known as the Spinal Community Integration Service (SCIS) to address all aspects of community participation including work, leisure and social roles. Analysis of the data collected in the 2 ½ year pilot program will be presented.

Methods:
This research of pre and post study design compares SCI patients receiving standard care (retrospective), with those involved in a pilot program providing targeted community integration intervention (prospective). The study recruited 119 participants across the two groups.

Results:
Early analysis shows clinically significant changes in self-perception of occupational performance in 70% of the SCIS participants. There is a trend towards improved vocational outcomes within the SCIS participants showing an increase in return to study and a decrease in unemployment in comparison to the control group and previous research. Goal attainment of at least two goals was achieved by 100% of SCIS participants. Independent Sample t-testing was used for the majority of comparisons between groups at six and twelve months following discharge from inpatient rehabilitation. Early analysis has shown no statistically significant differences between groups on measures of anxiety, depression and quality of life.

Conclusions:
The current results are an interim assessment as data collection is not yet complete. The early outcomes for vocational and occupational performance are trending positively. Further analysis of psychological wellbeing data will be presented along with recommendations for future longitudinal research.

Free Papers
14:45-16:00
Whittle Room

Inter-rater reliability of the International Standards for Neurological Classification of Spinal Cord Injury by using electromyography
Han, Zee-A; Shin, Ji Cheol; Yoo, Jeehyun; Yu, Su Jin
South Korea

Background:
The International Standards for Neurological Classification of Spinal Cord Injury (ISCSCI) is used for neurologic evaluation of spinal cord injury (SCI) patients. Early detection of motor recovery and adequate training of trace powered muscles are important for improved outcome in rehabilitation. However, it is difficult to differentiate between trace and zero motor power using manual muscle tests. The purpose of this study was to determine the reliability of motor and sensory examinations of ISCSCI, especially when motor power was trace or zero.

Methods:
Two physicians and two physiotherapists with more than two years of experience in the field of spinal cord injury participated as raters. Six SCI subjects comprised of one incomplete paraplegia, one complete and four incomplete tetraplegia, were included. Each patient was evaluated three times by different raters using the ISCSCI. Prior to the exam, a modulating physician evaluated all the patients and performed needle electromyography to trace and zero powered muscles. Inter-rater reliability for upper extremity motor score (UEMS), lower extremity motor score (LEMS), total motor score (TMS), light touch total score (LT), and pin prick total score (PP) was determined using intra-class correlation (ICC). Kappa was calculated to determine the degree of concordance between needle electromyography and motor scores rated by each rater.

Results:
ICC was high for UEMS (0.982, CI 0.932-0.997), LEMS (0.979, CI 0.918-0.997), and TMS (0.972, CI 0.890-0.996). However, LT (0.910, CI 0.703-0.986) showed high agreement but poor precision, and PP (0.757, CI 0.263-0.958) showed moderate agreement and poor precision. Concordance between needle electromyography and manual muscle tests of trace and zero motor powered muscles was high (kappa value=0.799).

Conclusion:
ISCSCI and manual muscle testing of trace and zero powered muscles by spinal cord injury rehabilitation experts are highly reliable although less so for LT and PP.
ISNCSCI Calculator (International Standards for the Neurological Classification of Spinal Cord Injury)

Waring, William¹; Echeverria, Eduardo²; Kirshblum, Steven¹; Reeves, Ronald¹
¹Physical Medicine and Rehabilitation, USA; ²Canada

Background:
The European Multicenter Study about Spinal Cord Injury (SCI) reported a human error rate of 15.3% for the American Spinal Cord Injury Association Impairment Scale, (AIS); 33.6% for the motor level and 49.8% for the neurological level of injury. These error rates would pose significant methodological and validity issues with data collection and analysis in SCI care and research.

Objectives:
The Rick Hansen Institute’s mission includes accelerating the discovery of a cure for spinal cord injury and improving quality of life, through fundraising and facilitating research. Consistent with their mission the Rick Hansen Institute is developing software that will be freely available for researchers and clinicians to perform error free classification, scaling and reporting with International Standards for the Neurological Classification of Spinal Cord Injury (ISNCSCI) data. The development of this program will include further reviewing, revision and testing followed by endorsement from the major SCI organizations.

Current Development:
The initial software version was designed to use the motor, sensory and anorectal data from the ISNCSCI exam to calculate left and right motor and sensory levels, the neurological level of injury, motor and sensory scores, AIS, the zones of partial preservation, and complete versus incompleteness. The software was 100% accurate with the imbedded case examples in the International Standards Training eLearning Program (InSTeP). However, the program had some problems with C3-5 injuries, unusual cases with very large ZPP’s and initially unable to use with not testable (NT) muscles. Future Development: Further testing, review, and updating will take place so that this computer program will be adapted for the 2011 revisions of the Standards and submitted for consideration of the International Standards Committee of ASIA.

Autonomic and motor recovery from cervical contusion boosted by midbrain stimulation

Hentall, Ian; Vitores, Alberto; Carballosa Gonzalez, Melissa
The Miami Project to Cure Paralysis, USA

The midbrain’s periaqueductal gray (PAG), when electrically stimulated for several days, was found to enduringly improve sensorimotor and anatomical recovery from incomplete acute thoracic contusion injury in rats [Hentall, Carballosa Gonzalez. Neurorehab. Neural Repair, Epub 2011]. Here we extend our studies to cervical injury, later intervention, longer treatment times and autonomic outcomes. A moderate cervical (C5) contusion was created with a controlled force (200 kdyne, 2.5 mm diameter). An implanted, wireless microelectrode-stimulator assembly delivered 8 Hz pulse constant-current trains in alternating 5-minute periods of stimulation and rest for 12 hours daily to the ventrolateral PAG. The stimulation had no immediately observable effects. For acute studies, stimulation began 1-2 hours after injury and lasted 7 days. For chronic studies, treatment with 22 days (mean) of stimulation started either 6 or 12 weeks after injury. Injured rats with inactive stimulator implants served as controls. Motor and sensory performance was tested weekly, beginning before the injury. Autonomic dysreflexia (AD) was assessed in one session under ketamine/xylazine anesthesia by measuring intracarotid blood pressure during colon distension (100 s) with a balloon catheter (4 cc) and during squeezing of each paw. AD was reversed by acute treatment but not by the chronic interventions (assessed respectively 42 days and 110 days post-injury). In the sensorimotor testing, grip strength and incline plane stability were improved in later weeks by acute treatment and by treatment at 6 weeks, but suspension by forelimbs and the paws’ mechanical nociceptive thresholds were unchanged. Various locomotor variables were also measured weekly on a Catwalk system (Noldus Inc.); of these, only forelimb stride length was significantly normalized, and only by the treatment given at 12 weeks. Since PAG stimulation is a proven safe neurosurgical procedure, it represents a potential general treatment for acute or sub-acute spinal cord injury that is readily translatable to man.
O22: 15:30-15:45

Intra- and interrater reliability of the Modified Ashworth Scale in individuals with Spinal Cord Injury.

Nissen, Ulla Vig; Skov Henriksen, Mette; Bjerregaard, Inge; Ellenson, Alec; Biering-Sørensen, Fin
Clinic for Spinal Cord Injuries, Denmark

Introduction:
Spasticity is often seen in individuals with spinal cord injury (SCI). One of the commonly used methods to measure the level of spasticity is the Modified Ashworth Scale (MAS). The purpose of this study was to test the intra- and interrater reliability (3 raters, 1488 tests) of MAS on flexion and extension over hip, knee, and ankle joints in people with SCI.

Methods:
Observational study on 31 SCI participants (11 men, 20 women) aged 15 to 88 years (mean 49). Each participant was tested four times distributed as two tests on two different days during the same week. Three experienced physiotherapists carried out all tests by following a rolling schedule so each participant was tested twice by one rater and once by each of the other two raters. As many factors as possible were monitored such as clothing, room temperature, activity before and distractions during testing. All tests were carried out in the morning before participants had risen from bed. Those who did not use indwelling catheter were allowed to empty their bladder in the bathroom. No other activity was carried out before testing, except moving from bed to bench.

Data analysis:
Cohen’s Unweighted Kappa divides data into 5 categories: < 0 = Poor; 0-0.20 = Slight; 0.21-0.40 = Fair; 0.41-0.60 = Moderate; 0.61-1.00 = Almost perfect.

Results:
The overall intrarater reliability for MAS was found to be Moderate and the overall interrater reliability Fair.

Discussion:
Even when factors such as activity, clothing, room temperature and distractions are being controlled MAS does not perform very well. When using MAS it is important that the same rater tests a particular person from time to time, since the intrarater is better that the interrater reliability.

O23: 15:45-16:00

The reliability of SCIM III by interview
Itzkovich, Malka; Front, I; Poliack, T; Shefler, H; Shachner, S; Gelernter, I; Catz, A
Israel

Background:
The third version of the Spinal Cord Independence Measure (SCIM III) was found valid and reliable when scored by observation. Assessment by interview is faster and less costly, however, and may be easier to perform in certain environments.

Objective:
Examine the reliability of SCIM III by interview.

Method:
Patients with spinal cord lesions (SCL) who during rehabilitation at Loewenstein Hospital were routinely assessed by a nurse using SCIM III by observation, were also assessed by interview by a physiotherapist (PT) and an occupational therapist (OT) who were not part of the team that treated the patients. The three assessments were carried out independently during the same week. Twenty-six patients were included (mean age of 62, 17 males, 14 with cervical SCL). AIS grade was A in 3 patients, B in 65, and D in 17. Patients with medical problems other than SCL that could affect function were excluded. Pearson’s correlation and t-test, as well as total agreement.

Results:
Correlation between the scores of all raters was high (r=0.79-0.91), and the difference in total SCIM III score between interview and observation was non-significant (p>0.19). The difference between interviewers, however, was significant (p<0.05), and total agreement was relatively low.

Conclusion:
Findings show that using SCIM III by interview for functional assessment of SCL patients can yield scores that correlate highly with observation scores, and that are not significantly different from them. It seems, however, that SCIM III interview reliability depends on the rater’s profession, and that raters may need specific training to improve agreement between them.
Effects of granulocyte colony stimulating factor (G-CSF) on central neuropathic pain after spinal cord injury
Kato, Kei; Koda, M; Yamazaki, M; Okawa, A; Mannoji, C; Furuya, T; Takahashi, H; Sakuma, T; Takahashi, K
Dept. of Orthop. Surg., Japan

Introduction:
We conducted a clinical trial using G-CSF for worsening symptoms of compression myelopathy, and encountered some patients in whom neuropathic pain was relieved simultaneously with relief of myelopathy. Thus, we hypothesized that G-CSF is effective for spinal neuropathic pain. We verified the effectiveness of G-CSF for spinal neuropathic pain by using rat spinal cord injury (SCI) model, and we examined the mechanism of pain-relief by G-CSF immunohistochemically.

Methods:
Thoracic (T8) spinal cord contusion injury was produced in male Sprague–Dawley rats by using NYU impactor (10 g from 6.25mm). At 3 weeks after injury, we administered G-CSF to the rats in which allodynia was observed in their hind paw. G-CSF was administered intraperitoneally for 5 consecutive days. The dose of G-CSF was 15ìg/kg/day in which neuroprotective effect was observed in our murine spinal cord injury model. We administered saline in the same method in the control group. Tactile allodynia of hind paw was assessed by using von Frey filament. The injury site and lumbar enlargement of spinal cord was removed and immunostained. We evaluated the expression of the pain-related glial cells.

Results:
Allodynia of hind paw was observed in about 30% of SCI rats. Paw withdrawal threshold had been significantly increased by G-CSF administration since 3 days passed. Motor function (BBB score) was not improved by G-CSF administration in chronic phase. The expression of Iba-1 positive cells in dorsal horn of lumbar enlargement was significantly decreased at 1 week after G-CSF administration.

Discussion:
In our study, it was suggested that G-CSF has a pain-relieving effect for neuropathic pain after SCI. It is considered that activation of microglia is associated with neuropathic pain after SCI, and inhibiting activation of microglia is effective for pain relief. One of the mechanism of pain-relief by G-CSF is implied inhibiting of microglial activation.

Somatosensory patterns in individual with neuropathic pain after Spinal Cord Injury
Arora, Mohit1; Chhabra, HS2
1Clinical Research, India; 2Department of Spine Service, India

Introduction:
There have been studies that document the somatosensory abnormality pattern associated with different neurological syndrome including central pain syndrome using QST tools. This study is designed to explore the spectrum of sensory abnormality and document the somatosensory patterns pertaining specifically to spinal cord injury using cheaper but validated alternative quantitative tools.

Study Design:
Prospective study.

Objective:
In this paper, we present the somatosensory pattern in individuals with neuropathic pain, post complete and incomplete spinal cord injury (SCI), using cheaper but validated alternative quantitative tools.

Participants/methods:
59 patients with a clinical diagnosis of neuropathic pain post SCI were assessed by validated quantitative tools similar to the tool of German Research Network on Neuropathic Pain. The test was conducted in complete and incomplete SCI (at Level and Below Level) and the findings were compared. The battery of tools includes sub-modalities of somatosensory system namely Sensory Threshold, Static Mechanical Allodynia, Dynamic Mechanical Allodynia, Punctate Hyperalgesia, Temporal Summation, Cold Allodynia, Cold Hyperalgesia.

Results:
There were 59.5% complete and 40.5% incomplete individuals. Across all parameter, 92% of the participants among incomplete group presented atleast one abnormality (commonly diminished light touch- 44%) on Sensory threshold battery. 14% of participants experienced one type of Mechanical Allodynia (Static Mechanical Allodynia- 10.5%) in incomplete group. Punctate hyperalgesia “at level” accounted for 93% and 95% in incomplete and complete injured respectively. 5% complete individual presented with cold hyperalgesia “below level”.

Conclusions:
The analysis of QST parameters using alternative qualitative sensory tools revealed different somatosensory patterns in individuals with complete and incomplete spinal cord injury. The present method used by the author is cost-effective and user friendly. Future work should aim to establish any links between somatosensory profiles and patho-physiological mechanism, and to examine whether patients with different somatosensory profiles respond differentially to treatment.
Voluntary modulation of EEG rhythms reduces central neuropathic pain in patients with spinal cord injury
Hasan, Muhammad Abul1; Vuckovic, A1; Fraser, M2; Allan, D2
1School of Engineering, United Kingdom; 2Queen Elizabeth National Spinal Injuries Unit, United Kingdom

Abstract:
The aim of this study is to quantify a relation between the intensity of Central Neuropathic Pain (CNP) and modulation of brain waves during neurofeedback (NF) treatment.

Introduction:
CNP produces measurable changes in electroencephalogram (EEG), such as lower frequency and amplitude of the dominant frequency [1]. Our hypothesis is that modulation of CNP signatures using NF can reduce CNP.

Methods:
Four chronic paraplegic patients (age 47.7±2.3, 2 complete SCI, 2 incomplete SCI) with CNP intensity 5-9 on the Visual Analogue Scale (VAS) participated in this single blinded study. They had up to 40 NF sessions, 2-3 times a week, for 40 min. A graphical user interface was used to provide visual information on EEG to the patient. During NF training the patient was attempted to suppressed the beta activity (20-30 Hz) and enhanced the alpha activity was . Patients were trained over the right centro-parietal sides of the cortex.

Results:
All patients had low dominant frequency peak, shifted towards higher frequencies. In a typical training session, the amplitude of the dominant frequency peak increased and shifted towards higher frequencies from 5-8 Hz to 7-10 Hz, while the energy in the higher beta band (20-30 Hz) decreased. NF produced measurable changes in patients’ EEG, related to immediate reduction of pain from 2 to 4 units on the VAS that lasted up to several days after each training session. Incomplete SCI patients also reported reduced spasm. All patients reported a pleasant sensation of warmth, that accompanied reduction of pain.

Conclusion:
NF therapy is a new promising non-pharmacological treatment for CNP. Reduction of pain might be related to both alpha increase and beta decrease.

Acknowledgement:
This work was supported by the MRC Grant number G0902257/1. Many thanks to the Spinal Injury consultant staff including Dr Purcell and Dr McLean for selecting patients.

Reference:
**Background:**
Little information and no dietary reference intakes are available for individuals with spinal cord injury (SCI). This diet quality assessment study can assist health care professionals in evaluating the nutrient needs of an athletic SCI population.

**Methods:**
3-day food diaries were obtained from university wheelchair athletes with SCI (n=41) and age-(mean±SD: 22.4±3.6yrs, 22.5±3.8yrs, SCI and able-bodied [AB] respectively; p=0.939) and BMI-matched (23.2±1.4kg/m2, 24.3±2.7kg/m2; p=0.324) sedentary AB controls (n=17). SCI athletes regularly participated in 12hrs/wk sport-specific and 3hrs/wk resistance training. AB controls' physical activity was ≤60min/wk. Food diaries were reviewed and mean daily intakes were analyzed using commercial software by one dietetic student.

**Results:**
Energy intake tended to be lower in SCI than AB (2132±645kcal/d, 2508±899kcal/d; p=0.084), fat intake was lower in SCI (76±25g/d, 95±39g/d; p=0.029), and protein (83±32g/d, 98±31g/d; p=0.117) and carbohydrate (283±98g/d, 298±97g/d; p=0.600) intakes did not differ between groups. Relative to caloric intake, protein (15.4±3.7%E, 15.6±2.4%E; p=0.803) and fat (31.2±5.9%E, 33.5±6.1%E; p=0.206) intakes did not differ between groups, but carbohydrate intake (52.3±7.5%E, 48.0±7.3%E; p=0.048) was greater in SCI athletes. Vitamin A (689±390RE/d, 1018±494RE/d; p=0.010), vitamin C (77±52mg/d, 124±73mg/d; p=0.008), thiamin (1.3±0.5mg/d, 1.6±0.6mg/d; p=0.037) and folate (278±152µg/d, 371±177µg/d; p=0.052) intakes were lower in SCI. Of minerals, calcium (903±416mg/d, 1215±465mg/d; p=0.016) and zinc (8.4±3.8mg/d, 11.7±5.9mg/d; p=0.014) intakes were lower in SCI. Compared to USDA Dietary Guidelines for Americans 2010 for active AB population, SCI athletes had low energy; vitamins A, D, E, and K; folate; calcium; potassium; iron; magnesium and copper daily intakes. Sodium intake was greater than recommendations.

**Conclusion:**
Our findings suggest that vitamin and mineral intake is not adequate in an athletic SCI population. Energy intake was low for such highly physically active individuals. However, taking into account the normal BMI in this group of SCI athletes, this level of calorie intake may be appropriate.
Effect of mobility on long-term outcomes of childhood-onset tetraplegic spinal cord injury
Zebracki, Kathy; Chlan, Kathleen; Vogel, Lawrence
USA

Objective:
To assess the relationship between functional mobility and employment, independent living, and emotional functioning in adults with childhood-onset tetraplegic spinal cord injury (SCI).

Methods:
Participants were 223 individuals with tetraplegia ages 24-45 years (M=31.6, SD=5.5): 68% male; 86% Caucasian; mean age at injury was 14.9 years (SD=3.1, 0-18y); 27% C1-C4 AIS ABC, 63% C5-C8 AIS ABC, and 9% C1-C8 AIS D. Participants completed a structured questionnaire and Craig Handicap Assessment and Reporting Technique, Short-Form 12® Health Survey- mental health scale, Satisfaction with Life Scale, and Patient Health Questionnaire-9 depression scale. Correlations and regression analyses were utilized.

Results:
Majority of participants were able to enter/exit their house without assistance (79%), access essential rooms independently (91%), and use transportation effectively (89%) whenever they want (85%). Many participants, however, did not drive (56%) and reported being unable to use transportation independently (53%). 54% of participants lived independently and 51% were employed (70% part-time). Several mobility tasks were significantly correlated with employment, living independently, life satisfaction, and mental health.

<table>
<thead>
<tr>
<th>Employed</th>
<th>Lives independently</th>
<th>Life satisfaction</th>
<th>Depressive symptoms</th>
<th>Perceived mental health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter/ exit home</td>
<td>.21**</td>
<td>.22***</td>
<td>.18**</td>
<td>-.19*</td>
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<tr>
<td>Access to essential rooms</td>
<td>--</td>
<td>-.18**</td>
<td>--</td>
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</tr>
<tr>
<td>Use transportation independently</td>
<td>.37***</td>
<td>.17*</td>
<td>.26***</td>
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<td>Effective transportation</td>
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<td>Transportation availability</td>
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<td>Use of transportation without notice</td>
<td>.20**</td>
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<td>.17*</td>
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<td>Drive independently</td>
<td>.35***</td>
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<td>.21***</td>
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</table>

After controlling for age and gender, three mobility predictors emerged. Ability to use transportation independently was a predictor of employment ($\beta=1.32$, $p<.05$). Ability to enter/exit house independently predicted living independently ($\beta=.88$, $p<.05$), perceived mental health ($\beta=.19$, $p<.01$), and negatively predicted depressive symptoms ($\beta=-2.31$, $p<.01$). Independent access to essential rooms also predicted living independently ($\beta=1.21$, $p<.05$).

Conclusions:
Among the mobility factors studied, few were predictive of key adult outcomes of employment, independent living, and emotional functioning. Mental health outcomes of depression and perceived mental health were predicted by the ability to enter and exit one’s home; whereas, none of the mobility factors were predictive of life satisfaction, despite that 6 of the 7 were correlated with life satisfaction. Employment is the one outcome studied that involved community participation and understandably was predicted by the ability to independently use transportation. Future research should examine potential mediator and moderator factors that may further explain the relationship between mobility and long-term outcomes.
Lung function in spinal cord injury up to 5 years after rehabilitation: deterioration in many individuals in spite of improvement at group level

Postma, Karin; Bussmann, JH; Haisma, JA; de Groot, S; Hopman, MTE; Bergen, MP; Stam, HJ
Netherlands

Background:
The aim of this study was to describe the course of forced vital capacity (FVC) in spinal cord injury (SCI) up to 5 years after rehabilitation and assess the incidence of decline and its associated factors in the years after discharge.

Methods:
180 Persons with SCI participating in a Dutch multi-centre prospective cohort study were included: 41 with motor complete tetraplegia, 29 with incomplete tetraplegia, 79 with motor complete paraplegia, and 31 with incomplete paraplegia. FVC was measured at 4 test occasions (start of rehabilitation, discharge from inpatient rehabilitation, 1 and 5 years after discharge) and expressed as percentage of the predicted value based on able-bodied persons of the same age, gender, and height. Potential factors of decline were determined 5 years after discharge; their association with change in FVC after rehabilitation was assessed.

Results:
FVC improved 12.4% during inpatient rehabilitation (p=.000) and 5.1% (p=.046) in the 5 years after. Improvements between discharge and 1 year after (3.4%), and between 1 and 5 years after discharge (1.7%) were not significant. In 41% of persons who were tested at discharge as well as 5 years after (n=101), FVC deteriorated beyond the normal age-related decline. Change of FVC was negatively associated with older age (p=.046, R2=.04) and higher body mass (p=.007, R2=.07). No significant associations were found with lesion characteristics, gender, smoking, physical fitness, and physical activity level.

Conclusions:
Even though FVC still improved during the 5 years after inpatient rehabilitation at group level, in 41% of the individuals lung function deteriorated. Since most of the variance in change could not be explained by the studied factors, we advise to monitor lung function in all persons with SCI regularly after rehabilitation. Adding an educational program on weight control to the rehabilitation program may help in preventing excessive decline in lung function.

Free Papers
09:00-10:00
Whittle Room

O32: 09:00-09:15
Early onset of morphological changes of the cord and brain following acute spinal cord injury

Freund, Patrick1; Fries, S1; Wolf, K1; Weiskopf, N2; Thompson, A3; Curt, A1
1Spinal Cord Injury Center Balgrist, Switzerland; 2Wellcome Trust Center for Neuroimaging, United Kingdom; 3Brain Repair and Rehabilitation, United Kingdom

Background:
While the spinal cord and brain reveal atrophic changes in chronic spinal cord injury (SCI), the onset and rate of these morphological changes are unknown.

Method:
Prospective cohort study of 12 acute SCI patients (C5- Th12) clinically assessed early after injury and after two and six months. Patients and 16 healthy controls underwent structural T1-weighted magnetic resonance imaging of the brain and spinal cord. At each time point the cross-sectional cord area at C2/C3 level, cranial white and grey matter volume and cortical thickness were assessed using voxel-based analysis and compared to matched controls.

Results:
At baseline, cord area was unchanged compared to controls but a reduction of white (pyramids, p=0.003) and grey (leg area of primary sensory area p= 0.001) matter volume was found and, in addition, a thinner cortical thickness in the leg area of the primary motor cortex (p=0.043). At 6 months cord area in patients decreased by 3.2% (p=0.01) compared to unchanged values in controls.

Conclusion:
Morphological changes occur early after acute SCI with distinct spatial and temporal pattern within spinal cord and brain areas. This is in accordance with preclinical studies and suggests that immediate and permanent changes in the connectivity of central pathways relates to the ensuing disability.
The Graded and Redefined Assessment of Strength, Sensibility and Prehension (GRASSP) allows for reliable prediction of hand function in acute C-SCI

Velstra, IM1; Bolliger, M2; Tanadini, L1; Baumberger, M3; Kalsi-Ryan, S2; Rietman, JS5; Curt, A2
1Clinical Trial Unit, Switzerland; 2Spinal Cord Injury Center, Switzerland; 3Switzerland; 4Toronto Western Hospital, Canada; 5Roessingh Research and Development, Lab of Biomechanical Engineering, Netherlands

Background:
Hand function has a high priority in individuals with tetraplegia. Depending on the level and completeness of spinal cord injury (SCI), the hand function outcome can range from no hand function to almost normal hand function. Therefore, prediction of hand function at an early stage after injury is clinically important for setting reasonable goals in rehabilitation and clinical decision making for the rehabilitation program accordingly, as well as improving the stratification of patients for clinical studies.

Objective:
To evaluate the predictive value of the GRASSP for the hand function outcome in acute cervical SCI

Design:
European prospective longitudinal multi-centre cohort study

Participants/methods:
In 77 individuals, GRASSP total sub scores of Manual Muscle Testing (MMT) and Semmes and Weinstein Monofilament Testing (SWMT) and qualitative - quantitative grasping were analyzed at one, six and twelve months after cervical SCI (level of injury from C2 to T1, AIS A-D). A logistic regression model was used to predict qualitative and quantitative grasping binary outcome at six and twelve months, using the total scores of MMT and SWMT at one month after injury as predicting variable. To determine which single predictor and which outcome variable should be used, correlations between MMT and SWMT, respectively between qualitative and quantitative grasping were tested using Spearman’s correlation coefficients.

Results:
Logistic regression analysis revealed that MMT total score at one month was able to correctly classify 84.2% of the patients’ grasping outcome at six months and 87.8% at twelve months after injury. SWMT total score at one month performed slightly less predictive with correctly classifying 70.2% of the patients at six months and 73.5% at twelve months, respectively. Receiver-operating curves confirmed the high in-sample-validity for both models utilizing MMT or SWMT total scores as predicting variables.

Conclusion:
The GRASSP sub scores MMT and SWMT are highly predictive of hand function outcome in acute tetraplegia. The results suggest that, based on high predictability of hand function using the GRASSP, an early patient stratification is achievable in individuals with acute C-SCI.

Support:
We thank the EMSCI network and the Institute for Research in Paraplegia (IFP, Switzerland) for their support.

Whole body CT in sepsis and severe sepsis in spinal cord injured patients: findings and outcomes

Wail, Ahmed; Lopez de Heredia, L; Belci, M; Hughes, RJ; Meagher, TM
National Spinal Injuries Centre, United Kingdom

Background:
Spinal cord injured patients have an increased incidence of infections particularly of the renal tract and chest. The cause of sepsis is not always apparent and when to use complex investigation such as CT to evaluate critically ill patients may be difficult.

Methods:
Sepsis was defined as infection with systemic manifestations. Our sepsis diagnostic criteria included infection (documented or suspected) and at least two variables of systemic inflammatory response markers including body temperature > 38.3°C or < 36°C, HR >90 bpm, RR > 20 breath per minute or one of the signs of severe sepsis including systolic BP <90 mmHg, lactate >2.5 mmol/L, urine output < 0.5 ml/kg/hr. Patients in hospital for more than 7 days with unexplained fever and SIRS who had CT of chest, abdomen and pelvis between 2008 – 2011 were included and CT scans and case notes retrospectively reviewed for final clinical diagnosis and outcome. Findings at CT were defined as a specific cause for sepsis or non-specific signs.

Results:
25 patients were identified. A specific cause was established in 13 patients at CT: pneumonia in 9, ureteritis in 1, pyelonephritis in 1, empyema in 1 and pleural effusion in 1. On follow up no final clinical diagnosis was established in 6 patients, 12 had pneumonia, 1 had UTI, 1 had UTI with septicemia, 1 had ureterocoele, 1 had heterotopic ossification, 1 had empyema, 1 had wound infection and 1 had ARDS. One of these 25 patients died within two weeks of CT.

Conclusion:
Whole body CT can help establish a diagnosis in sepsis and severe sepsis when the clinical
**Effects of a walking training on sensory-motor fMRI patterns in spinal cord injured people**

Bizzarini, Emiliana; De Maio, G; Urgesi, C; Pinzini, C; Maieron, M; D’Agostini, S; De Colle, C; Tomasino, B; Zampa, A

1Department of Rehabilitation Medicine, Italy; 2Spinal Lab – Udine, Italy; 3Department of Biomedical Sciences and Technologies and Department of Philosophy, Italy; 4Department of Radiologic Sciences, Italy; 5Italy

**Background:**

Aim of the study was to test the effects on FMRI sensory-motor patterns of a walking training using Body Weight Supported Treadmill (BWST) and Functional Electrical Stimulation (FES) in complete spinal cord injured (SCI) patients.

**Participants:**

14 thoracic level SCI patients, age 33.36±1.14 years, Asia Impairment Scale A and 8 able-bodied subjects.

**Material:**

BiacMed systems were used for FES walking, Compex Stimulator for Patten Electrical Stimulation (PES).

The SCI subjects were divided in two groups, the first (N=7) performed a walking program and the second (N=7) performed a PES assisted isometric program for quadriceps muscles, 3 sessions/week for 3 months.

The walking program was realized in four steps: 1) PES, 3 sessions/week for 3 weeks; 2) FES cycling, 3 times/week for 3 weeks; 3) FES walking at BWSTT (TR Spacetrainer), 3 times/week for 3 weeks; 4) over-ground FES walking training, 3 times/week for 4 weeks.

At every steps we tested 1) quadriceps isometric torque during contraction induced by PES (Biodex System 4); 2) O2 maximal consumption during stress test and energetic cost of gait with respiratory gases analyzer (VO2000, Medgraphics); 3) fMRI post-training changes of motor activations during observation and imagery of lower and upper limb movements (Siemens AVANTO, 1.5 Tesla).

**Results:**

At the end of the training we verified an increase of quadriceps torque (from 10.76 to 24.29 Nmxm), of aerobic performance, of walking speed (from 0.11 to 0.24 m/s) with a decrease of gait energetic cost (from 31.17 to 21.19 J/Kg/m). fMRI results showed increased activations of visual as well as of motor and premotor areas during observation and imagery of lower limb movements.

**Conclusion:**

Our finding confirm that motor patterns are preserved in SCI subjects, that inputs as BWSTT and FES realize physiologic and metabolic benefits and, more interestingly, they can guide cortical plastic changes.

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**Long Term Outcomes**

**10:30-12:30**

**Churchill Auditorium**

**O36:** 10:30-10:50

**Neglected traumatic spinal cord injuries: Do they affect outcome**

Chhabra, HS; Arora, M

1Department of Spine Service, India; 2Clinical Research, India

**Background:**

In emerging countries spinal injured often present quite late to a definitive centre. Injuries in which comprehensive management is not initiated in a timely fashion may be termed as Neglected Traumatic Spinal Cord Injuries (NTSCI). It is expected that outcome would be compromised in such patients.

**Study Design:**

Retrospective analysis.

**Objective:**

To compare the outcomes in neglected and non neglected spinal injured admitted at the centre.

**Methodology:**

Information was collected from case sheets of 61 persons with NTSCI for whom comprehensive management could not be initiated till 4 weeks after the injury and another 62 persons for whom treatment was initiated within two days of injury.

**Results:**

The average duration of neglect was 69.71 weeks. Premature discharge in first admission with inadequate or no rehabilitation was the major cause (54.11%), whereas late presentation by the patient accounted for 34.27%. Rehabilitation had not been initiated in 93.4% of patients. Bladder and bowel training had not been done in 91.8% and 96.8% of patients respectively. Pressure sores, contractures and renal complication rate was higher in the neglected group. There was a statistically highly significant (p<0.001) difference in the mean difference of Spinal Cord Independence Measure at admission and discharge and duration of hospitalization in the two groups in favor of non-neglected group. The cost of treatment was also statistically significantly higher (p<0.001) in the neglected group.

**Conclusion:**

NTSCI adds to the complexity of management of vertebral lesion and of rehabilitation. They have a much higher incidence of complications which are more severe, complicated and more difficult to manage. They require a longer and more expensive hospitalization. They adversely affect functional outcomes and also neurological outcomes in a few. Therefore, avoiding any delays in starting treatment after SCI and taking treatment in a definitive spinal injury centre is important.
**O37: 10:50-11:10**

**Are men different from women? - Preliminary results concerning osteoporosis in persons with chronic spinal cord injury (SCI)**

Frotzler, Angela; Hartmann, K; Berger, M; Baumberger, M; Perret, C

1Clinical Trial Unit, Switzerland; 2Radiology, Switzerland; 3Clinic, Switzerland; 4Sports Medicine, Switzerland

**Background:**
A secondary complication of SCI is a high-grade osteoporosis with associated fractures. The aim of this study was to investigate whether there is a difference in bone status between men and women with a chronic SCI, and therefore highly advanced bone loss in the lower extremity.

**Methods:**
Persons with traumatic SCI (AIS A/B; years post SCI>7) were recruited for this study. Able-bodied persons served as reference population. Trabecular (BMDtrab) and total (BMDtot) bone mineral density as well as bone mass of the distal tibia were assessed by pQCT.

**Results:**
So far, 16 women (age: 48.0±12.0 years; years post SCI: 23.5±9.3 years; years post SCI: 15.4±6.5 years; and 60 men (age: 49.6±13.6 years) were recruited as reference population. Bone parameters of women with SCI (BMDtot: 126.0±27.3mg/cm3; BMDtrab: 66.8±22.7mg/cm3; mass: 1.38±0.30g/cm3) were significantly lower (-56.6%, -69.9% and -54.6%, respectively) compared to the female reference population. In addition, bone parameters of men with SCI (BMDtot: 140.8±29.0mg/cm3; BMDtrab: 72.2±24.3mg/cm3; mass: 1.90±0.40g/cm3) showed a significant decline of 56.2%, 70.3% and 52.9%, respectively, compared to the male reference population.

In the gender-related comparison of persons with SCI, no significant differences between bone density parameters were found. However, women showed a tendency to have a slightly lower bone mineral density than men (differences: BMDtrab: 14.8mg/cm3, p=0.198; BMDtot: 5.4mg/cm3, p=0.646). Though, bone mass was about 0.59g/cm lower in women (p<0.001). In contrast, the corresponding comparison of the reference population revealed significantly lower bone parameters in women compared to men (differences: BMDtrab: 31.2mg/cm3, p<0.001; BMDtot: 23.5mg/cm3, p<0.001; mass: 1.00g/cm, p<0.001).

**Conclusion:**
Bone parameters in the paralysed lower extremity of both men and women are similarly reduced, indicating that gender seems not to be a dominant risk factor for osteoporosis in persons with SCI.

**O38: 11:10-11:30**

**Unintentional injuries occurring after spinal cord injury**

Saunders, L; Krause, J

USA

**Background:**
Persons with spinal cord injury (SCI) are vulnerable to unintentional injuries, often resulting in adverse outcomes. Circumstances surrounding these injuries have not been well documented. Our purpose is to quantify unintentional injuries after SCI, and identify the circumstances surrounding those injuries.

**Methods:**
804 adults with traumatic SCI responded to a survey on secondary conditions after SCI, which asked about the number of injuries in the past year and the circumstances surrounding those injuries.

**Results:**
Nearly 20% reported 1+ injuries in the previous year. There were no differences in sustaining an injury by gender, race, or ambulatory status. Those reporting an injury were younger on average and more likely to have a lower neurologic level of injury. Of those injured, 65.1% were seen in an emergency department, and 28.4% required an overnight hospital stay. 42.0% experienced an injury due to a fall. Injuries occurred somewhat more often in the home (53.3%) than the community (46.3%). Of injured, 25.2% were limited in normal activities, and 13.9% could not get out of their house for a month or more due to their injuries. Having an injury in the past year was significantly associated with an increased number of surgeries, emergency department visits, days in the hospital, and visits to the doctor in the past year compared to persons who did not sustain an injury.

**Conclusions:**
Unintentional injuries are frequent after SCI and often have serious consequences. Results showed that not only did having an injury in the past year limit participation but also was associated with increased healthcare utilization. Although unintentional injuries after SCI have rarely been the focus of investigation, they should be of great concern to rehabilitation professionals because of their frequency, consequences, and the likelihood that they relate to a similar pattern of risk factors to the original SCI.
Prospective Trajectories of Resilience, Depression, and Anxiety Following Spinal Cord Injury: A Longitudinal Investigation

Kennedy, Paul¹; Bonanno, George¹; Lude, Peter²; Elfstrom, Magnus³
¹United Kingdom; ²USA; ³Switzerland; ⁴Sweden

Objective:
To investigate longitudinal trajectories of depression and anxiety following spinal cord injury (SCI) as well as the predictors of those trajectories.

Method:
A longitudinal study of 233 participants, assessed during hospitalization, and at 12 weeks, one year, and two years follow-up, was examined using Latent Class Mixture Modeling (LGMM) to determine the best fitting model of depression and anxiety trajectories. Covariates assessed during hospitalization were explored as predictors of the trajectories.

Results:
Analyses for depression and anxiety symptoms revealed three similar latent classes: a resilient pattern of non-symptomatic, high symptoms followed by recovery, and delayed symptom elevations. A chronic high depression pattern also emerged but not a chronic high anxiety pattern. Analyses of predictors indicated that compared to other groups, resilient patients had fewer SCI-related quality of life problems, more challenge appraisals and fewer threat appraisals, greater acceptance and fighting spirit, and less coping through social reliance and behavioral disengagement.

Conclusion:
Overall, the majority of SCI patients demonstrated considerable psychological resilience. Models for depression and anxiety each evidenced a pattern of elevated symptoms followed by improvement and a pattern of delayed symptoms. Chronic high depression was also observed but not chronic high anxiety. Analyses of predictors were consistent with the hypothesis that resilient individuals view major stressors as challenges to be accepted and met with active coping efforts. These results are similar to other studies of major health stressors.

Wheelchair type and shoulder pain in full-time, manual wheelchair users with spinal cord injury

Rose, LS¹; Ferguson-Pell, M²
¹Physiotherapy Department, United Kingdom; ²Faculty of Rehabilitation Medicine, Canada

Objective:
To establish prevalence of shoulder pain in full-time, manual wheelchair users with spinal cord injury (SCI) in the United Kingdom (UK). To investigate the association between wheelchair type and severity of shoulder pain.

Methods:
The participants in a postal survey of wheelchair provision were invited to complete the Wheelchair User's Shoulder Pain Index (WUSPI). The study group comprised 705 full-time, manual wheelchair users less than 10 years post onset of SCI, recruited from 10 SCI centres throughout the UK. For further analysis, respondents were divided into ‘no pain’ and ‘with pain’ groups, where ‘with pain’ was defined as reporting pain in at least one item on the WUSPI.

Results:
The overall prevalence of shoulder pain was 66%. Prevalence was higher in respondents aged < 40 years (70%) than > 40 years (62%) (p=0.036) and higher in tetraplegics (74%) than paraplegics (62%) (p=0.007). The activities causing most pain were pushing > 10 minutes, pushing up inclines and sleeping. The majority of respondents used a custom-made or customizable, lightweight wheelchair – 68% in the ‘no pain’ group and 71% in the ‘with pain’ group. More severe pain was noted amongst folding frame wheelchair users for both pushing > 10 minutes (p=0.01) and pushing up inclines (p=0.001).

Conclusion:
The prevalence of shoulder pain in this study was higher than has previously been reported. Folding frame wheelchair users reported more severe shoulder pain than rigid frame users. Further investigations are required to clarify whether it is the wheelchair type in itself or associated behaviours that influence the severity of shoulder pain.

Acknowledgements:
Supported by The David Tolkien Award, United Kingdom Spinal Cord Injury Research Network and Buckinghamshire Healthcare NHS Trust.
Free Papers
10:30-12:30
Whittle Room

O42: 10:30-10:45
Implementation of therapy recording for patients with SCI in inpatient rehabilitation in 5 specialized rehabilitation centers in the Netherlands
van Langeveld, Sacha; Post, MWM
Center of Excellence for Rehabilitation Medicine Utrecht, Netherlands

Background:
Few research reports have documented contents of therapy in inpatient SCI rehabilitation. We developed the Spinal Cord Injury-Interventions Classification System (SCI-ICS) to classify provided therapy into 41 categories at 3 levels (body functions, basic and complex activities).

Objectives:
(1) To implement the SCI-ICS in 5 specialized SCI rehabilitation centers in the Netherlands, (2) to develop useful clinical reports, (3) to determine barriers and facilitators of recording therapy on a daily basis, and (4) to develop the elektronical version of the SCI-ICS.

Methods:
Physical, occupational and sports therapists recorded all therapy provided to patients with recent SCI in inpatient rehabilitation during 6 months. Various ways to report therapy data by center and by patient were developed. Questionnaires were administered to caregivers on barriers and facilitators for implementation.

Results:
Hundred and seven therapists participated in the implementation of the SCI-ICS. Therapists recorded 10715 treatments of 93 patients with SCI. Standardized therapy reports on the various levels and categories were developed and tested, and are being revised in an ongoing effort. Seventy-five questionnaires (70%) were collected. Delays in software development limited the possibilities to experiment with reporting therapy data of individual patients in settings with time constraints, such as team meetings. Key facilitators were the clarity of the reports showing the actual contents of therapy provided to patients and the possibility to compare therapy programs between centers.

Conclusion:
Therapists are able to record therapy with the SCI-ICS on a daily basis. The reports enabled us to show specific contents of therapy for the individual patient. Key barriers and facilitators for application of the SCI-ICS in routine care were identified.

O43: 10:45-11:00
Responsiveness and Sensitivity of a Clinical Impairment Measure Specific for Tetraplegia: An International Multi-Centre Study of the GRASSP
Kalsi-Ryan, Sukhvinder1; Velstra, IM2; Beaton, D3; Bolliger, M3; Curt, A3; Popovic, MR3; Reitman, JS3; Verrier, MC3; Fehlings, MG3
1Neurosurgery, Canada; 2Switzerland; 3Canada; 4Netherlands

Background:
GRASSP was developed to capture subtle changes in neurological impairment of the upper extremity after cervical spinal cord injury (SCI) during the acute, sub-acute, and chronic phases. Psychometric properties of reliability and validity are well established. Responsiveness testing is required to understand application of the GRASSP in clinical trials and interventional studies.

Scientific Aims:
1) To develop responsiveness, and establish the sensitivity of GRASSP
2) To establish how the measure can be applied in clinical trials and interventional studies.

Methods:
A prospective longitudinal study including individuals with acute tetraplegia is currently being conducted as a multi-centre/multi-national study. Serial testing consists of GRASSP, International Standards for Neurological Classification for Spinal Cord Injury (ISNCSCI), Spinal Cord Independence Measure (SCIM), Capabilities of Upper Extremity Questionnaire (CUE), Questionnaires and Life Satisfaction Survey (LISAT-11) administered 0 to 10 days, 1, 3, 6, and 12 months post injury. Analysis: A comparison of the standardized changes from baseline to each time point for GRASSP and ISNCSCI using the Friedmann and Wilcoxon signed rank test will be conducted to determine amount of change captured by all measures.

Sample:
To date 113 patients have been enrolled (35-Can, 78-Eur), 80 (20-Can, 60-Eur) with 6 month follow up and 55 with (Can-10, Eur-48) with 12 month follow up. Enrollment in Europe is closed and in Canada will close in July 2012.

Results:
Sub-analysis of small datasets show increased sensitivity of GRASSP in measuring the upper limb when compared to ISNCSCI across the recovery of one year.

Conclusion:
GRASSP Version 1.0 is a sensitive upper limb impairment measure which will be useful in clinical and research settings to assess the sensory, motor and functional changes occurring after injury. The subtleties that the measure characterizes are valuable in elucidating the underlying approaches to improve concomitant hand function and define efficacy of new interventions.

Funding and Acknowledgements:
Ontario Neurotrauma Foundation, Rick Hansen Institute, Physiotherapy Foundation of Canada, Canadian GRASSP Longitudinal Study Group, European Longitudinal Study Group, European Multicenter Study in SCI (EMSCI) and the Institute for Research in Paraplegia (IFP)
O44: 11:00-11:15

Therapists’ ability to predict future mobility for people with spinal cord injury

Batty, J1; Harvey, LA2; Chu, J3; Ben, M4; Avis, A5; Adams, R4

1Spinal Unit, Australia; 2Rehabilitation Studies Unit, Australia; 3Moorong Spinal Unit, Australia; 4Discipline of Physiotherapy, Australia

Background:
To determine the accuracy of therapists’ predictions of patients’ future mobility.

Methods:
A cohort observational study was undertaken. A consecutive series of 47 patients admitted for rehabilitation after spinal cord injury was recruited. Treating therapists predicted each patient’s future mobility at the time of admission to rehabilitation. Predictions were made using standardised scales that captured patients’ abilities to mobilise in a wheelchair, transfer, move about the bed and walk and included the transfer item of the Functional Independence Measure, the 5 Additional Mobility and Locomotor Items (5AML), the Mobility [Walking] Scale and the Walking Index for SCI (WISCI). One year after injury, the patients were assessed by blinded assessors using the same standardized scales. Therapists’ predictions on admission were then compared to patients’ outcomes at one year.

Results:
The correlation between treating physiotherapists’ predictions and patients’ mobility at one year was strong (Pearson’s correlation coefficients ranged between 0.53 and 0.87) with predictions being within two points of outcome at one year between 82 to 95 percent of the time. Therapists were most accurate at predicting patients’ future ability to walk using the WISCI and least accurate at predicting patients’ future ability to push a wheelchair on the flat using the 5AML.

Conclusion:
Physiotherapists can make reasonably good predictions of the future mobility of patients with spinal cord injury soon after admission to rehabilitation. This finding has important implications for goal setting, appropriate discharge planning and for equipment prescription.

O45: 11:15-11:30

Visual biofeedback balance training improves static stability and locomotion pattern in chronic motor incomplete (AIS D) spinal cord injury subjects

Tamburella, Federica; Scivoletto, G.; Molinari, M.

Spinal Cord Unit, Italy

Background:
Walking is rated as the most important goal after an incomplete spinal cord injury (SCI). Only recently it has been demonstrated that balance is a key factor for walking recovery, however no data on the efficacy of balance training in supporting walking functions in SCI subjects are available. The object of the study is to ascertain efficacy of visual biofeedback task-specific balance training (vBFB) in improving balance performances and gait capabilities in SCI subjects, in comparison to conventional over-ground rehabilitation (Rehab).

Methods:
6 subjects for vBFB group and 6 for Rehab one, with chronic SCI (at least 12 months post-injury), ASIA impairment scale grade D, able to maintain standing position unsupported and to walk at least 10 meters were enrolled. Both groups underwent 8 weeks of rehab, 5 times/week. Rehab group: 60 minutes devoted to balance and walking training; vBFB group: 40 minutes of Rehab plus 20 of vBFB. At baseline (T0), every ten sessions (T1, T2, T3), after 8 weeks (T4), one and two months after vBFB’s suspension the following data have been collected and statistically compared: Berg Balance Scale, Walking Index for Spinal Cord Injury, 6 Minute Walking, 10 Meters Walk and Timed up and go. Balance performance was assessed with stabilometric platform. Kinematic spatio-temporal gait parameters were collected using a two-dimensional motion system.

Results:
At T4, only EXP group showed a significant improvement of balance and gait features at clinical and instrumental evaluations, also maintained at follow-up examinations. For EXP group balance enhancement, already present at T1, precedes gait amelioration that became significant only at T3. Furthermore only for EXP group a significant correlation between gait and balance improvement was present.

Conclusion:
Our results supports vBFB for improving balance and gait in chronic SCI subjects, it resulted more effective in improving gait than conventional rehabilitation alone.
Effectiveness of community-based occupational therapy in meeting the re-integration needs of individuals with spinal cord injury: a pilot study

Price, P; J; May, L
Occupational Therapy, USA

Objective:
This pilot study's purpose was to investigate: 1) the efficacy of a community-based rehabilitation (CBR) program designed for individuals living in the community with spinal cord injury (SCI); 2) identify aspects of the program that made the most significant difference in the participants' lives; 3) improve program components through identifying gaps; 3) inform methods for future research.

Method:
A pre/post mixed method design was utilized for this study. Data was collected through semi-structured interviews, COPM, GAS, SWLS, CHART, and SF-36 scores. Researchers performed thematic analysis on interview data to explore participants' experiences of the therapy process and its effects on participation and life satisfaction. Descriptive statistics were utilized to analyze the findings from the quantitative instruments.

Results:
Five main themes were identified as having clinical implications within the qualitative findings. These include: 1) participant's criteria of a good life; 2) social roles and participation; 3) benefits and suggested improvements to intervention; 4) future plans and goals; and 5) meaningful activities. Descriptive analysis revealed clinically significant differences between pre and post test data for the COPM and CHART assessments. The GAS and SWLS showed a positive trend in scores.

Conclusion:
Our findings confirmed that the occupational therapy program was able to make a clinically significant change in the participant's goal achievement and participation in life. The research provides evidence that the COPM, GAS, and CHART are accurate and sensitive outcome measures for working in a community setting with a SCI population. A mixed method approach was optimal for gaining insights into the program, and how the intervention affected participants' goal attainment and independence. Critical components of the program were identified to promote individuals with SCI in achieving self-identified goals. The SF-36 and SWLS were not effective measures for this population; qualitative interview questions will be added to better capture experiences with program components. Further research is needed with a larger sample to replicate outcomes.

Effectiveness of virtual reality system TOyRA for evaluation and treatment of upper limb motor function in patients with spinal cord injury

Iris Dimbwadyo Terrer1; Peñasco-Martín1; De los Reyes-Guzmán1; Bernal-Sahún1; Polonio-López2; Gil-Agudo1
1Biomechanics and Technical Aids Department, National Hospital for Spinal Cord Injury, Spain; 2Senior Systems, INDRA Systems, Spain; 3Occupational Therapy, University of Castilla-La Mancha, Spain

Introduction:
Systems based on virtual reality could induce a better activity of the motor system and promote a cortical reorganization with the observation and imitation of actions, through the mirror neurons activation. The RV is presented as a novel and relevant implement in neurorehabilitation, allowing the development of rehabilitation treatments beyond the traditional methods of work.

Objective:
To examine the efficacy of VR system (TOyRA®) based on Inertial motion units (IMUs) as motion capture system. It can be used as a tool for assessment and treatment of upper limbs in people with cervical spinal cord injury (SCI).

Methods:
A randomized clinical trial of 10 participants, aged 18 to 60 years. All of these had sustained complete SCIs, according to the ASIA's impairment scale at the level of C5 to C8, with less than six months from SCI. Kinematic parameters were registered with TOyRA® system. The scales Barthel, FIM, SCIM, Motricity Index, Jebsen Taylor Hand Function test, Nine hole peg test were used to measure functional parameters, muscle balance, dexterity, coordination and grip function. The intervention group carried out Evaluation and Activities of Daily Living sessions with TOyRA®, like a complement to traditional therapy. The control group were treated only with Evaluation TOyRA® Sessions and traditional therapy.

Results:
Statistically significant differences were obtained after treatment in the intervention group (p<0.05) on subtest 5 of Jebsen-Taylor Hand test. Improving trends were observed in the kinematic parameters of shoulder flexion and forearm pronation as well as the SCIM and FIM scales.

Conclusions:
Subjects with TOyRA® system improved in dexterity, coordination and grip functions, and presented a trend of improvement of kinematic and functional parameters. It is necessary a study with larger numbers of patients and the development of specific tools that show us the benefits of the system.
O48: 12:00-12:15

SCIRehab: trends in practice patterns and outcomes following occupational therapy after acute SCI
Foy, Teresa
USA

Background:
The SCIRehab Project is a 5 year, 6-center research effort using the Practice Based Evidence approach to determine which SCI rehabilitation interventions are most strongly associated with positive outcomes. The purpose of this presentation is to describe predictors of motor FIM after SCI in people with motor complete SCI.

Methods:
Occupational Therapists documented intervention details about 26 Occupational Therapy (OT) activities. Level and completeness of SCI were determined using the International Standards of Neurological Classification of SCI. Regression modeling was used to predict motor FIM at discharge and at 1-year post injury for all patients and within two groups that showed no neurologic recovery from admission to discharge: cervical (C) 5-8 AIS A/B and thoracic (T) 1-9 A/B.

Results:
All 1032 patients received OT; a mean total of 54 hours (SD 37) were provided during 56,477 sessions. The most frequent OT activities were ADL and strength/endurance training. Patient characteristics predicted 65% of the variation in discharge motor FIM score; OT treatment variables added only 9%. The explanatory power of treatment variables was greater when examining homogenous subgroups. For patients with T1-9 A/B injuries, the R2 increased from 0.28 for patient variables alone to 0.58 with the addition of OT treatments. More time spent in lower body dressing, skin management, and manual wheelchair (WC) mobility training were significant positive predictors of lower body self-care components for the C5-8A/B group. More time working on clothing management/ hygiene for toileting was the strongest positive predictor of lower body self care components as well as discharge motor FIM scores for the T1-9 group. Models predicting FIM scores at 1-year post injury showed similar increases in predictive power with the addition of treatments.

Conclusion:
When examining outcomes in patients with motor complete SCI, it is important to consider OT treatments geared toward specific injury levels, as well as SCI level. OT treatments add much explanatory power to variation seen in motor FIM outcomes.

O49: 12:15-12:30

SCIRehab: trends in practice patterns and outcomes following physical therapy after acute SCI
McDowell, Shari
USA

Background:
The SCIRehab Project is a 6-center, 5-year research study using the Practice Based Evidence approach to examine clinical practice trends and determine which SCI rehabilitation interventions are most strongly associated with positive outcomes at one year post injury.

Methods:
Physical Therapists providing regular care documented time spent and intervention details about 20 physical therapy (PT) activities. Patient and injury characteristics were obtained via chart review. Level and completeness of SCI were determined using the International Standards of Neurological Classification of SCI. Regression modeling was used to predict Motor FIM at discharge and at the 1-year injury anniversary for all patients and within three groups that showed no neurologic recovery from admission to discharge: cervical (C) 5-8 AIS A/B, thoracic (T) 1-9 A/B and all patients with AIS D injuries.

Results:
58,607 hours of PT treatment (mean 57, SD=36, range 1.5-227 hours) provided during 62,953 sessions were documented for 1032 patients. The most frequent activities were strength training (10.5 hours, SD=9.9), ROM/stretching (8.0 hours, SD=8.1) and transfer training (7.0 hours, SD=5.1). Patients in the C5-8 A/B group spent the greatest amount of time working on strengthening, stretching, and transfer training. The T1-9 A/B group focused primarily on transfers, strengthening, and manual wheelchair (WC) mobility training. Patients with AIS D spent most of their time working on gait and strength training. Patient characteristics predicted 65% of the variation in discharge motor FIM score; this increased to 77% with the addition of PT treatment variables. Patients who were more participatory in PT sessions and spent more time in aquatic exercises, pre-gait and gait training, therapeutic strengthening exercises, and manual WC mobility training achieved higher scores. The increase in predictive power was much greater when examining homogenous subgroups of patients: the C5-8 A/B group increased from 36 to 61%, the T1-9 A/B group from 30 to 71%, and the D group from 36 to 54% with the addition of PT treatments.

Conclusion:
Selection and time spent in PT interventions vary based on level and severity of injury. Consideration of PT treatments is important when determining factors associated with improved motor FIM scores at the time of rehabilitation discharge and at the 1-year injury anniversary.
Effects of seated double-poling ergometer training on oxygen uptake, upper-body muscle strength and motor performance in paraplegics

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1Sweden; 2Department of Clinical Sciences, Danderyd Hospital, Sweden; 3Department of Neurobiology, Care Sciences and Society, Sweden

Background:
In wheelchair-dependent individuals with paraplegia, over 80% would benefit from health-intervention programmes due to increased risks for cardiovascular diseases. One way to reduce the likelihood of secondary complications and/or to enhance physical capacity is to add structured exercise activities throughout life.

Objective:
To study the effects of seated double-poling ergometer (SDPE) training on aerobic capacity, upper-body muscle strength, and cross-over effects on functional performance.

Methods:
Thirteen individuals with paraplegia performed 30 sessions of SDPE training during 10 weeks. Before and after the training period a) oxygen uptake was measured using the Douglas Bag system during sub-maximal and maximal double-poling ergometer tests, b) trunk, shoulder and elbow muscle strength measurements were performed during maximal voluntary contractions using an isokinetic dynamometer and c) functional tests were performed in wheelchairs included; sit-and-reach test, propelling 15 m on a level surface, propelling 50 m up a 3º incline and propelling 6 min on a 200 m indoor track. Test-retests were performed for all tests before the training began.

Results:
The average intra-class correlation coefficient for test-retest values was 0.91 (SD 0.07). Significant improvements after training were observed in oxygen uptake (22.7%), ventilation (20.7%) and blood lactate (22.0%) during maximal exertion exercises. At sub-maximal level, significantly lower values were observed in ventilation (-12.8%) and blood lactate (-25.0%). Maximal isometric trunk muscle strength (17.0%) and maximal isokinetic shoulder muscle strength (4.4%) in flexion and extension improved after training. There were significant improvements in the sit-and-reach test in forward directions (7.8%) and the 15 m sprint test (5.2%).

Conclusion:
Regular interval training on the SPDE was effective for wheelchair-dependent individuals to improve aerobic capacity and upper-body muscle strength. Results also showed that the training engaged important posterior muscle groups in the shoulder and trunk. Some cross-over effects on functional performance were also shown. Furthermore, the training did not cause any overload symptoms despite the high training intensity. Thus, this type of training on the SDPE improved several capacities beneficial to everyday life and can therefore be recommended as a safe, effective and attractive activity for individuals with paraplegia.

Long Term Outcomes

14:45-16:15
Churchill Auditorium

Long-term urinary outcomes in chronic spinal cord injured patients with transurethral indwelling catheters

Kovindha, Apichana
Rehabilitation Medicine, Thailand

Background:
Many spinal cord injured (SCI) patients in developing countries have inadequate bladder management. Therefore, we conducted a retrospective longitudinal study to reveal long-term urinary outcomes in chronic SCI with transurethral indwelling catheters (IDC), managed at Rehab ward, Maharaj Hospital, Chiang Mai, Thailand

Methods:
Demographic, urological complications and urodynamic (UDM) data were extracted from medical records of SCI patients with IDC > 1 year.

Results:
Among 138 patients with detrusor overactivity firstly detected by UDM, and 84 lost follow-up. When counting only those having follow-up UDM at least one year apart, there were 42 patients taking bladder relaxants: 31 females, 33 tetraplegics, and 29 AIS-A/B, mean duration of IDC 6 years; 40 changed IDC at least twice/month, and 60% took oxybutynin; 2 had urinary stones; 32 reported UTI and 14 experienced urinary incontinence; bladder compliance and cystometric capacity decreased and weakly correlated with duration of IDC (x); bladder compliance = -1.9865x + 17.602, R2= 0.3673; cystometric capacity = -14.399x + 323.46, R2 =0.2051; the last median bladder capacity was 250 ml and bladder compliance was 10. Moreover, those with increased bladder compliance had lower Pdet than those with decreased bladder compliance (15 vs 38.5 cmH2O, p = 0.003). Besides, all 6 not taking bladder relaxants had autonomic dysreflexia (AD) and decrease in bladder compliance; while 29/42 of those taking bladder relaxants had AD and 22/42 had increase in bladder compliance.

Conclusion:
Most of SCI patients with neurogenic detrusor overactivity using transurethral indwelling catheters took bladder relaxants but bladder compliance and capacity still decreased overtime. Increase bladder relaxant dosage to reduce detrusor pressure below 15 cmH2O may be considered to improve bladder compliance and capacity. Necessity of long-term bladder management should be more emphasized to reduce loss of follow-up and improve bladder outcomes of chronic spinal cord injured persons.
Role of external sphincterotomy on long term management of spinal cord injury patients
Gudla, Vijay Rao; Agarwal, M
Department of Urology, United Kingdom

Introduction:
Urological problems are the second most common cause of death in spinal cord injury patients. The optimal bladder management method should preserve renal function and minimize urinary tract complications. Clean intermittent catheterisation is a gold standard but it depends on lot of different conditions like level of injury, the physical ability to perform clean intermittent catheterisation, the level of care available, social restrictions and other conditions like recurrent urinary tract infections, autonomic dysreflexia or urethral stricture. Long term catheterisation is associated with multiple complications like recurrent blockages, urinary tract infections, urolithiasis and risk of malignancy. External sphincterotomy is one of the methods to keep the patients free from catheter. The aim of this study is to look at the catheter free period and associated long term complications.

Methods:
A database review of the patients undergoing external sphincterotomy in our hospital was done.

Results:
A total of 24 patients were included in the study (12 with paraplegia, 11 with tetraplegia). The mean follow up after the first sphincterotomy was 13.75 years (range 1-36). 16(67%) patients during the follow up needed the repeat sphincterotomy. 16 (67%) patients with the average duration of 16(1-30) years were catheter free. 3 (13%) patients went to have ileal conduit diversion, 5(20%) patients were converted into long term catheters.

Conclusion:
External sphincterotomy has an important role in the treatment of the spinal cord injury patients with a neuropathic bladder. It may be the treatment of choice for patients with a hypereflexic bladder and bladder outflow obstruction who are unable to catheterize themselves but can use condom drainage. However it may require ongoing surveillance and repeated revision.

Long term ventilation of SCI patients, experiences within 25 years of treatment
Hirschfeld, S; Thietje, R
SCI Centre Hamburg, Germany

Study Design:
Monocentric cohort study

Objective:
To investigate the differences by comparing ventilated high tetraplegic patients with non ventilated tetraplegic patients concerning type, course, complications and mortality.

Setting:
Level 1 trauma center

Methods:
Ventilated patients with traumatic and non traumatic SCI were included. Data were collected from 1985 to 2010 and stored in the Hamburg Database for readmission. All patients were comprehensive care patients with unexceptional stationary treatment. Data were calculated by using ÷2 –Test (Fisher’s exact-Test) and Student’s t-test.

Results:
110 ventilated and 994 non ventilated tetraplegic patients were included, 77% vs. 23% male : female, 84% vs. 16% traumatic : non traumatic.

Ventilated tetraplegic patients with ASIA:
A: 78%
B: 9%
C: 11%
D: 2%

and non ventilated tetraplegic patients with ASIA:
A: 38%
B: 9%
C: 35%
D: 18%

Further extracts among others:
Mortality non ventilated patients: 5%, ventilated patients: 38%. Av. Survival time in both groups 7.8 years. The major complication of ventilated patients is pneumonia, for non ventilated patients decubitus. Length or stay SCI rehab ventilated patients 388 d, non ventilated patients 175 d.

Conclusions:
Treatment of long term ventilated patients was previously only possible on intensive care units. Nevertheless 2/3 of these patients died within the first year. Optimization of intensive medical care from the accident scene to the clinic have lead to an increase in the number of ventilated tetraplegic patients. As a result of advances in technology and patient care this can now be carried out in out-of-hospital setting. This study shows the differences between ventilated and non ventilated patients. This is one reason why the german speaking medical society of paraplegia (DMGP) published recommendations for out-of-hospital treatment concerning ventilated SCI patients in 2009. This paper is considered the standard in Germany and the care should not fall below the recommended level.
Prediction of functional prognosis after contusive spinal cord injury in common marmosets by novel in vivo MR imaging technique: Myelin map

Konomi, Tsunehiko1; Fujiyoshi, K1; Hikishima, K1; Tsuji, O1; Iwanami, A1; Kobayashi, Y1; Takano, M1; Nori, S1; Yasuda, A1; Okano, H1; Toyama, Y1; Nakamura, M1

1Department of Orthopaedic Surgery, Japan; 2Department of Physiology, Japan

Background:
Myelin map MR imaging is a novel technique based on restricted diffusion of water molecular in myelin sheath and reflect the myelin condition in the central nerve system. The purpose of the present study is to determine whether Myelin map can depict myelin disruption and predict the functional prognosis after contusive spinal cord injury (SCI) in non-human primate.

Methods:
Graded contusive SCI was induced by weight-drop method as previously reported (Iwanami et al, 2005). In brief, one of three different weights (15g; mild, 17g; moderate or 20g; severe) was dropped at the C5 level on female adult common marmosets (n=9). Functional recvoery was evaluated using the following tests: original behavioral score, spontaneous motor activity, bar grip test and cage climbing test. Under general anesthesia, MRI was performed using 7.0 Tesla-MRI (Bruker, Germany) at 1, 3 and 10 weeks after SCI and myelin map was reconstructed. Histological examinations including Luxol Fast Blue (LFB) and Eriochrome Cyanine (EC) staining were performed thereafter. LFB and EC positive myelinated areas were quantified by Image J (ver. 1.43) and compared to the data of functional scores and Myelin map at the lesion epicenter among the three groups.

Results:
Quantitative Myelin map revealed that the myelinated areas decreased significantly as the severity of SCI increased, which was consistent with the histological findings of LFB and EC staining. Significant differences in several motor performances were observed among the three groups. Spontaneous motor activities, original behavioral scores and cage climbing tests were closely correlated with the residual myelinated areas at the lesion epicenter that were obtained by Myelin map.

Conclusion:
Previously we demonstrated that the number of motor neurons and the myelinated areas decreased significantly as the severity of SCI increased in non-human primates. The animals after mild and moderate SCI showed gradual recovery in motor performance, whereas almost no recovery was observed in severe SCI model. In the present study, we demonstrated that about 20 % of residual myelinated area based on the data of in vivo Myelin map at 1 week after SCI could be a prognostic indicator of functional recovery. Taken together, myelin map could be an essential tool for evaluating injured spinal cord non-invasively.

A dual role for sclerostin after SCI: therapeutic target in the acute phase and biomarker of osteoporosis severity in the chronic phase

Battaglino, Ricardo1; Sudhakar, S2; Lazzari, A3; Garshick, E4; Morse, LR5
1Skeletal Biology, USA; 2Spaulding-Harvard SCI Model System, USA; 3Primary Care Section, USA; 4Pulmonary and Critical Care Medicine Section, USA; 5Department of Physical Medicine and Rehabilitation, USA

Spinal cord injury (SCI) results in profound bone loss due to muscle paralysis and the inability to walk. Sclerostin, a Wnt signaling pathway antagonist produced by osteocytes, is a potent inhibitor of bone formation. Short-term studies in rodent models have demonstrated increased sclerostin in response to mechanical unloading that is reversed with reloading. We analyzed circulating sclerostin levels in 167 men with varying degrees of SCI who were 1 year or more after injury. We report that sclerostin levels are significantly elevated in subjects less than 3 years post-injury compared to subjects injured for 3 years or more. Subjects who were unable to walk had the highest levels of circulating sclerostin, suggesting that the degree of weight-bearing modulates the immediate sclerostin response to paralysis and mechanical unloading. We found significant differences in bone density based injury duration only in subjects injured 5 years or more. Thus, sclerostin elevation precedes bone loss, suggesting a mechanistic link. In subjects 5 years post-injury or more, sclerostin levels were positively associated with lower extremity bone density and bone mineral content. Bone density and sclerostin levels were lower in subjects using a wheelchair compared to those that walk. These data support our hypothesis that sclerostin levels in SCI are increased during the acute phase (less than 3 years post-injury) in response to mechanical loading. This response is time-limited and as bone loss progresses, circulating sclerostin is positively associated with bone density, and is lowest in subjects with severe osteoporosis. These findings support a dual role for sclerostin after SCI: therapeutic target in acute SCI and biomarker of osteoporosis severity in chronic SCI.
The effect of injury level on circulating inflammatory cytokine responses to wheelchair propulsive exercise.

Paulson, TAW; Goosey-Tolfrey, VL; Lenton, JP; Leicht, CA; Bishop, NC
School of Sport Exercise and Health Sciences, United Kingdom

Background:
Acute bouts of exercise induce the release of the inflammatory cytokine IL-6 from contracting skeletal muscle. This is dependent on exercise intensity and duration and related to falls in muscle glycogen content. Adrenaline infusion also increases muscle expression and plasma levels of IL-6. Increases in plasma IL-6 levels are associated with post-exercise increases in circulating concentrations of the anti-inflammatory cytokine IL-10. The anti-inflammatory environment promoted by regular exercise is associated with the prevention of chronic low-grade inflammatory conditions including insulin resistance and cardiovascular disease. This study investigated the effect of an acute bout of wheelchair propulsive exercise on circulating concentrations of IL-6 and IL-10 in individuals with thoracic and cervical level injury.

Methods:
Twenty six wheelchair-sportsmen (8 tetraplegic (TETRA, C5-7); 10 paraplegic (PARA, below T6) and 8 non-spinal cord injured (NON-SCI)) performed a 30-min submaximal exercise test followed by a graded exercise test to exhaustion on a motorised treadmill.

Results/Discussion:
There was no difference in resting IL-6 concentrations between groups. Immediately post and 30 min post-exercise IL-6 concentrations were significantly greater than resting values for both NON-SCI (P<0.01) and PARA (P<0.01). IL-6 concentrations in TETRA remained close to resting levels. Both PARA (41%) and TETRA (74%) showed elevated IL-10 concentrations compared with NON-SCI at rest (P>0.05); these differences were significant at post-exercise (P<0.05). In conclusion, high intensity wheelchair exercise increased circulating levels of IL-6 and IL-10 in individuals with thoracic and cervical level injury.

Improved assessment of contact heat evoked potentials in spinal cord injured subjects

Haefeli, J; Kramer, JL; Curt, A
Switzerland

Background:
The application of segmental contact heat evoked potentials (CHEPs) to assess conduction in ascending spinal pathways can improve the resolution of pathology close to the level of spinal cord injury (SCI). The objective of this study was to assess the influence of changes in baseline temperatures of contact heat stimulation on cortical evoked response parameters and perceived pain sensations after SCI.

Method:
18 healthy and 23 SCI subjects participated in the study. 2 different baseline stimulation temperatures (35°C and 42°C) were applied with target stimulation intensity of 52°C. In healthy subjects stimuli were applied to the dorsum of the hand and in patients to a total of 41 dermatomes adjacent to the neurological level of injury. SCI subjects were further examined with pinprick sensation according to the ISNCSI. N2P2-amplitudes of the evoked responses and the corresponding pain ratings were compared between the conditions in relation to pinprick sensation.

Results:
In healthy subjects the N2P2-amplitudes and pain rating significantly increased after stimulation with 42°C baseline temperature compared to 35°C. Similar, in SCI subjects the increase in baseline temperature resulted in an increase in amplitude and pain rating. With increased baseline stimulation dermatomes of normal, impaired and absent pinprick sensation could be differentiated whereby pain rating scores where only different between absent and impaired/ normal pinprick sensation. Increased baseline stimulation further evoked a response in some dermatomes previously rated with an absent pinprick sensation.

Conclusion:
The acquisition of CHEPs can be enhanced in both healthy and SCI subjects by an increase in baseline temperature; this can in part be explained by the reduced total duration to reach the target stimulation intensity leading to an enhanced synchronization of afferent volleys. Increased baseline stimulation revealed sensory sparing in dermatomes with absent pinprick sensation and CHEPs amplitudes allowed a reflection of pinprick sensation.
A pilot study to the altered skin temperature circadian rhythm in spinal cord-injured individuals

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1Physiology, Netherlands; 2Research Institute for Sport and Exercise Sciences, United Kingdom

Background:
Individuals with spinal cord injury demonstrate an altered circadian rhythmicity in core body temperature and the sleep-wake cycle. The impaired afferent and efferent information from the skin below the lesion may contribute to these changes in circadian rhythm.

Purpose:
To assess the circadian rhythm in core body temperature and skin temperature in spinal cord injured individuals (above and below the lesion) and age-and gender matched able-bodied controls.

Methods:
Intestinal core body temperature (telemetry system), skin temperature (wireless sensors, iButtons), and physical activity level (activity monitor) were measured continuously and simultaneously in 17 SCI individuals (8 tetraplegics and 9 paraplegics) and 10 able-bodied controls for 24-h. Two way repeated measures ANOVA was performed for preliminary descriptive statistics of core body and skin temperature during daytime and night time.

Results:
Differences in circadian rhythmicity in core body temperature between controls and SCI were only present during the night time (interaction; p=0.032). During daytime, changes in skin temperature (trunk above lesion (TrunkAL), trunk below lesion (TrunkBL), lower limbs (LL)) were comparable between SCI and controls, although average TrunkBL skin temperature below the lesion was higher in different between controls and SCI (TrunkBL; p=0.002, ) and SCI LL; skin temperature, was lower compared to controls ( p=0.002). During night time, a (borderline) significant interaction-effect was observed between able-bodied controls and SCI for all measurements below lesion (LL; p=0.001, TrunkBL; p=0.052). More specifically, skin temperature in SCI individuals below the lesion did not demonstrate a plateau, but continued to increase throughout the night.

Conclusion:
Taken together, spinal cord-injured individuals demonstrate a disturbance in the circadian rhythm of core body temperature, characterised by a different pattern during night time. These alterations in core body temperature coincided with a different pattern in skin temperature below the spinal cord lesion during night time. Detailed chronobiology analysis is required to clarify these unique and interesting observations.

Complete absense of evening melatonin increase in tetraplegic individuals

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1Department of Rehabilitation, Netherlands; 2Department of Physiology, Netherlands; 3Research Institute for Sports and Exercise Science, United Kingdom

Objective.
Individuals with a spinal cord injury (SCI), especially tetraplegics, experience poor sleep quality, and this may be related to impaired control of circadian rhythmicity. Melatonin is an important component of circadian control and its evening rise is especially important for the initiation of sleep in humans. Therefore, we examined the evening onset of melatonin secretion in people with a complete traumatic cervical (tetraplegic) and thoracic (paraplegic) SCI, as well as age- and sex-matched able-bodied controls.

Methods.
Multiple samples of salivary melatonin were obtained during the evening hours and analyzed by ELISA methods in 10 controls, 9 paraplegic (spinal cord lesion between T4-T12, AIS A) and 6 tetraplegic (spinal cord lesion between C4-C7, AIS A) SCI individuals. Sleep quality was assessed with the Pittsburg Sleep Quality Index and Epworth Sleepiness Scale in all participants. Ambulatory accelerometry was employed to account for any changes in activity level.

Results.
A significant group versus time interaction was evident in melatonin levels (p=0.022). Interactive effects of group and time were found for melatonin levels (p=0.022). Between 19:00-23:00 h, melatonin levels increased significantly from 2.59±1.04 to 10.62±4.59 pg/ml in controls and from 4.28±3.28 to 13.10±7.39 pg/ml in paraplegic SCI individuals, respectively (both P<0.001). However, tetraplegic SCI individuals showed no significant change in melatonin levels (from 5.25±3.72 to 2.41±1.25 pg/ml) during the evening. Decreased sleep quality was more prevalent in SCI individuals with tetraplegia (83%) and with paraplegia (75%) compared to controls (20%) (P=0.02).

Conclusion.
Unlike in controls and paraplegic SCI individuals, the evening increase in melatonin concentration was completely absent in tetraplegic SCI individuals. This provides unique insight into sleep regulation in humans and provides better understanding of the poor sleep quality in tetraplegic SCI individuals.
High sensitivity multiplex cytometric bead array reveals deficient Th2 response in early spinal cord injury (SCI)

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1South Australian Spinal Cord Injury Research Centre, Australia; 2Robinson Institute, Australia; 3South Australian Spinal Cord Injury Service, Australia

Background:
Spinal cord injury results in significant trauma and inflammation originating at the injury site as well as from systemic compartments. A key event in the maintenance of this inflammatory response is the activation of the cell-mediated adaptive immune system resulting in an inflammatory cascade.

Aims:
To examine:
1. Commonality and uniqueness of pro-/anti-inflammatory cytokine and pro/anti-apoptotic protein balance following spinal cord injury; and
2. Relationships between cell-mediated T-helper 1 (Th1) and humoral Th2 immune responses.

Design:
Prospective, controlled, single blind

Methods:
Males (18-55 years, traumatic SCI, AIS A-D, C2-T12) and healthy male individuals (CON) participated. A bead based multiplex sandwich immunoassay (Millipore) read with a Luminex system (Luminex Map Technology) determined concentrations of CCL2, CCL3, CCL5, CXCL1, CXCL8, CXCL10, CCL22, G-CSF, GM-CSF, TNF-α, IL-1β, IL-6, IL-17. Th1 and Th2 responses were assessed in terms of CCL5 (Th1 and Th2) and CCL22 (Th2).

Sera were collected at weeks 3, 6, 12, 26 and 52 (SCI), or entry (CON).

Results:
Nine patients (19-49, 29±11 yrs, 3 AIS A-B, 6 tetra) participated, as did 9 CON (21-57, 35±12 yrs; P>0.05). Patients had higher mean serum CCL5 levels than CON (8,224±5177; 5,094±450 pg.ml⁻¹ P= 0.04), whereas mean serum CCL2 levels approached significance (SCI 696±306; CON 552±113 pg.ml⁻¹ P=0.08). Differences between other chemokines and canonical cytokines were non significant. CON values for CCL2 associated with CCL5 (CON r=−0.69, P=0.04) and also, CXCL8 (CON r= 0.73 P=0.03). In contrast to the strong relationships observed between Th2 markers and parameters of pro-inflammation and apoptosis in controls, the corresponding SCI data showed no significant relationships.

Conclusion:
This paper investigates links between Th-cell polarization and the mechanism of action of chemokines and shows findings which are indicative of a deficient Th2 response. These findings provide a starting point for investigations of immunogenetic susceptibility for proinflammation early after SCI.
Pre-clinical validation of adult olfactory bulb ensheathing glia for the treatment of patients with spinal injuries

Ramon-Cueto, Almudena¹; Muñoz-Quiles, C²
¹Neural Regeneration Unit, Spain; ²Spain

Background:
Olfactory ensheathing glia or cells (OEG or OEC) enfold olfactory axons in their course through the olfactory mucosa and bulb. There are two distinct types of OEG: one located in the periphery (mucosa) and the other within the CNS (olfactory bulb). Mucosal and bulbar OEG are different in gene expression, proliferative properties in vitro, interaction with the host after transplantation and ability to promote functional and histological repair after spinal cord injury (SCI). These differences confer olfactory bulb ensheathing glia (OB-OEG) superior properties for SCI repair.

Methods:
For the translation of any pre-clinical strategy to humans, the validation pathway should meet the International Campaign for Cures of Spinal Cord Injury (ICCP) guidelines (http://www.icord.org/ICCP/).

Results and conclusions:
Adult purified OB-OEG transplantation fulfills ICCP criteria, which include reproducibility, robustness, fundamental nature and relevance of the therapeutic approach. The capability of these cells to promote positive effects in animals with SCI has been corroborated independently by several groups. These effects include axonal regeneration across the lesion and beyond, survival and tissue sparing, stimulation of angiogenesis, remyelination, neuroprotection and recovery of motor and sensory functions. Also, variations on the way that adult OB-OEG were applied have provided similar results, and their healing effect was repeatable in different SCI types (complete transection, segment removal, contusion, compression, unilateral CST lesion, dorsal column transection or crush, photochemical, heat or demyelinating lesions) and in different species (rat, dog, monkey, pig), which demonstrates the robustness and the fundamental nature of this strategy. The relevance to human application has also been validated by testing the reliability of primate and human OB-OEG and by determining the compatibility with humans of the timing for the intervention, the surgical procedures and the functional assessment. Finally, an autologous treatment using OB-OEG is viable what guarantees the safest scenario to patients. Thus, the pre-clinical validation of adult OB-OEG for SCI repair has been accomplished and, accordingly, the next logical step should be the bench to bed translation of this experimental therapy. An account of these conclusions were published in Experimental Neurology 229 (2011): 181-194.

Effect of hind-limb cycling on severity of orthostatic hypotension and autonomic dysreflexia in rats with SCI

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ICORD, Canada

Background:
Spinal cord injury (SCI) above the major splanchnic sympathetic outflow causes a host of cardiovascular complications, of which autonomic dysreflexia (AD) and orthostatic hypotension (OH) are two of the most potent. Lower-limb exercise provides a novel potential therapeutic aid by which the degree of cardiovascular dysfunction may be attenuated.

Aim:
To determine the effect of acute hind-limb cycling exercise on severity of OH and AD in a rodent model of SCI.

Methods:
Twelve male Wistar rats underwent complete transection of the spinal cord at T3. Group 1 (n = 5) acted as controls (SCI_ONLY) and group 2 (n = 7) received daily hind-limb cycling exercise (SCI_EX; 2 x 30 min sessions, 10 min break between sessions). Hind-limb cycling was initiated on day 6 post-injury and lasted for 5 days. On day 12, all animals were assessed for systolic blood pressure (SBP) at rest and in response to two episodes of visceral stimulation (colorectal distension, a known trigger of AD in rats with SCI) and two periods of orthostatic challenge (head-up tilt 90 deg). SBP was measured beat-to-beat via a carotid artery cannula.

Results:
Resting SBP was not different between SCI_ONLY and SCI_EX (115 ± 6 vs. 124 ± 9 mmHg, p = 0.486). In response to colorectal distension, SCI_EX demonstrated an attenuated increase in SBP compared to SCI_ONLY (20 ± 6 vs. 41 ± 6 mmHg, p = 0.037). In response to head-up tilt, SCI_EX demonstrated a minimal reduction in SBP compared with SCI_ONLY (-3 ± 6 vs. -35 ± 4 mmHg, p = 0.001).

Conclusion:
We show for the first time that an acute bout of hind-limb cycling exercise attenuates the severity of AD and abolishes OH in rats with T3 SCI. These findings provide compelling evidence that lower-limb exercise may improve cardiovascular function in the acute period following SCI.
The allogeneic transplantation of neural stem/progenitor cells into injured spinal cord in adult common marmosets

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1Orthopaedic Surgery, Japan; 2Physiology, Japan

Background:
There were many reports that allograft of neural stem/progenitor cells (NS/PCs) promoted functional recovery in rodent animal models of spinal cord injury (SCI). However, it is absolutely necessary to inspect allogeneic transplantation of NS/PCs in nonhuman primates model of SCI before clinical trial. Therefore, the objective of the present study is to investigate the effectiveness and the safeness of allograft of NS/PCs into injured spinal cord in common marmosets (Callithrix jacchus).

Design:
Translational SCI research using cervical contusion model in common marmosets.

Methods:
Adult female common marmosets received cervical contusive injury using modified NYU impactor. 14 days after SCI, NS/PCs derived from the fetal marmoset were transplanted into the epicenter of injured spinal cord and PBS was injected instead of NS/PCs in the vehicle control group. The animals were subcutaneously injected with FK506 (1.0 mg/kg) daily. Motor function was assessed by original open field scoring scale (Kitamura et al, PLoS One 2011), bar grip test and cage climbing test. The spinal cord tissues were extracted 12 weeks after transplantation and processed for immunohistological analyses.

Results:
The grafted group showed a better performance in the original open field score, grip strength and cage climbing test compared to the vehicle control group. A large amount of the grafted cells were survived and differentiated into neurons, astrocytes and oligodendrocytes. There was no tumor formation in all the animals for 12 weeks after transplantation.

Conclusion:
This is the first study to report the efficacy and the safeness of the allogeneic NS/PCs transplantation for SCI in nonhuman primates.

Comparative study of neural stem cell transplantation for spinal cord injury in between young and aged mice.

Morito, Takano1; Takahashi, Yuichiro1; Yasuda, Akimasa1; Nori, Satoshi1; Nishimura, Soraya1; Iwai, Hiroki1; Tsuji, Oshiko1; Toyama, Yoshiaki1; Okano, Hideyuki1; Nakamura, Masaya1
1Orthopaedics Surgery, Japan; 2Physiology, Japan

Introduction:
To reflect the transition to aging society, it has been pointed out the number of patients with SCI over 60 years old tends to increase. Therefore, establishment of the treatment for elderly patients with SCI is an urgent need. In this study, we compared the therapeutic effects of Neural stem cells (NSCs) transplantation for SCI in young adult (2-month-old) and aged (15-month-old) mice.

Methods:
SCI was induced by IH impactor (70kDyn) in both young and aged mice, fetal brain derived NSCs of CAG-fluc-venus Tg mice were transplanted into the lesion epicenter at 9 days after SCI (young- and aged TP groups). In the vehicle control group of both young and aged mice, PBS was injected into the lesion site (young- and aged –control groups). Behavioral analysis was performed using BMS score and the survival of the grafted cells was examined using bioluminescence imaging. For histological analysis, the spinal cords of two groups were resected and analyzed by immunohistochemistry.

Results:
The BMS score of the aged-control group was significantly lower than that of the young-control group. Interestingly, compared to the aged-control group, significantly better functional recovery was observed in the aged-TP group, which was similar to that observed in the young-TP group. The survival rate of grafted NSCs in the aged-TP group was significantly higher than that in the young-TP group. In the aged-TP group, the grafted NSCs predominantly differentiated into neurons and less into astrocytes. Furthermore, RT-PCR analysis of inured spinal cord harvested at 2 weeks after SCI revealed lower gene expression of sema3a, robo3, IL-6 and CTNF, and also higher gene expression of hepatocyte growth factor in the aged-control group compared to the young-control group.

Conclusion:
Taken together, the difference in the microenvironment between young and aged SCI plays a role in functional recovery after NSCs transplantation. We conclude that advanced age does not prevent a beneficial response to NSCs transplantation following experimental spinal cord injury.
**Health Economics**

**09:00-10:20**

**Whittle Room**

**O65:** 09:00-09:20

**Economic impact of traumatic spinal cord injury in Canada: total economic burden and potential cost-avoidance by preventing secondary complications**

Rivers, Carly; Noonan, V; Trenaman, L; Joshi, P; Dvorak, M; Krueger, H

**Canada**

**Background:**

An estimated 1,400 Canadians survive a traumatic spinal cord injury (tSCI) per year and suffer a high rate of preventable secondary complications. We aim to determine the economic burden of tSCI in Canada, and evaluate potential costs avoided by reducing the incidence of secondary complications, particularly pressure ulcers (PUs) and urinary tract infections (UTIs).

**Methods:**

Health economics analysis. This study uses information from academic/grey literature on the incidence, prevalence, resource use, survival and quality of life of individuals with tSCI to estimate the lifetime economic burden of a tSCI and potential costs avoided if the incidence of secondary complications (e.g., PUs/UTIs) can be reduced. Direct and indirect costs are calculated in estimating the lifetime economic burden of a tSCI while the focus is on direct costs avoided by reducing the incidence of secondary complications.

**Results:**

Total lifetime economic burden of a tSCI occurring at age 35 is $1.47-$3.03 million dollars; 50% are direct costs. The total annual economic burden of tSCI in Canada is estimated at $2.67 billion. If Grade II-IV PUs and hospitalisations for UTI were completely eliminated in the Canadian tSCI population, $197 and $61 million in direct care costs, respectively, could be avoided annually. Reductions of 80% in PU incidence/hospitalisations for UTI could result in cost-avoidance of $147 and $49 million annually. Other significant secondary complications that should be addressed include neuropathic pain, autonomic dysreflexia, depression and respiratory issues. Results from a current survey of Canadians with SCI assessing the personal impact of secondary complications will be included in the presentation.

**Conclusion:**

The economic burden associated with tSCI is substantial. Advances in the prevention of secondary complications can reduce the burden on tSCI patients while reducing health care costs. These advances will likely be relevant to other patient groups, leading to even further patient and economic benefit.

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**O66:** 09:20-09:40

**Spinal cord injury and durable employment: Potential interventions to prevent post-injury job loss**

Murphy, Gregory; O’Hare, Mary Alice

**Public Health, Australia**

**Background:**

In Australia, at any point in time post-discharge, approximately 43% of SCI survivors report being employed. A clear majority (median of 62%) report having worked at some time post-injury, which implies a relatively high incidence of job loss following initial RTW.

**Aim:**

The aims of this three-phase research program were to (1) identify the reported factors that led to post-injury job withdrawal among those living with SCI (2) identify potential interventions to minimize the impact of the reported job withdrawal factors and (3) evaluate the potential benefits and drawbacks of the proposed interventions.

**Methods:**

Using a combined survey and focus group methodology, 30 SCI participants were interviewed about the details of their post-injury job withdrawal (Phase 1); next, 18 rehabilitation service providers brainstormed potential interventions to minimize the impact of the job withdrawal catalysts (Phase 2); finally, 35 SCI participants evaluated the potential benefits and drawbacks of the potential interventions (Phase 3).

**Results:**

Phase 1: The job-withdrawal factors found to significantly and negatively influence current post-injury full-time employment levels were: disability level; bowel/bladder management; lack of career progression; and lack of workplace social support. Phase 2: Rehabilitation providers (clinicians and community rehabilitation professionals) furnished the following potential interventions: better access to pain management team; hospital-led unit dedicated to return-to-work; employer/employee education on providing effective workplace support to SCI survivors; additional post-placement physical workplace assessment and review of equipment. Phase 3: Ratings of the potential benefits of the proposed interventions by SCI survivors were high, ranging from 53% to 90%. Interestingly, however, participants perceived the potential interventions as being more beneficial to others relative to themselves (i.e., subjective norms were higher).

**Conclusion:**

The majority of the potential interventions identified by the rehabilitation providers were viewed as providing benefit to SCI survivors, if implemented.
O67: 09:40-10:20

From evidence to policy to practice? Implementation of a World Health Organization (WHO) report
von Groote, Per; Bickenbach, JE
Switzerland

Background:
In the past, the World Health Organization (WHO) has been criticized for the lack of appropriate use of existing research evidence in its World Health Report's recommendations. In addition, no research to date has analyzed the implementation of those WHO recommendations from a World Health Report that are partly founded on the lived experience of people with disabilities. The International Perspectives on Spinal Cord Injury (IPSCI) is a WHO report that provides a single global perspective on the lived experience of people with SCI. IPSCI recommendations not only lie in the medical and health rehabilitation area, but also in social integration, equality of opportunity, health access, self-determination and quality of life of people living and aging with SCI. The processes of development, dissemination and implementation of IPSCI offers health policy research the unique opportunity to analyze the link between critically appraised quantitative clinical and qualitative social science evidence to policy so that the evidence directly and positively can impact policy reform.

Specific aims:
The specific aims are to a) describe the process of producing a WHO report taking IPSCI as a case in point, including the appraisal of the evidence base of recommendations made; b) to lay out the theoretical framework behind implementation science; c) to give an overview of existing implementation guidelines and tools in health; and d) to critically appraise their potential for application to IPSCI implementation.

Methods:

Results:
The review presents multiple concepts and strategies behind implementation science in contiguous and disparate research and implementation guidelines and tools in use in the field of evidence informed health policy. In general, quantitative evidence is the basis of implementation efforts in health policy. Related guidelines and tools show little relevance to policy recommendations that are based on qualitative evidence and the lived experience of people with disabilities and none are specifically designed to be used in WHO health report implementation. There is a strong need to develop, test and distribute implementation guidelines and tools for WHO health reports such as IPSCI.

O68: 10:00-10:20

Reasons for Extending Length of Stay in Inpatient Spinal Cord Rehabilitation
Flett, Heather; Yee, JA; Guy, K; Cournoyea, N; Zee, J; Burns, AS
Spinal Cord Rehab Program, Canada

Background:
Improving patient flow across the continuum of care is a priority in healthcare settings globally. In order to maximize patient flow, spinal cord rehabilitation programs have focused on reducing length of stay (LOS) and facilitating timely discharge into the community.

Objective:
To examine the reasons that LOS were extended in an in-patient spinal cord injury rehabilitation (SCR) setting.

Methods:
Benchmarking of SCR LOS was completed using national comparator data. A “tentative discharge date” was determined using a standardized formula to establish objective LOS targets for specific patient groups based on diagnostic categories (trauma/non-trauma), admission Functional Independence Measure motor score, and age. SCR program discharge criteria and team consultation were used to develop six categories of reasons for extending LOS as follows: 1. Continued need for inpatient SCR; 2. Community services not available; 3. Housing not available; 4. Equipment not obtained; 5. Service interruption due to change in patient health status; 6. Logistical issues. A patient census tool was implemented to track extensions to target LOS and associated reasons for extension.

Results:
139 individuals were admitted for inpatient SCR from April 1- December 31, 2011. 50 individuals (36%) had a LOS above target with a total of 94 reasons for extending LOS. The most frequent reasons for extending LOS were: equipment not obtained (31%), continued need for inpatient SCR (27%), service interruption (17%), and discharge housing not available (16%). Individuals with non-traumatic SCI were more likely to have LOS extended particularly due to continued need for inpatient SCR.

Conclusions:
Objectively setting and monitoring LOS targets while examining the underlying reasons for extension enables organizations to better understand individual patient needs in preparation for discharge as well as identifying potential system barriers.
Free Papers  
10:45-12:45  
Churchill Auditorium

O69: 10:45-11:00  

**Cardiac Arrhythmias the First Month After Acute Traumatic Spinal Cord Injury**  
Bartholdy, K1; Sørensen, TB2; Malmsjö, L1; Ballegaard, M1; Krassiovskii, A1; Svendsen, JH4; Kruse, A1; Welling, KL8; Hansen, B1; Sørensen, FB1  
1Clinic for Spinal Cord Injuries, Denmark; 2Clinic for Spinal Cord Injuries and Dept. of Cardiology, Denmark; 3Clinic for Spinal Cord Injuries and Dept. of Clinical Neurophysiology, Denmark; 4Department of Clinical Neurophysiology, Denmark; 5Western Department of Medicine, Div. Phys. Med. & Rehab., ICORD, Vancouver and Spinal Cord Program, GF Strong Rehabilitation Centre, Canada; 6Department of Cardiology, Rigshospitalet, Faculty of Health Sciences, Denmark; 7Spine Section, Department of Orthopedic Surgery, Denmark; 8Department of Neuroanaesthesiology, Denmark

**Background/Objective:**  
Cardiovascular problems including arrhythmias remain a clinical challenge in the management of acute traumatic spinal cord injury (SCI). Still, there is a lack of knowledge regarding the characteristics of arrhythmias in patients with acute traumatic SCI. The aim of this longitudinal observational study was to investigate the occurrence of cardiac arrhythmias in patients with acute traumatic SCI.

**Methods:**  
25 patients were early after injury Holter monitored for 24 hours. Additional Holter recordings were performed one, two, three and four weeks after SCI. 12-lead ECGs were obtained shortly after SCI and at 4 weeks. During Holter recordings procedures performed were documented.

**Results:**  
Bradyarrhythmia (heart rate < 50 bpm) was present in 26-37% of the cervical SCI patients (n=19) within the first 14 days. In the following 14 days the occurrence increased to 33-41%. Bradyarrhythmia was less frequent in the thoracic SCI group (n=6), occurring mainly in younger patients. However these results were not statistically significant. Several atrioventricular blocks and three cardiac arrests were observed in the cervical group as well as a statistically significant tendency to short lasting supraventricular tachycardia (SVT) peaking in the middle of the observation period. Sinus node arrests were seen in both patient groups and were among other things in the cervical group due to tracheal suctioning. 16% of the cervical patients received a pacemaker due to uncontrolled bradyarrhythmia.

**Conclusion:**  
Many cervical SCI patients experience arrhythmias such as bradyarrhythmia, sinus node arrest, supraventricular tachycardia and more rarely cardiac arrest the first month after SCI. Apart from sinus node arrests and limited bradyarrhythmia no arrhythmia were seen in thoracic SCI patients. While the cause of bradyarrhythmia, sinus node arrest and AV-block is well described, the mechanisms and cause of SVT remain unclear and require further investigation.

O70: 11:00-11:15  

**Body mass index do not predict cardiovascular disease risk after spinal cord injury**  
Kerstin, Wahman1; Flank, P2; Levi, R2; Fahlström, M2  
1Karolinska Institutet/Neurobiology, Care Sciences and Society, Sweden; 2Umeå University/Department of Community Medicine and Rehabilitation, Sweden

**Background:**  
The prevalence of cardiovascular disease (CVD) and its risk factors, diabetes mellitus (DM), hypertension (HTN), dyslipidemia (DL) as well as overweight and obesity has been reported to be increased in the spinal cord injury (SCI) population. In the general population body mass index (BMI), with a cut-off score of 25 and above, is widely used in clinical settings as an indicator for overweight/obesity and increased CVD risk. However BMI ¡Ý25 has been questioned as a valid level in the SCI population and new lower cut-off scores at levels 22 and 23 have been suggested. Thus, the aim of the study was to assess CVD risk factors at different BMI levels in this population.

**Method:**  
Study participants were 135 individuals with wheelchair-dependent traumatic paraplegia (AIS A-C), age range 18-79 years and ¡Ý1 year post injury. CVD risk factors as diabetes mellitus (DM), hypertension, and a serum lipid profile were analyzed by six different BMI levels.

**Results:**  
The examined CVD risk factors were found to be common at all BMI levels. It was especially true for DL that was found in 80% of the participants regardless of BMI levels.

**Conclusion:**  
Higher BMI levels seem to be associated with HTN and DM. However, DL was prevalent through all BMI levels. The suggested lower SCI-specific BMI cut-off scores at 22 and 23 did not automatically detect CVD risk after SCI. When assessing CVD risk in clinical settings, BMI must be complemented with at least blood pressure and serum lipids. Further studies are required to explore the need for SCI-specific CVD screening as well as CVD prevention.
O71: 11:15-11:30

Body composition determined by bioimpedance analysis in patients with spinal cord injury: a comparison of two devices
Perret, C; Flury, I; Zangger, C; Baumberger, M
Switzerland

Background:
The determination of body composition based on bioimpedance analysis (BIA) is a non-invasive, simple and well established method. An advantage of BIA is the unproblematic use as bedside measurement for patients with a spinal cord injury (SCI). For this purpose, several products from different manufacturers are on the market. The aim of the present study was to compare two such commercially available BIA devices (Bodystat vs. Inbody) concerning measurement reproducibility and feasibility of handling in daily clinical practice.

Methods:
16 male in-house patients with SCI were investigated. BIA was performed with both devices consecutively in randomized order. Measurements were repeated on a second occasion within one week. For data analysis fat mass, fat free mass and total body water were used. For each device the coefficient of variation (CV) was calculated to determine the measurement reproducibility. To compare the two devices Bland and Altman plots were used.

Results:
The CVs for the parameters measured by Bodystat ranged between 2.33-8.40% and between 4.70-11.56% for the Inbody, whereas for each single parameter lower CVs were found for the Bodystat device. Bland and Altman plots showed that one device could be replaced by the other. However, the plots showed a systematically lower fat mass (4%), a higher fat free mass (4%) and a higher total body water content (3%) using the Bodystat compared to the Inbody. Our nutritionists rated the Inbody as less user-friendly for daily clinical use.

Conclusion:
In general, both devices are comparable concerning the measured parameters, whereas the Bodystat showed lower CVs, which points towards a better reproducibility compared to the Inbody. We recommend to critically validate BIA devices concerning measurement accuracy, reproducibility and handling in daily clinical practice before making a final decision, which device will be used.

O72: 11:30-11:45

Putting evidence into practice; guidelines for neurogenic bowel management in the United Kingdom
Coggrave, Maureen
National Spinal Injuries Centre, United Kingdom
On behalf of the MASCIP Bowel Guideline Group.

Background:
Neurogenic bowel dysfunction is highly prevalent following spinal cord injury (SCI) and is recognised as having a significant negative impact on quality of life. A need was identified for a succinct yet comprehensive source of information and guidance regarding practical bowel management for individuals with SCI both within and beyond the UK spinal injury service.

Method:
To develop the guidelines a group representing every spinal cord injury centre (SCIC) in the UK and Ireland was established; attendees were predominantly nurses, in inpatient and outreach/liaison roles. Input from other multidisciplinary team members was sought during the process. The guidelines were derived through literature review and discussion of best clinical practice to achieve consensus.

The aims of developing the guidelines were:
• UK SCI centres to adopt a unified, evidence based approach to bowel management
• raise awareness among and educate community/non-specialist staff
• promote the quality of life of SCI individuals
• promote good and consistent clinical practice
• promote communication between UK spinal units
• provide information for patients and carers

Results:
The guidelines include:
• Quick guide to bowel management
• Aims of bowel management
• Development of an individualised programme
• Outcome measures
• Pre transfer management
• Acute care
• Rehabilitation
• Post-discharge long term support
• Education for patients and their carers
• Supporting information - neurogenic dysfunction, interventions, diet, non-conservative interventions

More than 60,000 hard-copies of the guidelines have been distributed through outreach services, study days and to support clinical intervention in the community; in addition the document is available for electronic download from all SCICs, service user organisation websites (Spinal Injuries Association, Spinal Cord Injuries Ireland, Spinal Cord Injuries Scotland), MASCIP and the Royal College of Nursing.

The guidelines are currently under review for republication this year. The support of Coloplast Ltd in developing and printing the guidelines is gratefully acknowledged.
O73: 11:45-12:00
Validation of the Screening Tool for the Assessment of Malnutrition (STAMP) in patients with Spinal Cord Injuries (SCI).

Wong, Samford1; Graham, Allison2; Harini, Shashi1; Grimble, George3; Forbes, Alastair3
1National Spinal Injuries Centre, Stoke Mandeville Hospital, United Kingdom; 2School of Health Science, United Kingdom; 3Centre for Gastroenterology and Clinical Nutrition, United Kingdom

Background & aims:
The Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP) has been developed for use in paediatric patients but its validity in spinal cord injury (SCI) patients, its reliability and agreement with other published tools requires investigation. Our aim was to validate the STAMP in paediatric SCI patients.

Methods:
Children's baseline clinical data, anthropometric measurements and STAMP score were assessed on admission. The validity of STAMP was assessed by (i) comparison with a full dietetic assessment (criterion validity); (ii) comparison with generic paediatric screening tools: the Paediatric Yorkhill Malnutrition Score (PYMS) and the Waterlow criteria (weight for height <90th centile) (concurrent validity); and (iii) completion of an additional STAMP to assess inter- and intra-rater reliability. The agreement was assessed using Cohen's k-statistics.

Results:
Fifty-one children were screened by STAMP. The prevalence of malnutrition risk was 42.1%. STAMP had moderate agreement with dietitian assessment (k:0.507), a fair agreement with PYMS (k:0.314), and poor agreement with the Waterlow criteria (k:0.091). The STAMP had substantial reliability (inter-rater reliability: k:0.752; intra-rater reliability: k:0.635). When compared with dietetic assessment as a reference standard, STAMP had a sensitivity of 83.3%, specificity of 66.7% and an overall agreement of 76.5%.

Conclusion:
The present study shows that malnutrition is common in children with SCI. The STAMP is an acceptable (valid and reliable) tool to identify SCI children at risk of malnutrition.

O74: 12:00-12:15
The effect of singing on respiratory and voice function following cervical spinal cord injury: a randomized controlled trial

Tamplin, Jeanette1; Baker, F2; Grocke, D3; Pretto, JJ3; Brazzale, DJ4; Ruehland, WR5; Buttifant, M6; Brown, DJ7; Berlowitz, DJ8
1Music Therapy, Australia; 2School of Music, Australia; 3Dept of Respiratory & Sleep Medicine, Australia; 4Institute for Breathing & Sleep, Australia; 5Voice Analysis Clinic, Australia; 6Victorian Spinal Cord Service, Australia

Background and Aims:
Reduced lung function and diminished voice projection are common following quadriplegia. Respiratory muscle training has been shown to improve respiratory function but is limited by poor compliance and carryover. Singing training has facilitated improved respiratory capacity and voice projection in other populations and may be a more motivating way to train the respiratory muscles. We therefore aimed to examine the effect of a group therapeutic singing intervention on respiratory function, voice quality and mood in people with quadriplegia.

Method:
Twenty-four participants with chronic quadriplegia (C4-C7, ASIA A & B) were randomly assigned to experimental or active control groups. The experimental group (n=13) received group singing training 3 times weekly for 12 weeks. The control group (n=11) received group music appreciation and relaxation for 12 weeks. Assessments were conducted pre, mid, immediately post and 6 months post intervention. Assessments included respiratory function tests, electromyography, voice recording and analysis, in addition to mood, voice, and quality of life questionnaires.

Results:
The singing group achieved a significant increase in projected speech intensity (p=0.028) and maximum phonation length (p=0.007). Trends for improvements in respiratory function, muscle strength and recruitment were also evident for the singing group. These effects were limited by small sample sizes with large inter-subject variability. Both music therapy groups demonstrated an improvement in mood (p=0.002) and this improvement was maintained by the music appreciation and relaxation group after 6 months (p = 0.017).

Conclusions:
Group music therapy can have a positive effect on not only physical outcomes, but also can improve mood, energy, social participation and quality of life for an at-risk population such as those with quadriplegia. Specific singing therapy can augment these general improvements by improving vocal intensity. Further research could examine the longer-term, community effects of this training on respiratory complications and voice function.
Provision of Care for Traumatic Spinal Cord Injury in Canada: Are There Differences?
Noonan, Vanessa; Atkins, D; Santos, A; Lewis, R; Soril, L; Fehlings, MG; Singh, A; Townson, A; Dvorak, MF
Canada

Background:
With increasing demands on the health care system there is a need to identify ways to provide cost-effective quality care. Existing studies have examined different models of care following SCI but few have looked at the entire care continuum (time of injury until discharge into the community). The objective of this study was to describe current models of care delivery for traumatic SCI in Canada and determine how the provision of care impacts outcome along the continuum.

Methods:
Data for this study was examined as part of the national Access to Care and Timing (ACT) project. High-level process maps were developed to describe the provision of care in the Rick Hansen SCI Registry (RHSCIR) sites using RHSCIR data and a survey. Detailed process maps, along with data from RHSCIR, the literature and expert opinion were used to develop a discrete event simulation (DES) model to evaluate how differences in care delivery affect outcomes.

Results:
High-level process maps were developed for 25 SCI facilities in 12 cities, covering 7 provinces. There are 13 acute facilities and 10 rehabilitation facilities and 2 facilities with integrated care. The number of patients admitted to the acute and rehabilitation facilities per year ranged between 11 and 104 (median 36). Only 51% of patients were directly admitted to the acute facility following injury. There are differences in the time of admission to specialized centres, time to surgery and length of stay among the facilities which can be attributed to processes of care delivery.

Conclusions:
There is tremendous variability in the provision of care for patients with similar types of injuries. The methods used in the ACT project will assist in defining best practices for care delivery in Canada. Further work should compare the provision of care internationally and the development of standards.

Cost effectiveness, length of stay and outcome of inpatient rehabilitation for traumatic spinal cord injured patients.
Eelmae, P; Pakkanen, M; Englas, K
Estonia

Background:
Length of stay in in-patient rehabilitation settings has increased over time. The content and intensity of rehabilitation for spinal cord injured (SCI) patients differ remarkably between cultures, countries, and hospitals. Financing schemes vary as well. The aim of the retrospective study was to evaluate cost of rehabilitation, length of stay and treatment outcomes of traumatic SCI patients treated in Haapsalu Neurological Rehabilitation Centre (HNRC) between April and December 2011.

Materials and methods:
93 patients (mean±SD age 35.48±15.26) participated in the study. Male-female ratio was 74:19. The severity of injury AIS grade representation was A-36, B-14, C-7, D-25 and for 11 patients unknown. Both acute and chronic cases were included irrespective of reason for or type of injury, level of independence, type of financing. Cases longer than 14 continues days were include. Functional Independence Measure (FIM®) was used for evaluating the outcome of rehabilitation. FIM® was measured during first three days in admission and during last three days before discharge. All other data were collected from patients’ case histories.

Results:
The average length of stay was 26.27±1.14 days. For AIS grade A the length of stay in days was 28.17±2.46; B – 25.64±2.05; C – 26.86±3.97 and D – 24.08±1.51. The average cost of one patient case was 2028.30±72.39 euro and average cost for one hospital day was 78.74±1.72 euros. Average FIM® score at admission was 87.76±2.89 and at discharge 90.76±2.84, (maximum change being 34, minimum 0). FIM® scores at admission for patients with AIS grade A (75.06±4.26) and B (70.79±5.44) were significantly (p<0.05) lower as compared to AIS grade C (107.57±10.30) and D (110.60±3.49).

Conclusions:
The length of stay doesn’t differ significantly between different AIS grades. Most expensive was one hospital day for AIS grade B patients. There is a tendency of more expensive cases to have better outcome.
Epidemiology of traumatic Spinal Cord Injury (SCI) due to falls; Data from 2003-2011 from Midlands-Centre-for-Spinal-Injuries (MCSI); demographic trends

Ramamurthy, Poornashree; Kumar, N; Zobina, I; Osman, A
United Kingdom

Background:
There has been an observed increase in the incidence of SCI due to fall. This has also been associated with increasing age. We aim to confirm this and evaluate the current service provision to manage these patients in order to assess the need for any changes required.

Method:
Retrospective epidemiological observational study of consecutive patients with traumatic SCI due to fall, admitted to the MCSI between Jan-2003 to Dec-2011. Consecutive patients (n=47) in 2003-2004 were compared against consecutive patients (n=52) in 2011 to study the trends. Data collected on demographic-information, aetiology, comorbidities, SCI based on ISCoS –ASIA classification, neurological and functional outcome (FIM), discharge venue and length of stay. Data was collected on a purpose-designed proforma from Medical records, including Electronic-Patient-Records (EPR). Data was collated and analysed using standard arithmetic proportions using Microsoft-Excel.

Results:
A total of 807 new cases of SCI were admitted between Jan 2003 to Dec 2011 of which the mechanism of injury was due to a fall in 300 cases. The incidence of SCI due to falls was 29.0% (47/162) in 2003-04 and 39.7% (52/131) in 2011. The mean age was 49 years (range 12 to 90) in 2003-04 of which 14 were aged >60. The mean age was 56.13 (20 to 87) in 2011 of which 24 cases were aged >60. 59.6% (28/47) had associated comorbidities in 2003-04 as compared to 80.8% (42/52) in 2011. 11 cases improved neurologically in 2003-04 of which 3 were aged >60. 18 improved in 2011 of which 7 were aged >60. There was no statistically significant difference in the discharge destination between the two study groups, 74.5% were discharged home.

Conclusions:
The incidence of SCI due to falls is rising and this has directly correlated with increasing age and comorbidities. Neurological improvement was noted irrespective of age in this study group.

The global map for traumatic spinal cord injury epidemiology: Update 2011, global incidence rate

Lee, Bonsan Bonne1; Cripps, RA2; Michael, Fitzharris2; Peter, Wing3
1 Spinal Medicine department, Australia; 2 Australia; 3 Canada

Study Design:
Literature review.

Objectives:
Update the global maps for traumatic spinal cord injury (TSCI) and incorporate methods for extrapolating incidence data.

Setting:
An initiative of the ISCoS Prevention Committee.

Methods:
A search of Medline/Embase was performed (1959-Jun/30/2011). Enhancement of data-quality ‘zones’ including individual data-ranking as well as integrating regression techniques to provide a platform for continued regional and global estimates.

Results:
A global-incident rate (2007) is estimated at 23 TSCI cases/million (179,312 cases/annum). Regional data are available from North-America (40/million), Western-Europe (16/million) and Australia (15/million). Extrapolated regional data are available for Asia:Central (25/million), Asia:South (21/million), Caribbean (19/million), Latin-America, Andean (19/million), Latin-America, Central (24/million), Latin-America:Southern (25/million), Sub-Saharan Africa:Central (29/million), Sub-Saharan Africa:East (21/million).

Discussion:
It is estimated that globally in 2007, there would have been between 133 and 226 thousand incident-cases of TSCI from accidents and violence. The proportion of TSCI from land-transport is decreasing/stable in developed but increasing in developing-countries due to trends in transport mode (transition to motorised-transport), poor infrastructure and regulatory challenges. TSCIs from low-falls in the elderly are increasing in developed-countries with aging populations. In some developing-countries low-falls resulting in TSCI occur while carrying heavy loads on the head in young people. In developing-countries high-falls feature, commonly from trees, balconies, flat-roofs and construction sites. TSCI is also due to crush-injuries, diving and violence.

Conclusion:
The online-global maps now inform an extrapolative statistical model which estimates incidence for areas with insufficient TSCI data. The accuracy of this methodology will be improved through the use of prospective, standardised data-registries.
Prevalence of non-traumatic spinal cord injury in Victoria, Australia
New, Peter¹; Farry, A²; Baxter, D²; Noonan, VK²
¹Spinal Rehabilitation Unit, Australia; ²Canada

Background:
There is very little research on the prevalence of non-traumatic spinal cord injury (NTSCI). This information is important to assist with health-care planning because the incidence rates of NTSCI are highest in older age groups, and hence both the incidence and prevalence levels of NTSCI will increase in many countries as a result of the projected aging of their populations. The objective of this project was to determine the prevalence of NTSCI at 30th June 2010 in Victoria, Australia.

Methods:
Population modelling using the following: incidence of NTSCI based on state-wide, population-based, health-administration database of hospital admissions; State and National population profiles and life tables; levels of NTSCI based on National rehabilitation outcomes data; and life expectancy for persons with SCI.

Results:
The estimated prevalence of NTSCI in Victoria was 2,034 persons. This is equivalent to a population prevalence rate of 367.2 per million persons. There were more males with NTSCI and the prevalence was much higher among those with paraplegia and incomplete NTSCI. Ventilator dependency was extremely rare.

Conclusion:
We have reported a method for calculating an estimate of the prevalence of NTSCI which provides information that will be vital to optimise health care planning for this group of highly disabled members of society. It is suggested that refinements to the modelling methods are required to enhance its’ reliability. Future projects should be directed at refining the mortality ratios and performing cohort survival studies.

Trajectories and predictors of the course of mental health in persons with spinal cord injury
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Background:
Conflicting research findings have been reported with respect to the course of mental health after SCI. Moreover, all studies reported average scores or overall proportions. This might obscure individual differences in the course of mental health after SCI.

Objective:
To study the course and predictors of mental health in the period between the start of active SCI rehabilitation and 5 years after discharge. The hypothesis was that different mental health trajectories can be identified.

Methods:
Multi-centre prospective cohort study in eight SCI specialised Dutch rehabilitation centres with measurements at the start of active rehabilitation, after 3 months, at discharge, 1, 2, and 5 years after discharge. 206 Persons with recently acquired SCI and age between 18 and 65 years participated. The main outcome was the five-item Mental Health Index (MHI-5) with a total score between 0 (lowest mental health) and 100 (highest mental health).

Results:
Levels of mental health increased between the start of active rehabilitation and three months later, remained stable thereafter, and increased again between 2 and 5 years after discharge. Latent Class Growth Mixture Modelling revealed 5 trajectories: (a) high scores (above 80) at all time-points (52%), (b) low scores (60 or below) at all time-points (4%), (c) early recovery from 40 to scores above 70 (13%), (d) intermediate scores from 60 to scores above 70 (29%), and (e) severe deterioration of scores above 70 to scores below 30 (2%). Pain, sex, and educational level were predictors, but only predicted a small part of the variance in mental health trajectories.

Conclusions:
Five different mental health trajectories were identified. About a third of the persons with SCI still perceived moderate to severe mental health problems 5 years after discharge. Pain, sex, and educational level were predictors to distinguish between the five trajectories.
**O81:** 15:00-15:15

Venlafaxine XR for major depression after spinal cord injury: a multi-site randomized controlled trial
Fann, Jesse1; Bombardier, CH2; Tate, D3; Richards, JS3; Heinemann, AW4; Wilson, C5; Warren, AM5; Cardenas, D6; Brooks, L7; Bushnik, T8; Temkin, N9
1Psychiatry and Behavioral Sciences, USA; 2Rehabilitation Medicine, USA; 3Physical Medicine and Rehabilitation, USA; 4Rehabilitation Psychology, USA; 5Division of Trauma, USA; 6Neurological Surgery, USA

**Background:**
Major depressive disorder (MDD) is common and impairs functioning after spinal cord injury (SCI), but it is undertreated and there are no placebo-controlled trials of antidepressants in this population. We evaluated the efficacy and tolerability of venlafaxine XR, a serotonin-norepinephrine reuptake inhibitor with potential added benefit for neuropathic pain, for MDD after SCI.

**Methods:**
Multi-site, randomized, double-blind, placebo-controlled trial (Project to Improve Symptoms and Mood after SCI, PRISMS). Inclusion criteria: Persons with SCI, 18-64 years old, >1 month post-SCI, at least moderately severe MDD or dysthymia. Exclusions: high suicide risk, medically unstable, current alcohol dependence or history of psychosis or bipolar disorder. Primary outcome: Hamilton Depression Rating Scale (HAM-D) at 12 weeks. Secondary outcomes: pain intensity, anxiety, quality of life.

**Results:**
As of November 2011, 2476 persons were screened, 273 were eligible for and 165 assessed with the Structured Clinical Interview for DSM-IV, and 124 completed the trial (goal =168). Participants are 41.0 (+11.5) years old, 75% male, 51% White, 40% African American; 7% Hispanic, 17% employed, 58% with paraplegia, 53% AIS A. 70% of participants achieved at least 150 mg/day of venlafaxine XR for 6 weeks or more. Only 4 participants dropped out. The most common emerging/worsening side-effects are sedation, vivid dreams, flatulence, headache, dry mouth and dizziness/lightheadedness. Mean change in spasticity on modified Ashworth was minimal (range -0.14 to 0.18).

**Conclusion:**
Venlafaxine XR appears to be well-tolerated by people with SCI. This trial will be completed in September 2012 and updated efficacy data will be presented. Results will help guide future treatment and research on depression after SCI.

**O82:** 15:15-15:30

Self-efficacy and self-esteem explain participation of people with spinal cord injury
Geyh, Szilvia; Nick, E; Stirnimann, D; Ehrat, S; Michel, F; Lude, P
Switzerland

**Background:**
Spinal cord injury (SCI) has physical, but also psychological, and social consequences. The consequences of SCI depend on lesion-characteristics, but also on environmental and personal factors. This study aimed to explore the relationship of the psychological-personal factors self-efficacy and self-esteem with participation in people with SCI from a comprehensive bio-psycho-social perspective according to the conceptual framework of the International Classification of Functioning, Disability, and Health - ICF.

**Methods:**
A multi-centre cross-sectional study was conducted in Switzerland including people with SCI living in the community (6 months to 5 years post discharge). Data were collected using self-report questionnaires sent out by postal mail. The questionnaires were selected to cover all components of the ICF’s bio-psycho-social model: health conditions, body functions, participation, environmental, and personal factors.

**Results:**
In the three study centres, 557 persons with SCI were screened for eligibility, 394 persons were contacted, and 102 responded to the questionnaires (response rate: 25.9%). Self-efficacy (r=0.54) and self-esteem (r=0.61) were found strong correlates of participation in people with SCI. Participation seemed to be independent of gender, age, level or completeness of injury. Self-efficacy and self-esteem explained together with time since discharge and education 48% of variance in participation in a multivariate linear regression model controlling for sociodemographics, lesion-related variables, pain, anxiety, depressive symptoms, coping, sense of coherence, and social support.

**Conclusion:**
Self-efficacy and self-esteem are potentially changeable psychological-personal factors that were stronger correlates of participation outcomes than other examined factors in this study. Thus, they might represent important intervention targets in multidisciplinary rehabilitation to enhance participation. Considering self-efficacy and self-esteem within the comprehensive framework of the ICF contributes to a better understanding of functioning, disability, and health in SCI, which in turn may facilitate the development of interventions to support the persons’ adjustment and reintegration.
Secondary Conditions and Life Satisfaction in Adults Aging with Traumatic Spinal Cord Injury in the USA

Methods:
Using binary and ordinal logistic regression, data on 343 subjects were analyzed to identify correlates of secondary conditions, life satisfaction, and death following SCI. Data was collected across five SCIMS sites. In addition to demographic and injury data, variables included the Functional Independence Measure (FIM), the Center for Epidemiological Studies Depression Scale (CES-D), and the Life Satisfaction Questionnaire Revised (LSQ-R). A single item from the Brief Pain Inventory (BPI) was examined as well. Researchers were interested in how to best identify risk factors associated with secondary conditions, life satisfaction and mortality after SCI.

Results:
Subjects were on average 45.7 years old, with 25% having been injured more than 20 years prior to data collection. Subjects were classified as ASIA D (11%); Para ABC (49.6%) or Tetra ABC (39.4%). Depressive symptoms and FIM scores were significantly related to secondary conditions. Depression was associated with an elevated risk of these conditions. Greater functional independence appeared to decrease the risk for secondary conditions while lower FIM scores predicted mortality and poor life satisfaction. Non-white subjects, those with two or more secondary conditions were less likely to experience higher life satisfaction as were subjects reporting pain interference with general activity; and smoking. Surprisingly, higher levels of education were inversely related to life satisfaction.

Conclusions:
Several factors are associated with secondary conditions and life satisfaction. Depression and lower physical functioning are risk factors for secondary conditions, suggesting interactions between physical and psychological components of health. It is also possible that more educated subjects held higher non met expectations about their life thus reflected by lower satisfaction scores in this area. Further research in this area will enhance our understanding of factors to consider when caring for those aging with SCI.

Social Networks and Secondary Health Conditions: The critical secondary team for individuals with a spinal cord injury

Background:
The study utilizes a subset of participants followed from 2000 to 2005, from a larger longitudinal study conducted by the Spinal Cord Injury Model Systems funded by the National Institute on Disability and Rehabilitation Research. The study objectives are to examine the demographic, health and behavioral correlates of secondary conditions in those aging with SCI; and the relationship between these factors, secondary conditions and both life satisfaction and death.

Methods:
We used a mixed method exploratory descriptive approach. In-depth semi structured interviews were conducted with community-dwelling individuals with a SCI living in Ontario. The recruitment strategy included purposeful snowball sampling for maximum variation experiences. The Arizona Social Support Interview Survey was used to measure social networks. Participants were asked the following open-ended questions: (1) What have been your experiences with your health care in the community? (2) What have been your experiences with care related to prevention and/or management of SHCs?, (3)What has been the role of your informal social networks (friends/family) related to SHCs?

Results:
Fourteen key informant interviews were conducted (6 men, 8 women). The majority of individuals (n=13; 92.8%) reported significant challenges with SHCs in the past year. The overall median for available informal networks was 11.0 persons (range 3-19). Networks were larger for social support (median=6.5), and physical assistance (median=4.0), followed by positive feedback (median=3.5), advice (median=3.0), material assistance (median=2.5) and intimate relations (median=n=2.5). The informal network engaged in the following roles: (1) advice/validating concerns; (2) knowledge brokers; (3) advocacy; (4) assisting with finances; (5) preventing SHCs; and (6) managing SHCs. Participants described their informal networks as a “secondary team”, that is, a critical and essential force in dealing directly and indirectly with SHCs.

Conclusions:
While networks are smaller for persons with SCI compared to the general population, these ties are stronger, which is essential when the roles involve a level of trust, certainty, tacit knowledge, and flexibility. These informal networks serve as essential key players in filling the gaps that exist within the formal health care system.
Do Risk Perceptions Explain Gender Differences in Community Integration and Participation after Spinal Cord Injury?

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USA

Background:
There is little research on risk and spinal cord injury (SCI). The research that exists focuses on risk and the etiology of SCI, particularly for men who engage in ‘high-risk’ behaviors. Yet many desired and necessary activities for people living with SCI (e.g. bathing/showering alone, going for a roll in the neighborhood) involve some inherent degree of risk. There are also ‘social risks’ related to trusting people which may be an important step toward participation in the community. There are no studies that examine whether risk-taking is positive for adults with SCI.

Purpose/Objective:
The purpose of this study was to: (1) to describe how individuals with SCI rate the risks posed by a set of everyday activities, measured using the Risk Inventory for persons with Spinal Cord Injury (RISCI) (Neufeld & Lysack 2010); and (2) to evaluate the relationship of RISCI scores to community integration and participation.

Research Method/Design:
Men and women living with SCI in metropolitan Detroit (n=140) rated their level of, and satisfaction with participation and completed the Community Integration Measure (CIM) [1] and the Risk Inventory for SCI (RISCI) [2]. Two in-home interviews included standardized scales and qualitative questions.

Results:
Women with SCI reported lower levels of participation (p<.01), less satisfaction with their participation (p<.01), lower levels of community integration as indicated by the CIM (p<.01), and much greater ‘risk aversion’ (p<.001) than the men in the sample. For women, those with the highest RISCI scores also reported the lowest participation and satisfaction. For men, there was no relationship between risk perceptions and integration or participation.

Conclusions/Implications:
Elevated perceptions of risk were significantly associated with lower participation, less satisfaction with participation, and worse community integration, but only for women. For men, injury severity and environmental barriers mattered much more. Research is needed to determine whether the levels of risk perceived by women are truly warranted, whether the risks perceived by men are merely bravado, and whether a sense of vulnerability for women with SCI is unnecessarily limiting their chances at ‘a good life’ after injury.
The Spinal Cord Independence Measure. How Much Change is Clinically Significant for Spinal Cord Injury Subjects

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Background:
Although the psychometric properties and the statistical significance of the Spinal Cord Independence Measure (SCIM III) have been widely studied, the clinical significance of this tool (i.e. the improvement of the scores that has a meaningful impact on the patients) is still unknown.

Objective:
To calculate the clinical significance of the SCIM III.

Patients and methods:
Retrospective review of the charts of 255 patients with registration of the total SCIM score and of the four subscale scores. Clinical significance has been calculated according to several distribution based approaches: Minimal Important Differences, effect size–based estimate for a small change and a substantial change, Standard Error of Measurement and Minimal Detectable Change. The clinical significance has been compared with the real improvement of the patients in order to discover the percentage of patients who achieved a significant improvement.

Results:
The results of the entire group of patients demonstrate that to obtain small clinical significance, an approximately 1.5 point change is needed for Self Care, 2.2 for Respiration and Sphincter Management, 1 for Mobility (room and toilet), and 1.5 for Mobility (indoors and outdoors) and 4.5 points for the Total SCIM. Different values were obtained when examining the patients according to the level and severity of the lesion.

Conclusions:
The results provide useful benchmarks for clinicians and researchers to interpret whether patients' change score on the SCIM III can be interpreted as true or clinically meaningful and to make clinical judgments about the patients' progress and the clinical significance of an intervention.

International retrospective comparison of non-traumatic spinal cord injury rehabilitation outcomes

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1Spinal Rehabilitation Unit, Australia; 2Department of Physical Medicine &Rehabilitation, USA; 3Ireland; 4Center of Excellence in Rehabilitation Medicine, Netherlands; 5Canada; 6India; 7Italy; 8on behalf of the SwiSCI study group, Switzerland; 9Pakistan

Background:
Most studies of patients with non-traumatic SCI (NTSCI) are from single centres and involve relatively small numbers of patients. There are few international comparisons studies of SCI.

Methods:
An international, multi-centre (n=9; Australia, Canada, Italy, India, Ireland, The Netherlands, Pakistan, Switzerland, USA), retrospective study was conducted of all patients admitted into participating units between 1/1/2008 and 31/12/2010.

Results:
843 patients were admitted over the study period. Median age at admission was 59.0 years (interquartile range [IRQ] 45.2 - 70.0). 510 (60.5%) patients were male. The pattern of onset of NTSCI symptoms was: 1 day or less=27.1%, < 8 days=13.9%, > 1 week - 1 month=10.4%, and > 1 month=48.6%. The most common aetiologies were: degenerative (n=270, 32.0%), malignant tumours (n=139, 16.5%), ischaemia (n=84, 10.0%), benign tumours (n=73, 8.7%), bacterial infections (n=49, 5.8%), inflammatory (n=36, 4.3%) viral infections (n=33, 3.9%), haemorrhage (n=33, 3.9%), vascular malformations (n=31, 3.7%), tuberculosis (n=20, 2.4%), other (n=63, 7.5%), and unknown in 11 (1.3%). 71.5% of patients had paraplegia. The AIS grade on admission was: A in 114 (13.5%) cases, B in 53 (6.3%), C in 190 (22.5%), D in 457 (54.2%), E in 1 (0.1%), and missing n=28 (3.3%). The length of stay in rehabilitation was a median of 41 days (IQR 16 - 79.5). The FIM was reported by 5 units, with a median (IQR) FIM-motor score on admission of 32 (IQR 25 - 45) which increased by discharge to a median of 75 (IQR 35 - 74). The Barthel Index was reported by 5 units, with a median (IQR) Barthel Index on admission of 27 (IQR 13 - 53), which increased by discharge to a median of 72 (IQR 40 - 90). Most (81.1%) patients were discharged home.

Conclusion:
Our findings provide a global perspective of the demographic characteristics, clinical features and outcomes of patients with NTSCI.
O89: 15:30-15:45

UAB Index of Motor Recovery (UABIMR): A new validated outcome measure to verify significant neurological return after spinal cord injury (SCI)

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Background:
SCI research has been impeded by the lack of outcome measurements. The UAB Index of Motor Recover (UABIMR) was developed to reliably document neuromuscular return as a function of time post-SCI.

Objective:
To validate the UABIMR as an outcome measurement tool that proves significant neurological return post-SCI.

Methods:
In this multicenter trial, two examiners at each of 4 centers were trained by an outside agency to perform the UABIMR. Examiners completed time-dependent, serial UABIMR testing in patients with acute (ASCI) (0-4 weeks) and chronic (CSCI) (> 3 years) SCI. Each rater examined the patients and determined the UABIMR score. 14 voluntary motor group actions in each leg (=28 total) were tested. Each muscle group that was present was given the score of 1.

Data analysis:
Coefficients of variation (CV), confidence intervals(CI), and intra-class correlation coefficients (ICC) were determined to prove reliability of inter-rater, intra-rater, and test/retest; stability over time; and sensitivity to detect neuromuscular changes. Total mean scores were stratified and analyzed according to complete and incomplete injuries.

Results:
245 patients entered the study: ASCI = 113 (30 complete, 61 incomplete); CSCI = 100 (31 complete, 59 incomplete); 32 were excluded. Inter-rater and intra-rater reliability for ASCI (CI=0.983-0.984) and CSCI (ICC=0.975-0.977) patients was significantly high. Testing/retesting of ASCI at days 1 and 3 (ICC=0.982) and CSCI at days 1 and 7 (ICC=0.981), showed statistically significant high reliability. Examination of ASCI during initial hospitalization and then 4 weeks and/or 1 year later revealed statistically significant (p<.0001) changes in the UABIMR scores when all patients and the incomplete subgroup were analyzed for sensitivity to change. ASCI complete patients only had slight insignificant (p=0.053) increases in mean scores over time.

Conclusions:
The UABIMR is a new outcome measure that is valid for verifying improved neurological return over time.

O90: 15:45-16:00

Clinical significance of diffusion tensor tractography as a prognostic predictor of functional recovery in cervical myelopathy after laminoplasty

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1Orthopaedic Surgery, Japan; 2Department of Advanced Therapy for Spine and Spinal Cord Disorders, Japan

Background:
MRI is important to determine not only the degree of spinal canal stenosis, but also the intramedullary state of the spinal cord in cervical myelopathy (CM) patients. The purpose of the present study was to determine whether changes in the fractional anisotropy (FA) value and diffusion tensor tractography (DTT) of the cervical spinal cord can predict the prognosis of CM patients.

Methods:
Twenty-eight CM patients were treated by laminoplasty from 2008 to 2009. T2-weighted imaging and DTT were performed before and after surgery. The FA values were analyzed and fiber tracking was performed. The tract fiber (TF) ratio was calculated by the following formula: (TF number at the compressed level)/(TF number at the C2 level) x100%. JOA score system was used to determine pre- and postoperative neurological status of patients, and the Hirabayashi method was used to calculate the recovery rate.

Results:
There was a significant difference in the preoperative JOA scores between the T2HSI (+) and (-) groups. It should be noted that the recovery rates in the T2HSI (+) group varied widely, suggesting that preoperative T2HSI may reflect several different pathologies as previously reported. There was a significant correlation between the preoperative TF ratio and the recovery rate, suggesting that the preoperative TF ratio could be a good prognostic predictor for cervical myelopathy patients after decompressive surgery. Notably, we found that we could anticipate a poor prognosis (recovery rate < 40%) for cervical myelopathy patients with a preoperative TF ratio below 60%.

Conclusions:
The preoperative TF ratio correlated significantly with the recovery rates in CM patients. The preoperative DTT can be a new prognostic predictor for neurological recovery in CM patient after laminoplasty.
Effects of daily acute intermittent hypoxia on overground walking in persons with chronic incomplete spinal cord injury

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USA

Background:
Spinal plasticity is important for locomotor recovery after spinal cord injury (SCI). In animal models of SCI, daily exposure to acute intermittent hypoxia (AIH) facilitates spinal plasticity as well as inducing improved ladder-walking performance. Although recent work found that a single exposure to mild AIH enhances leg strength in persons with SCI, no studies have addressed the effects of daily AIH on walking performance. Thus, the purpose of this study was to examine the effects of daily AIH on overground walking in persons with incomplete SCI. We hypothesize that daily AIH increases walking distance in persons with SCI, with greatest effect when it is combined with overground locomotor training.

Methods:
Six subjects with chronic incomplete SCI (ASIA D) participated in daily AIH alone or with locomotor training. Daily AIH consisted of 5 consecutive days of breathing sessions, which included 15, 1.5-minute episodes of AIH (FiO₂=0.09) or SHAM treatment (FiO₂=0.21) delivered at 1-min intervals. Daily locomotor training consisted of 30-minute overground-walking sessions immediately following the breathing intervention. Repeated measurements of distance, using the 6-minute walk test, were recorded at baseline and day 5.

Results:
We found significant increases in walking distance in all subjects after daily AIH (17 ± 6%) as compared to daily SHAM (6 ± 4%, p = 0.04). Subjects increased walking distance 11 ± 5% relative to baseline after daily AIH alone. Greatest increase in walking distance occurred after daily AIH with locomotor training (29 ± 14%), changes not evident in SHAM trials.

Conclusion:
Results from this work offer first evidence for AIH-induced enhancement of overground walking in persons with incomplete SCI. These results support our hypothesis and compliment previous findings in animal models of SCI. Thus, daily AIH may be an effective pre-treatment to enhance the efficacy of locomotor training after SCI.
P1

TRANSPLANTED CD34+ PERIPHERAL BLOOD CELLS MOBILIZED BY G-CSF PROMOTE MOTOR RECOVERY AFTER SPINAL CORD INJURY IN MICE
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Background:
CD34+ cells normally exist in bone marrow as hematopoietic progenitor cells, and are mobilized to peripheral blood by granulocyte colony-stimulating factor (G-CSF). Previous studies have shown that local administration of CD34+ peripheral blood cells mobilized by G-CSF facilitates angiogenesis and has a therapeutic effect for ischemic diseases including myocardial infarction. Thus, we hypothesized that intraspinal transplantation of CD34+ peripheral blood cells mobilized by G-CSF facilitates angiogenesis in injured spinal cord and promotes functional recovery after spinal cord injury (SCI).

Methods:
NOD-Scid mice (8 weeks old) were subjected to SCI by Infinite Horizon Impactor (60 kilo dyne). Human CD34+ peripheral blood cells (1.0x10^5) mobilized by G-CSF were injected into injured spinal cords one week after SCI (CD34 group). In control group, buffer was similarly injected. Hind limb functional recovery was assessed weekly, and the spinal cord sections were obtained at one, four, and eight weeks after the transplantation. Immunohistochemistry for human mitochondria and von-Willebrand factor were performed.

Results:
Mice in CD34 group showed significant locomotor recovery of hind limb motor function in Basso Mouse Scale from six to eight weeks after the transplantation compared with control group (p<0.01). A certain amount of transplanted cells were detected until four weeks, and they were differentiated into vascular endothelial cells thereafter. At four weeks, the number of endogenous endothelial cells was larger in CD34 group than that of control group.

Conclusions:
The present results indicate that intraspinal transplantation of CD34+ peripheral blood cells mobilized by G-CSF facilitates the angiogenesis in injured spinal cord and promotes functional recovery in mice. This finding provides us with the possibility of intraspinal autologous CD34+ cell therapy for patients with SCI.

P2

Estimating glomerular filtration rate in patients with spinal cord injury using serum cystatin C
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Background:
To investigate the relationship between 51Cr-EDTA-clearance, serum cystatin C, serum creatinine, creatinine-clearance, and estimated glomerular filtration rate (eGFRMDRD) based on serum creatinine in patients with complete and incomplete spinal cord injury (SCI), and to develop and evaluate a GFR estimating equation using serum cystatin C.

Methods:
Ninety-eight men and 47 women aged 11.3 to 82.4 years with complete (n = 57), and incomplete (n = 88) spinal cord injury were included. Serum cystatin C was measured by an automated particle-enhanced nephelometric immunoassay, serum and urine creatinine by an enzymatic method traceable to the IDMS creatinine reference method, and 51Cr-EDTA-clearance by a multiple plasma sample method.

Results:
Comparison of the area under the curves (AUC) in the non-parametric ROC plots for serum cystatin C with serum creatinine, and eGFRMDRD revealed significant difference (p-value < 0.05) for all SCI patients. There was no significant difference between AUC for serum cystatin C compared with AUC for creatinine-clearance. GFR (mL/min/1.73 m^2) can be calculated from serum cystatin C (CysC) values (mg/L) using the equation eGFRCysC = 212-exp(-0.914\cdotCysC). The model predicted 88% within ± 30% of the measured GFR, and 50% within ±10% of the measured GFR.

Conclusion:
In patients with SCI, GFR can be estimated by a new developed equation based on a single serum cystatin C value independent of age, sex, and muscle mass.
Long-term follow-up of spinal cord stimulation (SCS) to restore cough in subjects with spinal cord injury (SCI)

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Background:
SCS has been shown to restore an effective cough mechanism by activation of the expiratory muscles in subjects with SCI.

Objective:
To evaluate the long-term clinical effects in subjects who have used the SCS cough system for a minimum of 2 years (mean 4.4 years).

Design:
Clinical trial assessing clinical outcomes

Interventions:
SCS was performed at home, 2-3 times/day, on a chronic basis, and also as needed for secretion management.

Participants:
Subjects with SCI (n=7)

Main Outcome Measure(s):
Ease in raising secretions, life quality, degree of caregiver support and incidence of respiratory tract infections

Results:
Each subject continued to use the device on a regular, usually daily, basis. Moreover, each subject relied on the cough system as their only method of secretion management. There were significant improvements in each of the measures related to airway clearance. Difficulty in raising sputum improved markedly (p<0.01). The frequency during which cough interfered with daily activities decreased significantly. The incidence of acute respiratory tract infections fell from 1.7±0.3 to 0.2±0.2 events/subject year (p<0.01), and mean level of trained caregiver support related to secretion management decreased from 13.6±9.6 to 0.3±0.2 times/week (p<0.05). Subject life quality related to respiratory care improved significantly. Some subjects were aware of leg jerks during use of the device. There were no incidences of bowel or bladder leakage.

Conclusion:
Long-term use of SCS to restore an effective cough is safe and efficacious as a method to manage airway secretions. The fact that subjects continue to use the device on a regular basis for years following implantation suggests that this device has a high degree of clinical utility.

Support:
NIH-NINDS (R01NS049516 and RC1NS068576) and NCRR (M01RR0080 and UL1RR024989).

Disclosure:
Dr. DiMarco is a Founder of and has a significant financial interest in Synapse BioMedical, Inc, a manufacturer of diaphragm pacing systems.
**Role of xenobiotics in susceptibility for neuropathic pain in spinal cord injured patients**

Clark, JM; Marshall, R; Palmer, JE; Coller, JK; Hutchinson, MR

South Australian Spinal Cord Injury Research Centre, Australia; South Australian Spinal Cord Injury Service, Australia; Discipline of Medicine, Australia; Discipline of Pharmacology, Australia

**Background/Aims:**
Spinal cord injury results in significant trauma and inflammation originating at the site of injury as well as from various systemic compartments. A key event in the initiation of this inflammatory response is the activation of the innate immune system pattern recognition receptor Toll Like Receptor 4 (TLR4) in peripheral and central immune cells, resulting in an inflammatory cascade. It is now apparent that exogenous xenobiotics, such as medications that may be clinically administered at the time of injury are able to activate the same TLR4 inflammatory cascade.

**Hypotheses/Aims:**
1. Susceptibility and presentation of chronic pain conditions following spinal cord injury;
2. Opioid use at time of injury, which in turn significantly may impact the presentation of chronic pain conditions following spinal cord injury;

**Methods:**
Non-randomised prospective and retrospective case-note review.

Male patients (18-55 years), C2-T12, AIS A-D were enrolled at week three from injury. Patients with pre-morbid neuropathic pain, or a psychiatric history were excluded. Opioid exposure (dose, dosing interval) was extracted from the case-record. Data were aggregated by requirement for centrally-acting medications at discharge and visual analogue scale (VAS) score at one year follow up.

**Results:**
Thirty-five patients participated (19 motor complete, 26.5 ±6.3 yrs; 15 motor incomplete, 34.2 ±10.6 yrs, P<0.05). 17 were symptomatic (VAS>6, 31.6±10.6 yrs P>0.05; opioid dosing 3.4± 2.1 days); vs. asymptomatic (VAS<6; opioid dosing 7.3±3.1 days, P=0.01). The VAS demonstrated significant dose- and time-dependent associations: cumulative opioid exposure (days) vs. VAS r = -0.79; P<0.01; cumulative dose (mg) vs. VAS; r = -0.83; P<0.01.

**Conclusion:**
We conclude that at time of injury exposure to exogenous xenobiotics may significantly impact the presentation of chronic pain conditions following spinal cord injury, prompting further investigation of mechanism-specific pharmacological management.

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**Reliability of external anal sphincter EAS contraction as a trigger for conditional neuro-modulation of NDO using a novel wearable device**

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**Background:**
Following spinal cord injury (SCI) neurogenic detrusor over-activity (NDO) combined with detrusor sphincter dyssynergia (DSD) can result in incontinence and potential damage to the upper tracts. Neurmodulation of the sacral roots has been shown to effectively suppress unwanted NDO. More recently a novel wearable device which uses external anal sphincter (EAS) electrical activity to trigger trans-rectal conditional neurmodulation (CM) has been shown to increase bladder capacity and reduce detrusor pressure. The aim of this study was to investigate the reliability of EAS activity to predict onset of NDO contractions.

**Methods:**
8 patients with supra-sacral spinal cord injury who had stopped anti-muscarinic medication were investigated with standard subtraction cystometry. The novel CM device which consists of recording and stimulating electrodes was placed in the anal canal. Three control fills at 60 ml/min were performed to measure mean capacity and maximum detrusor pressure. Raw EMG traces were rectified and smoothed using digital signal processing. Records were studied to determine relationship between onset of NDO and EMG activity of EAS. NDO was defined as the when Pdet exceeded 15 cmH2O, the time of onset was termed T_NDO. The value of processed EMG signal at this time was evaluated. Additionally, the time at which the processed EMG signal increased was termed T_EMG.

**Results:**
In all cases (n=24 fills and 8 patients) T_NDO was associated with an increased EAS EMG. The onset of NDO and increased in EAS EMG coincided such that there was no significant difference between T_EMG and T_NDO (p>0.05).

**Conclusions:**
Their were no occasions when NDO occurred in the absence of increased EAS EMG, in these patients. Therefore, EAS EMG appears to be a reliable indicator of NDO. This thereby justifies its use as signal trigger for CM in the novel device, which has been shown to effectively increase bladder capacity and reduce detrusor pressure.
Brain of neuropathic pain after traumatic spinal cord injury
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Background:
The involvement of central nervous system in chronic neuropathic pain has been supposed. The aim of this study was to investigate the anatomical and functional changes in the brain in patients with neuropathic pain after spinal cord injury.

Methods:
Eleven patients suffering from chronic neuropathic pain after traumatic spinal cord injury and 10 healthy control subjects were enrolled. FDG-PET, T1-anatomical MRI and diffusion tensor imaging were applied to all participants.

Results:
Decreases in regional glucose metabolism and loss of gray matter volume were detected in the anterior insula (decreases in both glucose metabolism and gray matter volume), right medial frontal gyrus (glucose metabolism) and left superior frontal gyrus (gray matter volume) which areas are involved in main modulation by emotional and cognitive process. Meanwhile, decrease in mean diffusivity was demonstrated in the right internal capsule including from anterior to posterior limb and cerebral peduncle as components of the corticospinal and thalamocortical tract, and also in the bilateral frontal and parietal white matter reaching into precentral and postcentral gyrus, which indicated that loss of connection in brain regions related with sensory perception of pain as well as the regions directly projected from spinal cord injury itself.

Conclusion:
This study identified that the abnormalities in gray and white matter reflect different aspects of pain using multimodal imaging methods. Multimodal imaging of neuropathic pain could elucidate precise mechanisms of persistent pain and future directions for treatment.

Incidence of urinary tract infections and asymptomatic bacteriuria in patients with neurogenic lower urinary tract dysfunction
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Background:
The integrity and function of the lower urinary tract is often affected by neurologic disorders. Depending on the type of the neurologic disease, a wide range of disturbances occurs. Recurrent urinary tract infections (UTI) have a major impact on quality of life and remain one of the most challenging issues in neuro-urology. Therefore we investigated the incidence of symptomatic UTI and bacteriuria in patients with neurogenic lower urinary tract dysfunction (LUTD) and assessed potential risk factors.

Methods:
A consecutive series of 185 patients (63 women, 122 men) with neurogenic LUTD undergoing urodynamic investigation (UDI) were prospectively evaluated. Before UDI, urine samples for urine culture were collected by sterile catheterization. At that time, no patient had clinical signs of UTI. Patients were prospectively followed for assessing the rate of symptomatic UTI. Data were normally distributed and the values are presented as mean ± standard deviation. To identify predictors for bacteriuria and/or symptomatic UTI we performed uni- and multivariate analyses (including age, gender, type and duration of the neurologic disorder, mode of bladder emptying, and video-urodynamic parameters).

Results:
The underlying neurologic disorder of the 185 patients (mean age 49 ± 16 years) was spinal cord injury (n = 120, 65%), multiple sclerosis (n = 23, 12%), spina bifida (n = 2, 1%), Parkinson’s disease (n = 3, 2%), and other neurologic disorders (n = 37, 20%). The mean duration of the neurologic disorder was 11 ± 15 years. The favourite modes of bladder emptying were spontaneous voiding (n= 51, 28%) and aseptic intermittent self-catheterization (n= 71, 38%). Evaluating the urine culture before UDI of the 185 patients, 70 (38%) patients had no bacterial growth, 39 (21%) a bacterial growth <10⁴/mL, and 76 (41%) patients a bacterial growth >10⁵/mL. E.coli (n= 33, 18%) and Klebsiella pneumoniae (n= 18, 10%) were the most frequent bacteria, but all patients were asymptomatic. During follow-up, the mean symptomatic UTI rate was 1.0 ± 1.9 per year. In uni- and multivariate analyses, there were no factors predicting bacteriuria and/or symptomatic UTI.

Conclusions:
Although more than 60% of our patients had bacteriuria, the incidence of symptomatic UTI was only about 1 per year, emphasizing that asymptomatic bacteriuria is negligible and needs no treatment in patients with neurogenic LUTD.
Acute, hyperventilation associated with diaphragmatic pacing
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Case Description:
A 32-year man with congenital central hypoventilation, status-post laparoscopic diaphragm pacer implantation, was noted to have dynamic airway obstruction due to arytenoid prolapse. As a result he could not use the diaphragm pacer at night. To address this he had an elective arytenoidectomy. Due to concerns about positive pressure ventilation causing subcutaneous air dissection after his arytenoid resection, continuous utilization of the diaphragm pacer was recommended. Prior to arytenoid resection his blood gas analysis had repeatedly been normal since optimizing the pacer settings. One week following his arytenoidectomy he presented with symptoms of confusion and lethargy. He was found to be hypocapnic with a PCO2 of 20 and a pH of 7.63. The decreased airway resistance after surgery was presumed to have allowed pacer-related hyperventilation. The diaphragm pacer was reprogrammed with lower intensity settings. His blood gases improved and alternative causes were ruled out. He was dismissed and currently remains stable using the diaphragm pacer on a daily basis.

Discussion:
With diaphragm stimulation, strengthening of the diaphragm is expected and adjustment of the stimulus intensity is necessary. In this case, the abrupt change in the patient’s airway resistance likely precipitated the change in his status. To our knowledge, this is the first reported case of hyperventilation due to altered airway resistance and diaphragmatic pacing. Because diaphragm pacing is indicated for patients with ventilator dependence, due to high cervical cord injury, it’s important for clinicians in Spinal Cord Medicine to be aware of this potential complication. Because these patients have an absent or impaired ability to auto-regulate, their respiratory equilibrium is easily off-set by subtle physiologic changes like decreased airway resistance or increased metabolic demand.

Conclusion:
Close monitoring and adjustments of diaphragm pacer systems after airway surgery may be necessary to prevent hyperventilation.

A novel thermoelectric cooling device using Peltier modules for inducing local hypothermia of the spinal cord.
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Although systemic hypothermia has been reported to be beneficial for the recovery of motor function after spinal cord injury, a local cooling system for spinal cords is necessary to achieve a longer hypothermic treatment. We developed a novel thermoelectric cooling device using Peltier modules for the rat spinal cord. The extracorporeal electrically cooling component was attached to the aluminum arched plate which was placed on the surface of the spinal cord after the contusion injury in the 11th thoracic spinal cord. The spinal cord cooling (33°C: hypothermic animal) was performed for 48 hours after the contusion injury occurred. During the hypothermic treatment, rats were awake and could move in the cage. The normothermic animal received the same procedure and the temperature of the spinal cord was maintained at 37°C. Hind limb motor function was evaluated using a BBB scale until 8 weeks after the injury. A histological examination was additionally performed to evaluate the inflammatory response in the spinal cord.

The BBB scale in the hypothermic animals was significantly higher than that in the normothermic animals from 2 weeks to 8 weeks after the injury. A remarkable increase of OX42-positive cells (microglia) and TNF-a-positive cells was observed after the contusion injury. Compared with normothermic animals, the hypothermic treatment significantly reduced the number of OX42-positive cells and TNF-a-positive cells. The hypothermic treatment improved hind-limb motor function via reduction of secondary neuronal damage, such as microglial proliferation after spinal cord injury.
Challenging the significance of the American Spinal Injury Association standards. How much change is meaningful for spinal cord injury subjects?

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**Background and aim:**
Although the psychometric properties and statistical significance of the American Spinal Injury Association (ASIA) standards have been widely examined, the clinical significance of motor and sensory scores (ie, the improvement in score that has a meaningful impact on patients) is unknown. The aim of the study was to calculate their clinical significance.

**Patients and methods:**
Retrospective review of charts of 600 patients with registered ASIA Motor scores (total score and individual upper and lower extremity scores) and ASIA Sensory scores. Clinical significance was calculated per several distribution-based approaches: minimal important differences, effect size-based estimates for small and substantial changes, standard error of measurement, and minimal detectable change. The calculated clinical significance was compared with improvements by the patients to determine the percentage of patients who achieved significant improvement.

**Results:**
Motor scores were more amenable to change than sensory scores. A 5-point change in motor score resulted in a clinically significant improvement of 0.2, and an 11-point change in motor score was associated with an improvement of 0.5. The percentages of patients with a significant improvement varied from 8 to 80% according to the level and severity of the lesion.

**Conclusions:**
Our results provide useful benchmarks for clinicians and researchers with which changes in patient ASIA motor and sensory scores can be interpreted as clinically meaningful, thus allowing a clinical judgment on interventions based on patients’ progress. Furthermore, the proportion of patients with clinically significant improvements is a useful benchmark in a clinical trial: an intervention should be considered to be effective not only if it produces a greater statistically significant improvement in neurological status than another intervention or the natural course of the lesion but also if it effects an increase in the percentage of subjects who achieve a clinically significant improvement.

Benign paroxysmal positional vertigo (BPPV) in people with traumatic spinal cord injury (SCI): Incidence, treatment efficacy and clinical implications

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**Background/Objectives:**
The aim of this study is to determine the incidence of benign positional paroxysmal vertigo (BPPV) and its treatment efficacy in traumatic spinal cord injury (SCI) population, as well as to arrive at implications for clinical practices and set foundation for future research. No previous study had attempted to investigate the extent of BPPV in traumatic SCI population although it was found clinically affecting rehabilitation progress.

**Setting:**
Tan Tock Seng Rehabilitation Centre, a tertiary rehabilitation centre in Singapore

**Method:**
Consecutive traumatic SCI patients who were admitted to the rehabilitation centre during the period from August 2008 to December 2010 were screened for BPPV using the Dix-Hallpike test and roll test. The treatment efficacy was reflected by the number of treatment required for complete resolution of BPPV symptoms.

**Results:**
A total of 62 subjects were included and the overall incidence of BPPV was 14.5%. People with cervical SCI were 2.87 times more likely to have BPPV compared to people with thoracic/lumbar SCI. The treatment efficacy for posterior and horizontal canal canalithiasis were 75% and 100% respectively with one manoeuvre. All BPPVs were resolved within three manoeuvres without any complication.

**Discussion/ Conclusion:**
This is the first study to look into the incidence and treatment efficacy of BPPV in people with traumatic SCI. The high incidence is worth clinicians’ attentions that a routine screening for BPPV might be necessary. The treatments were also highly effective for immediate symptoms resolution. We recommend that assessments and treatments for BPPV could be incorporated into the standard care for people with traumatic SCI.
Applicability of brief ICF core set in comprehensive evaluation of acute spinal cord injury
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Background:
To evaluate the feasibility of brief International Classification of Functioning, Disability and Health (ICF) core set application for initial comprehensive evaluation of acute spinal cord injury (SCI) patients.

Methods:
Comprehensive evaluation of 62 acute SCI patients was done by rehabilitation team members such as physicians, physical therapists, occupational therapists, nutritionists, medical social workers, and nurses. They recorded each of their evaluation contents intuitively, according to ICF first level classification. Contents of comprehensive evaluation record were linked to ICF second level categories retrospectively. The linked codes were compared with the brief ICF core sets for acute SCI consisting of 25 items.

Results:
In intuitive evaluation of acute SCI patients based on first level ICF categories, 82.4% of contents were linked to the brief ICF core set, such as muscle power functions (b730), spinal cord and related structures (s120), transferring oneself (d420), and health professionals (e355). There were 30 ICF second level categories that were mentioned in the comprehensive evaluation but not included in the brief core set. Among them, 10 ICF items were frequently linked, like individual attitudes of immediate family members (e410), energy and drive functions (b130), digestive functions (b515) and blood pressure functions (b420). Prognosis insight, a personal factor which is not linkable to an ICF code, was mentioned in 29.0% of patients.

Conclusion:
Brief ICF core set can provide the structural base for comprehensive evaluation of acute SCI patients.

The cause of hyponatremia in cervical spinal cord injured patients: SIADH versus CSW
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Introduction:
Hyponatremia is a common electrolyte abnormality after spinal cord injury (SCI). The syndrome of inappropriate antidiuretic hormone (ADH) secretion and cerebral salt wasting (CSW) due to sympathetic denervation are two potential causes of hyponatremia. Although there is considerable overlap in the clinical presentation each other, the treatment of each condition is quite different. Distinguishing between these two disorders can be challenging and is important.

Aim:
The purpose of this paper is to determine which hormonal insufficiency is responsible for hyponatremia after spinal cord injury. (20)

Patients and methods:
This is a retrospective case-control study and comprised of cervical SCI patients who underwent medical treatment in our institute within 2 days after injury. All of them were followed up for the minimum of 3 months. Plasma antidiuretic hormone (ADH), plasma atrial natriuretic peptide (ANP), serum sodium, 24h volume of urine, fractional excretion of sodium, and mean blood pressure were evaluated 4 days after the injury. Spearman rank-order correlations (r) were carried out.

Results:
This study comprised of 45 patients (10 females, 35 males). They were aged 20 to 91 years, median 58.6 years. From lower to higher plasma ANP, serum Na reduced (143-119 mmol/L), mean blood pressure diminished (116-59 mmHg), urine volume increased (1300-3600 ml) r=-0.21 (p<0.01), -0.29 (p<0.01), 0.27 (p<0.01). Elevated plasma ADH didn’t correlate with serum sodium concentrations.

Conclusions:
Raised plasma ANP correlate with reduced sodium conservation, hypotension, and polydipsia. CSW resulting from increased plasma ANP may cause hyponatremia after SCI. Otherwise, plasma ADH didn’t correlate with hyponatremia in this study. It can be mentioned that administration of NaCl is indicated in patients with hyponatremia associated with SCI. However, we should investigate the effect of the sitting or upright standing on plasma ADH and hyponatremia, because plasma ADH could be variable according to the postures.
Reliability and validity of the Duruoz Hand Index in patients with tetraplegia
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Objective:
Primarily to investigate the reliability and validity of the Duruoz Hand Index (DHI) in assessing hand function in tetraplegic patients and secondarily to detect the differences or similarities between the questioning and observational rating of the DHI.

Methods:
A consecutive sample of 40 patients with traumatic cervical spinal cord injury was included. Functional assessment was performed using the American Spinal Cord Injury Association (ASIA) 2000 revised criteria, the DHI questionnaire, the observational rating of the DHI, the Quadriplegia Index of Function-Short Form (QIF-SF), the Visual Analogue Scale of Hand Function (VAS-Func) and the Health Survey Short Form-36 (SF-36), respectively.

Results:
For the construct validity, significant high correlations were found between the DHI and physical functioning (PF) and physical compound summary (PCS) scores of SF-36, upper extremity motor score (UEMS), ASIA, QIF-SF and VAS-Func values. For the test-retest reliability, participants (n=30) were administered the second questionnaire, 3-6 months later. The scores of the first questionnaire were significantly higher –more unsuccessful (t=-2.561, p<0.05). The internal consistency of the DHI proved to be significantly high with a Cronbach alpha coefficient of 0.970. The comparison of the questionnaires with observational rating showed that observational rating scores were significantly lower –more successful– than both of the questionnaires (t=7.15, p<0.001; t=-3.33, p<0.005).

Conclusion:
Both of the questioning and observational rating of the DHI were found as valid methods in the assessment of hand functions in tetraplegics. However, test-retest reliability could not be shown, possibly because of the misleading effect of the observational rating.

Domiciliary ventilation service evaluation in tetraplegic patients – patients, carers and family perspective
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Scotland

Background:
Long term domiciliary ventilation has been shown to be effective in patients with high level spinal cord injury.

Quality Issues:
We investigated the effectiveness of our ventilation service, and level of satisfaction among patients, family and care providers.

Methods:
All patients treated at the Queen Elizabeth National Spinal Injuries Unit and discharged home with a ventilator were included (n=12). We developed a survey questionnaire addressing:
- clinical practice with domiciliary ventilator
- fault type, and speed of response to problems
- users’ view on ventilation network support group
- frequency of review by respiratory specialist nurse
- satisfaction with the service.

The questionnaire was sent to all patients, family and care providers.

Results:
Response rate was 66.7%. On a scale of 1 (highly satisfied) to 7 (unsatisfied), the average level of satisfaction was 2.2 for patients, 1.8 for care providers and 2.0 for families. 4 patients experienced complications with their ventilator. Other faults included problems with batteries (2 patients), alarms (1 patient), and air vents (1 patient). Average level of satisfaction with speed of response was 1.8. Most patients did not feel a ventilation network support group (7/8) would be useful, but 50% of care providers disagreed. 50% of patients were very satisfied with annual reviews.

Changes Implemented: The knowledge, skills training, and support given were felt to be very effective, leading to high satisfaction ratings of our ventilation service. One possible change would be to initiate a network support group for care providers.
Spinal shock in spinal cord injuries - is duration of shock related to neurological level?
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Introduction:
The definition & etiology of spinal shock remain controversial. Time passed after trauma in initial recovery of any reflex is duration of spinal shock and this duration varies among patients. The factors influencing this duration and its clinical significance are not well studied.

Objectives:
A study was done to determine the duration of spinal shock in spinal cord injury (SCI), the first reflex to return while recovering from spinal shock & the factors influencing duration of spinal shock.

Methods:
116 patients in spinal shock following SCI were included. A detailed neurological examination of sensory, motor and reflex activity was done everyday till the patients were out of spinal shock. The duration of spinal shock by appearance of any reflex, the first reflex to return & the influence of variable factors on duration of spinal shock were studied.

Results:
In 76 patients (85.4%) anal wink (AW) was the first reflex to return either alone or simultaneous with BC / DPR. In 7 patients cremastric reflex, in 3 pathological reflexes & in 2 deep tendon reflexes (ankle) were the first to return.
Mean duration of spinal shock (MD of SS) was shorter in children, shorter in malnourished, shorter in untrained/laborers, shorter in patients admitted early and shorter in patients without any complications. "MD of SS" was not influenced by sex of patient, associated injuries and by different modalities of treatment.

Conclusion:
On statistical analysis of duration of spinal shock with neurological level as a variable "MD of SS" was 1.7 days in cervical cord lesions, 8.2 days in upper thoracic, 15 days in lower thoracic and 17 days in lumbar cord lesions. Such an arithmetical progression was also found at each segmental level i.e. the duration of spinal shock progressively increased at every segmental level. "MD of SS" was 1.36 days at C4, 1.60 at C5, 1.72 at C6, 8.1 at T6, 12.4 at T8, 13.1 at T10, 15.3 at T12 & 21.6 at L2.

Significance: An arithmetical relationship exist between the duration of spinal shock and the segmental level of spinal cord injury - the duration of spinal shock was directly proportional to level of injury. Higher or proximal the lesion, shorter is the duration. We do not have the answer of this important observation. Does the duration of spinal shock dependant on the cord length / neuronal mass involved / spared?

Motor segmental recovery in traumatic paraplegia - A blessing in disguise!
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Introduction:
Recovery following spinal cord injury is most difficult to predict. Spinal cord does not regenerate once damaged, but nerve roots may do so if an optimum environment is provided. Although distal neurological recovery is unlikely in ASIA Impairment Scale AIS-A (complete lesions), root recovery of spared nerve roots at the site of injury can occur. ASIA has recognized Zone of partial preservation & Zonal segmental recovery below the neurological level. Such a recovery in motor functions (Motor segmental recovery -MSR) of lower cervical roots in tetraplegia, and of lumbar roots in paraplegia may make all the difference in final outcome of ambulation & functional status of the patient.

Method:
100 patients of Thoracolumbar injuries with complete neurological deficit (AIS - A) underwent surgery. In 60, posterior instrumentation alone (Gp1) and in 40 posterior instrumentation with laminectomy (Gp2) was done. Results of these were compared with age sex matched 100 cases treated conservatively (Gp3). At 1 year follow-up, functional distal neurological recovery (FDNR) was said to be significant when AIS A improved up to AIS- D/E and MSR was said to be significant (MSR-Sig) when key muscle had a power > 3 on MRC scale.

Results:
Merits of surgery (Gp1 & Gp2) over conservative (Gp3) were many in terms of reduction, stability, pain-function scores, total hospital stay, ambulation mode and ambulation time. In Gp3, FDNR was 7% (7/100) and MSR-Sig was 40% (40/100). In Gp1 FDNR was 11.67% (7/60) and MSR-Sig was 68.33% (41/60). When laminectomy was added with instrumentation (Gp2) FDNR was 12.5% (5/40) and MSR-Sig was found in 92% (37/40) of cases.

Conclusion:
A very significant observation in surgically treated group was that when laminectomy (posterior decompression) was added to posterior instrumentation, significant MSR was found in 92% cases. This was especially beneficial in thoracolumbar injuries where MSR-Sig of the L1 & L2 roots made all the difference between an ambulatory life (with braces) and an otherwise permanent wheel chair bound life.
MRI in spinal trauma - a predictor of neurological recovery!

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Objectives:
To correlate MRI findings with neurological recovery and functional outcome as predictor of recovery in spinal cord injury

Methods:
We performed this prospective study on sixty two patients of acute spinal trauma. We evaluated the epidemiology of spinal trauma & various traumatic findings by MRI. Then the MRI findings were correlated with clinical findings at admission & discharge according to ASIA impairment scale. Four types of MR signal patterns were seen in association with spinal cord injury- cord edema / non haemorrhagic cord contusion (CC), severe cord compression (SCC), cord hemorrhage (CH) and epidural heamatoma (EH). Isolated lesion of cord contusion was found in 40%. All other MR signal patterns were found to be in combination. In cord contusion we further subdivided the group into contusion of size < 3 cm and contusion of size > 3 cm to evaluate any significance of length of cord contusion. In cord heammorhage involving >1cm of the cord, focus was said to be sizable

Results:
On bivariate analysis, there was a definitive correlation of cord contusion (CC) involving <3cm & > 3cm of cord. In >3cm chances of improvement was 5.75 times lesser than in patients with CC involving <3cm of cord (odds ratio = 5.75 (95% CI: 0.95, 36), Fisher’s exact p = 0.0427 (p<.05).
Presence of sizable focus of haemorrhage (HC) in cord (>1cm) was most strongly associated with the poor outcome. The risk of retaining a complete cord injury at the time of follow up for patients who initially had significant haemorrhage in cord was more than 6 folds with patients without initial haemorrhage (odds ratio 6.97 and p=.0047). It was noted that the patients in which epidural hema-toma (EH) was present, no improvement was seen, however, by statistical analysis it was not a risk factor and was not related with the outcome (odds ratio = 0.5 and p = 0.22). Presence of severe cord compression (SCC) was a risk factor for poor outcome (odds ratio = 4.90 and p = 0.0143)

On multiple logistic regression / multivariate analysis for estimating prognosis, sizable focus of hemorrhage was most consistently associated with poor outcome (odds ratio -6.73 and p= 0.32). In severe cord compression the risk of poor outcome was more (odds ratio 4.3 and p=0.149 however was not statistically significant. Presence of cord oedema / non haemorrhagic contusion was not associated with poor outcome (odds ratio 0.25 and p=0.178)

Misdiagnosis of thoracic cord arteriovenous malformation: a case report

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USA

A 65-year-old male with a medical history of diabetes and hypothyroidism presented with a 4-year history of inability to walk and bilateral lower extremity weakness. He had previously been evaluated by neurology and was diagnosed with chronic inflammatory demyelinating polyneuropathy. He had undergone intravenous immunoglobulin treatments without improvement of his symptoms. The patient denied any bowel or bladder symptoms. Results of a physical examination revealed unsteady and ataxic gait, tenderness to palpation over the thoracic spine, and 3/5 muscle strength in the lower extremities. Deep tendon reflexes were 2/4, and there was no evidence of upper motor neuron signs.

Previous magnetic resonance images (MRI) of the brain, cervical spine, and lumbar spine showed no significant abnormality. MRI of the thoracic spine was performed, which revealed significant cord edema and signal abnormality from T5 to T9, and multiple abnormal vessels consistent with a large vascular malformation. Neurosurgery was consulted, and the patient was recommended to undergo embolization. Unfortunately, the patient passed away due to unrelated causes before scheduling the procedure.

Spinal cord arteriovenous malformations are rare disorders that can cause neurologic deterioration. Due to the abnormal connections between arterial and venous pathways, venous pressures are increased, which result in a decreased ability of these veins to clear blood from the area, which can predispose the patient to ischemia or hemorrhage within the cord and a loss of spinal cord function. Patients may present with abrupt pain; progressive loss of strength or sensation; or bowel, bladder, or sexual dysfunction. Diagnosis is made by MRI of the spine. Treatment options include open surgical ligation or resection of the malformation, endovascular occlusion, spinal radiation, or a combination of these techniques.

We present a rare case of a patient with a thoracic spinal arteriovenous malformation. Clinicians should be aware of this entity and should consider further imaging of the cervical and thoracic spine in patients presenting with lower extremity weakness and a normal lumbar MRI.
**P20**

**Effect of Poncirus Fructus on Colonic Motility and Bowel Habits in Spinal Cord Injured Patients**

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**Background:**
The Poncirus Fructus (PF) is a dried immature fruit of Poncirus trifoliate (L.) Raf. and widely used as a traditional folk medicine in Southeast Asia. PF has been used for gastrointestinal disease such as constipation.

**Objective:**
To investigate the effect on improvement of colonic motility and bowel habits and the safety of PF in spinal cord injured (SCI) patients. Method: A total of ten SCI patients were recruited. Plain capsules containing PF 50g per day was administered to these patients for 14 days. Patient interview and medical records review such as pattern of SCI, level of injury, bowel habit pattern, constipation score and Bristol scale was conducted. Total and segmental colon transit time (CTT) were assessed using radio-opaque markers (Kolomark). We compared the symptoms related to constipation before and after PF administration. We also compared CTT before and after PF administration, adverse events related to PF administration were investigated.

**Results:**
The symptom changes before and after PF administration were as follows: 1) frequency of bowel movement (4.4 vs. 5.1, p<0.05), constipation score (6.3 vs 5.1, p<0.05) and Bristol scale (3.75 vs. 3.48). Total CTT was 52.0±24.4 hours before PF administration while 39.4±25.5 hours after PF administration (p<0.05). Right, left and rectosigmoid CTT was 21.2±21.4, 26.3±17.3 and 12.5±9.4 hours before PF administration while 7.4±7.3, 13.1±10.7 and 16.1±25.5 hours after PF administration. No significant adverse events occurred, but two patients were complains diarrhea.

**Conclusion:**
PF seems to be effective and safe on constipation in SCI patients. But, further investigations about the safety and effective dose of PF were needed.

**P21**

**Overactivity of the bladder after SCI can be attenuated by tamsulosin**

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**Objective:**
To investigate whether the hyperactivity of the bladder caused by spinal cord injury can be attenuated or not by tamsulosin, is an alpha-blocker that works by relaxing the muscles in the bladder neck and prostate.

**Method:**
Forty eight Sprague-Dawley rats were divided into 3 groups: the control (CON), the SCI (SCI) and the SCI with tamsulosin treatment (SCI+TAM) group. A spinal cord transection was performed surgically at the T10 vertebral level. Tamsulosin was injected intraperitoneally at doses of 1 mg/kg which was dissolved in distilled water once every morning for a week in the SCI+TAM group. After 1 week, in a part of the animals, continuous filling cystometry was performed in conscious animals 2 days after the bladder catheter implantation in both group of rats and basal pressure (BP), maximal voiding pressure (MVP), micturition duration time (MDT) and micturition interval time (MIT) was measured in each rat. In the other animals, the whole bladder was removed after decapitation as fastly as possible and used for in vitro organ bath study. The whole bladder was cut as a horizontal ring from the dome to the bladder neck and mounted in a 10-ml organ bath. The percent changes in contractility from baseline after Ach treatment alone, Ach with muscarinic (M) 2 receptor blocker (AQ-RA741) pretreatment, and Ach with M3 receptor blocker (4-DAMP) pretreatment were compared between groups.

**Results:**
In conscious cystometry study, compared to the CON group, all parameters are significantly reduced and prolonged in SCI and SCI+TAM group (p<0.05). However, there was also a significant increase in voiding interval in SCI+TAM group compared to the SCI group (p<0.05). In the organ bath study, acetylcholine-induced contractility in the SCI and SCI+TAM group was significantly higher than that in the CON group (p<0.05). However, there was a significant decrease in Ach-induced contractility in SCI+TAM group compared to the SCI group. Additionally, there was also a significant decrease in Ach-induced contractility under 4-DAMP pretreatment in SCI+TAM group compared to the SCI group.

**Conclusion:**
These results suggest that the hyperactivity of the bladder after SCI can be attenuated by tamsulosin treatment.
Techniques and results of neurosurgical treatment of Chiari malformation at adults.
Slinko, Eugene
Ukraine

Aim of background:
The best surgical tactics in Chiari malformation not established yet. Many authors used syringes drainage, craniovertebral decompression of various kind.

Material and Methods:
The results of supervision and surgical treatment of 93 patients with various kinds of Chiari malformation, which were operated in 1995-2011 in Institute of Neurosurgery were analyzed. Among 93 patients Chiari malformation 0 is marked at 5 patients, Chiari malformation I at 57, Chiari malformation 1,5 - at 16, Chiari malformation II - at 13 patients, Chiari malformation III has not been marked, Chiari malformation IV is marked at 2 patients. For the period of 1995-2011 we consistently applied three different variants of surgical tactics depending on type of Chiari malformation. Change of surgical tactics for 1995-2011 has been caused by search of ways of improvement of clinical results and unsatisfactory results on the control MRI researches in case of application of the first and the second surgical tactics.

Results:
Control MRI was executed in various lines from 12 days till 9 years after operation. After operation the neurological semiology has been in details appreciated, subsequently in the remote period she was estimated at out-patient supervision over patients. The remote terms of supervision have made 3.7 years (on the average), the longest period has made 9 years. Data on the remote period are received from 68 patients.

Conclusion:
For achievement of the best result surgical treatment intervention should be directed on treatment of Chiari malformation and, accordingly: suboccipital decompression, restoration of cerebrospinal fluid outflow in craniovertebral junction, increase in total amount of a posterior fossa or and cranio-vertebral junction.

Renal tract computed tomography in spinal cord injured patients: trends, indications and outcomes.
Lopez de Heredia, Luis; Hughes, Richard; Belci, Maurizio; Meagher, Tom
National Spinal Injuries Centre, United Kingdom

Objective:
To evaluate the indications for, trends in use of and outcomes of computed tomography of the renal tract (CT) in patients with spinal cord injury.

Methods:
Single institution retrospective study. All patients having CT of the renal tract between 2006 and 2011 were included. The indications for the studies, findings and numbers of scans per patient in the study period were reviewed. Numbers, size of renal and ureteric calculi were recorded as was the presence of renal scarring. There was a year on year significant increase in use of CT.

Results:
118 patients had 209 CT scans. The most frequent indications were evaluation of known calculi in 61 (52%) patients, investigation of outflow obstruction in 16 (14%), recurrent UTI 8 (7%) and clarification of calculi suspected on other investigations 7 (6%). 62 (51%) patients had renal calculi and 8 (7%) patients had ureteric calculi. 23 patients had 3 or more CT studies (range 1 -7) in the study period.

Conclusion:
CT is increasing in use in the spinal cord injured population most frequently for the monitoring of stone disease. The incidence of ureteric stones supports early use of CT in patients with hydronephrosis.
P24
Type II odontoid fracture in patients older than 65 years: relationship with osteoarthritis in the upper cervical joints
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Object:
An older person usually sustains a Type II odontoid fracture in a fall from standing or a seated height. A relationship between osteoarthritis in the upper cervical spine and Type II odontoid fracture has been reported. However, to our knowledge, few reports have investigated statistically whether disproportionate degeneration between joints influences the susceptibility to fracture. The purpose of this study was to assess predisposition to Type II odontoid fracture, evaluating CT findings by focusing on osteoporosis and the disproportion in degeneration between each of the upper cervical joints.

Methods:
Our series included 38 patients aged 65 years and older. Seventeen patients had a Type II odontoid fracture (G-Type II), and 21 patients had other axis fracture types (G-other). Using the CT findings, we classified osteoporosis at the dens–body junction and the severity of degenerative changes in the atlantoaxial, atlantooccipital, and lateral atlantoaxial joints as none, mild, moderate, or severe. The proportion of patients with moderate or severe osteoporosis and degenerative changes in each joint and that of patients with disproportionate degenerative changes between joints (difference in grade of ≥ 2 levels between joints) were compared statistically.

Results:
Patients with osteoporosis and with disproportionate degenerative changes between the atlanto-odontoid and lateral atlantoaxial joints were significantly more likely to have a G-Type II than a G-other. These two factors were also assessed in multivariate logistic analysis. The disproportionate degenerative change between the atlantoaxial and lateral atlantoaxial joint remained significant, even after adjusting for osteoporosis.

Conclusions:
The elderly with the dens fixed to the atlas because of degeneration of the atlantoaxial joint and a smooth lateral atlantoaxial joint seem to sustain Type II odontoid fractures because, during a simple fall, the rotation of the head produces torque force on the dens–body junction.

P25
Unstable atlas fractures treated by anterior plate fixation with transoral approach
Ma, Weihu
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Background:
Although most unstable atlas fractures can be managed by external immobilization with good results, surgery is usually preferable in highly unstable cases, and clear transverse ligament injury and in patients with atlantoaxial joint instability. Surgical stabilization has been described using posterior approaches as fixation on C1-C2 or C0-C2. However, atlantoaxial fixation and occipitocervical fixation for the treatment of atlas fractures is at the expense of atlantoaxial and occipitocervical most of the functions. Among the different posterior approaches, direct fixation of unstable atlas fractures with transpedicular screw has the advantage of preserving motion of the atlantoaxial and occipitocervical. Unfortunately, transpedicular screw fixation can not deal with the anterior arch fracture.

Methods:
Throughout March 2004 to May 2010, 12 patients with unstable atlas fracture were admitted. They included 9 male patients and 3 female patients ranging in age from 23 to 68 years with a mean of 47.8±15.2 years. Of the 12 cases of unstable atlas fracture, 4 cases were classified as anterior arch fracture, 8 cases were classified as 1/2 ring Jefferson fractures. All 12 patients were treated surgically by anterior plate fixation by means of transoral approach. The whole procedure was done under monitoring of C-arm fluoroscopy for safety and accuracy.

Results:
All patients were followed up from 12 to 81 months, with the average of 48.6±21.1 months. There were no screw loosen and breakage, no plate displacement, and no spinal cord and vertebral artery injury intraoperation. A total of 12 plates were placed and all 24 screws inserted into atlas lateral mass. Computed tomographic scans demonstrated 2 screws were placed too close to the vertebral artery canal, but without clinical consequences. Static and dynamic films demonstrated that fusion was achieved in all cases at 6 months after surgery. No plate-related complication was observed in all patients in the whole follow-up period.

Conclusion:
C1 anterior plate fixation is an effective method for management of unstable atlas fractures, which proved its value as a method achieving solid bony fusion combined with low rate of complication.
Penile Plethysmography in Patients with Spinal Cord Injury
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Department of Rehabilitation Medicine, Korea, Republic of

Objective:
Penile plethysmography is a tool for assessing changes in blood flow in the penis. The sympathetic nerves to the penis originate from the T10 to L2 spinal segments, and it is related to penile blood flow regarding erectile dysfunction. We investigated the relationship between penile plethysmography and preservation of the thoracic sympathetic trunk outflow in patients with spinal cord injury.

Method:
We enrolled 25 males with spinal cord injury. The mean age was 45.8 years (range 18-74 years). The neurological levels of spinal cord injury were included from C3 to L2 levels. The patients were classified into two categories according to the injured level (above T9 and below T10 levels) and completion (AIS A and B-D). We measured both brachial and ankle blood pressures, penile blood pressure to calculate the Ankle Brachial Index (ABI) and Penile Brachial Index (PBI). The PBI and ABI were measured using penile plethysmography (Nicolet VasoGuard®). Interdependence of such variable quantities were assessed using independent samples T-test.

Results:
The mean PBI were 1.05 in above T9 group and 1.18 in below T10 group. PBI showed reliable difference between two groups (p=0.047). However, there was no significant difference between two groups regarding completion of spinal cord injury.

Conclusion:
The PBI has a positive relationship with the preservation of thoracic sympathetic trunk outflow. Penile plethysmography would be useful to evaluate quantitative penile blood flow in patients with spinal cord injury. Further studies related with actual erectile function and relationship with drug provocation effect for the patients with SCI.

Incidence of Deep Vein Thrombosis in Korean Patients without Pharmacologic Thromboprophylaxis at Acute Rehabilitation Service after Spinal Cord Injury
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Physical and Rehabilitation Medicine, Korea, Republic of

Objectives:
To evaluate the incidence of deep vein thrombosis (DVT) and to identify the risk factors of DVT after spinal cord injury (SCI) at acute rehabilitation in a Korean population.

Setting:
Acute rehabilitation service in a tertiary referral hospital.

Methods:
We retrospectively analyzed the medical records of 185 SCI patients admitted for acute rehabilitation service at a tertiary referral hospital from January 2002 to July 2011. Patients were not able to ambulate with bipedal locomotion and underwent color Doppler ultrasonography to screen for the occurrence of DVT in both lower extremities at the time of initial presentation to acute rehabilitation service and in the absence of pharmacologic thromboprophylaxis. Primary study outcome was the incidence of DVT (asymptomatic as well as symptomatic). Possible risk factors for DVT including the epidemiologic characteristics, completeness of motor paralysis, cause of injury, spasticity, surgery, and cancer were analyzed.

Results:
The incidence of DVT after SCI was 27.6% [95% confidence interval (CI) 21.1, 34.0] at the time of initial presentation for acute rehabilitation. Proximal DVT was found in 12 patients (6.5%, 95% CI 2.9, 10.0). In multiple logistic regression analysis, absence of spasticity was a significant independent risk factor (p<0.05) for occurrence of DVT. Symptomatic pulmonary embolism was evident in seven patients (3.8%, 95% CI 1.0, 6.5) without an episode of sudden death.

Conclusion:
The incidence of DVT at acute rehabilitation without pharmacologic thromboprophylaxis after SCI in Korean patients was comparable with previously reported results in Western populations. This result suggests that pharmacologic thromboprophylaxis should be considered in Korean patients with SCI.
Predictors of complications after traumatic spinal cord injury
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Background and aim:
Complications frequently occur in patients with spinal cord injury (SCI) during acute care or rehabilitation. Prevention of complications shortens the stay in a rehabilitation centre and increases the chance of returning home after rehabilitation. The aim of this study was to determine the occurrence and risk factors for complications in recently injured SCI patients.

Patients and methods:
Retrospective review of charts of 274 patients with traumatic injuries. The number of patients with and without complications had been counted for the following dichotomous parameters: gender (males/females), associated lesions (presence/absence), surgery (yes/not), AIS grade (A/other categories), lesion level (lumbar/other levels), lesion-to-admission time (less/longer than 1 month). The odd ratio (OR) and relevant 95% confidence interval were computed for all the parameters resulted significantly influencing the presence of complications at admission. These factors have been included into a binary logistic regression analysis (forward stepwise).

Results:
Complications at admission were observed in 104 patients (41.6%), especially for males (OR=3), lesion-to-admission time longer than 1 month (OR=3.4), presence of associated lesions (OR=3.1), AIS grade A (OR=4.5), whereas lumbar lesions were associated to a significantly reduced presence of complications at admission (OR=0.3). In the regression analysis the factors entering into the model were: AIS grade, lesion-to-admission time, associated lesions and gender. The final model explained the 74% of the variance of data. With the exception of gender, all the other factors significantly (p<0.01) influenced the presence of complications at admission, with OR between 2.3 and 5.4.

Conclusions:
Despite advances in the acute management of patients with SCI, the study unveiled a high percentage of patients with complications at admission to rehab. The risk factors identified in the study allow to determine the population of subjects who are at higher risk of developing complications and need special care management.

The effects of lower limb compression garment on orthostatic hypotension in acute spinal cord injury patients
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Orthostatic hypotension (OH) following traumatic spinal cord injury (SCI) may present during the initial stage of rehabilitation in a significant number of SCI survivors and may persist for years. OH impacts on the general health of SCI individuals, their cognitive performances, sitting tolerance, mobility and ambulation potential. The profound effects of orthostatic symptoms had been neglected in many OH interventions despite its significant impact. The study objectives are to evaluate the effects of lower limb compression on OH orthostatic symptoms and orthostatic tolerance in acute traumatic SCI patients.

The study is a case control study of consecutive admissions to the inpatient SCI Rehabilitation service, UMMC. Subjects with OH following an orthostatic challenge test were randomized into intervention or control groups. The intervention consists of thigh-length lower limb compression garment conferring 40 mmHg pressure at the ankle worn during 1 hour therapy session daily. The control subjects were using thromboembolic deterrent thigh-length stockings. The orthostatic challenge tests were repeated weekly for four weeks whereby blood pressure, orthostatic symptom evolution and orthostatic tolerance time were monitored. The symptom burden was assessed using the Symptom-Specific Score- Orthostatic Intolerance Questionnaire.

12 subjects were recruited between September 2009 to January 2010. Only 10 subjects had positive orthostatic challenge test. There was significant improvement (p <0.01) in orthostatic tolerance and symptom burden after four weeks of lower limb compression use. Recurrence of orthostatic hypotension was not prevented by lower limb compression after 4 weeks. The motor complete cervical and upper thoracic subjects consistently showed a higher incidence and persistence of OH.

In conclusion, lower limb compression has lead to symptom reduction and increased orthostatic tolerance with repeated use during the early rehabilitation phase in individuals with tetraplegia and high paraplegia. This may promote early rehabilitation participation; reducing the risk of developing complications and may improve functional outcome.
**P30**

"Long Term Assessment of Neurogenic Bladder Following Myelopathies by Repeat Urodynamic Study & Correlation with Neurological & Functional Recovery"

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**Study Design:**
Prospective follow-up study

**Objective:**
To assess neurogenic bladder following traumatic & non-traumatic myelopathies during inpatient rehabilitation by performing urodynamic study (UDS). Procedure repeated at least after 12 months follow-up to observe any change in the bladder behavior and correlation between neurogenic bladder and neurological & functional recovery of the patients during the same period.

**Setting:**
Rehabilitation unit in university tertiary hospital.

**Methods:**
Thirty-one patients (24 males) with myelopathies (23 non-traumatic & 8 traumatic), mean age of 31.2±11.9 yrs (8-65 yrs) admitted for inpatient rehabilitation. All had neurogenic bladder with initial UDS suggestive of; 17 patients with overactive detrusor and 14 with underactive/normal detrusor. Management advised accordingly. After minimum 12 months follow-up (12-23 months, 15.5±3.5), UDS was repeated.

**Results:**
Significant change (p<0.001) in detrusor behavior observed comparing initial and follow-up UDS findings. During both occasions there was no significant correlation (p>0.05) between bladder behavior and neurological recovery (using American Spinal Injury Scale-ASIA) & functional recovery (using Barthel Index scale-BI). Significant functional recovery (p<0.001) observed between Admission & discharge & discharge & follow-up in patients according to BI scores. Neurological recovery was significant between admission & discharge (p<0.001) but insignificant (p>0.05) between discharge and follow-up according to ASIA scale.

**Conclusions:**
Detrusor behavior following myelopathies is dynamic and not dependent on neurological & functional recovery. Repeat UDS is essential at regular intervals for effective management of neurogenic bladder and to avoid urinary complications.

**Keywords:**
Myelopathies; Urodynamic study; neurological & functional recovery

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**P31**

A global map for non-traumatic spinal cord injury epidemiology: towards a living data repository

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**Background:**
There is very little epidemiological study on non-traumatic spinal cord injury (NTSCI). No review has been located on this topic. As an initiative of the ISCoS prevention committee, a literature review was performed to globally map key NTSCI epidemiological measures and provide a framework for an ongoing repository of data for NTSCI.

**Methods:**
A literature search of Medline and Embase (search terms ‘epidemiology of spinal cord injury’, ‘prevalence of spinal cord injury’, ‘incidence of spinal cord injury’; ‘nontraumatic’; ‘spinal cord damage’). Relevant articles in any language regarding adults with NTSCI were included. Stratification of information about incidence, prevalence into Green/Yellow/Red quality ‘zones’ allowed comparison between data.

**Results:**
The abstracts of 377 publications were reviewed, 47 of these from 25 countries in 12 of the 21 WHO global regions had relevant information. Survival data was very limited. Prevalence data for NTSCI existed for only two countries, India (prevalence of 2,309.7/million population, Kashmir region) and Canada (prevalence of 1120/million/population, but results were extrapolated). The incidence rates were: Asia Pacific, High Income 20.4 /million population/year; Australasia (26/million adults/year); Western Europe median of 5.8/million population/year; North America, High Income median 76/million population/year (but based on poor quality studies); and Oceania 8.7 /million population/year. Developed countries tended to have a higher proportion of cases with degenerative conditions and tumours. Developing countries, in comparison, tended to have a higher prevalence of infections, particularly tuberculosis and HIV, although it was interesting that a number also reported tumours as a major cause.

**Conclusions:**
Missing survival, prevalence and insufficient incidence data is a recurrent feature of this review. The piecemeal approach to epidemiological reporting of NTSCI, particularly failing to include sound regional denominators has exhausted its utility. Minimum data collection standards are required.
Taking a Back Seat: Driving after Spinal Cord Injury for Low-Income Urban Minorities
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USA

Background:
There is a growing literature on driving after spinal cord injury (SCI). Studies have identified the minimal level of physical ability required to drive, and newer research is helping us understand the mechanisms underlying independent driving and its association with longer term outcomes like community integration and participation.

Purpose/Objective:
The purpose of this study is to extend this research and ask who has access to independent driving, and further, what this access to driving (or lack thereof) means in daily life.

Method:
In-home interviews were conducted with a community-dwelling sample of men and women with SCI (n=140) residing in a large city in the mid-western United States. The interviews were part of a larger NIH-funded R01 study on community participation after SCI. Standardized scales of function and health were administered and questions were asked about driving status, possession of a valid driver’s license, vehicle ownership, employment, community integration, alternative transportation use, satisfaction with transportation, and for non-drivers, reasons for not driving.

Results:
The study found that 51% of the sample was driving (n=71) at 10.5 years post-injury. Factors significantly associated with driving included: more time since injury, paraplegia (versus tetraplegia), being male, being White, and living in a suburban or rural (versus urban) area. Drivers were also more likely than non-drivers to be employed, satisfied with their transportation situation, and report better community integration. While two-thirds of non-drivers hoped to return to driving, the cost of a car and modifications (e.g., hand controls) posed a significant barrier.

Conclusion:
Access to driving and the social benefits that follow are not equally distributed in the SCI population. For low-income urban minorities in particular, financial cost makes adapted driving nearly unattainable. More research is needed to identify cost-effective alternative transportation options.

Spinal cord injuries as a consequence of falls: are there differential rehabilitation outcomes?
Kennedy, Paul; Cox, Angeline; Mariani, Alessia
1United Kingdom; 2Italy

Study Design:
Case series, consecutive sample, survey.

Objectives:
To examine the incidence of spinal cord injuries sustained as a result of falls compared to other causes, and to investigate rehabilitation outcomes between these two groups.

Setting:
Tertiary care, spinal cord injury rehabilitation unit (National Spinal Injuries Centre), Stoke Mandeville Hospital, UK.

Method:
Demographic information and descriptive statistics were examined for individuals sustaining their injury via falls versus non-falls. Statistical analysis investigated rehabilitation outcomes between the groups.

Results:
The etiology of SCI reported is similar to previous findings. Individuals who sustained their SCI as a result of falls and other causes made equal improvements from the start to end of rehabilitation, according to the Needs Assessment Checklist, a clinical measure of individual rehabilitation needs in ten domains. However, those in the falls group achieved less overall throughout rehabilitation, and this was significant at pre-discharge for the areas of bladder management, mobility, and discharge.

Conclusion:
Results highlight the need for specific consideration to be made of the rehabilitation needs of individuals who sustain SCI as a result of a fall, and for these to be addressed in rehabilitation programming.
**Perceptions of gain following spinal cord injury: A longitudinal qualitative analysis**

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¹United Kingdom; ²Switzerland; ³Sweden

**Study Design:**
Qualitative, longitudinal, multi wave panel design.

**Objectives:**
To explore individuals’ perceptions of gain following the experience of spinal cord injury (SCI).

**Setting:**
The data was collected as part of a large longitudinal multicentre study investigating coping and adjustment in SCI (Kennedy, Lude, Elfstrom, & Smithson, 2010). Participants in the present study were recruited from specialist units in selected British and German spinal cord injury centres.

**Method:**
Participants were asked the following question: ‘What do you think you have gained from the experience of spinal cord injury?’ This was administered at four time points post-injury: 6 weeks, 12 weeks, 1 year and 2 years.

**Results:**
Participants’ responses were analysed qualitatively using the framework of thematic analysis. Thirteen themes were identified: relationships, appreciation of relationships, perspective and appreciation of life, new goals or priorities, understanding of SCI or disability, appreciation of health or healthcare, changed personality, opportunity or challenge, knowledge of SCI or body, newly acquired skills, spirituality, acceptance, and nothing. Descriptive statistics were incorporated in presentation of the data.

**Conclusion:**
This study provides evidence that a broad range of positive as well as negative psychological outcomes are possible following SCI. More research is needed in order to better understand the process through which these outcomes arise, and to inform how such outcomes may be communicated to those experiencing this type of injury.

**Continuing with life as normal: Positive psychological outcomes following spinal cord injury**

**Kennedy, Paul; Griffiths, Helen**

United Kingdom

**Background:**
Research into the psychological sequelae of spinal cord injury (SCI) has traditionally focused on individuals experiencing psychological distress, despite prevalence rates of mental health difficulties remaining low. Positive psychological frameworks such as resilience and posttraumatic growth (PTG) have begun to explore how some individuals do not report psychological distress, while appraisals have been posited as a possible mediators of psychological outcome. Research into positive psychological outcomes in people with SCI is still in its infancy. This research focused on individuals reporting lower levels of distress following SCI and their description and explanation of the positive psychological outcomes they experience.

**Objective:**
To provide a description of the positive psychological outcomes experienced by people reporting low levels of psychological distress and to generate an understanding of how these individuals explain their positive outcomes. To consider the implications for research, theory and practice.

**Method:**
Six participants (two female, four male) reporting low levels of psychological distressed were interviewed using a semi-structured interview schedule exploring their experiences of SCI and their psychological journey. Interpretative phenomenological analysis was used to analyse the data.

**Results:**
Three superordinate themes were identified: “Living a normal life, just doing things differently”, “Overcoming challenges: Determination to succeed” and “Using the resources available to me”. Describing and explaining a positive psychological outcome was complex. Positive psychological outcomes did not mean not experiencing psychological difficulty to participants; moreover they described an ability to overcome difficulty. Challenge focused appraisal styles, social support and meaningful activity were identified by participants as being particularly important to their psychological outcome.

**Conclusions:**
Positive psychological outcomes following SCI are complex and research and theory need to better understand the experience of individuals following SCI in order to inform clinical practice.
Light touch scores consistently higher than pinprick in the ASIA impairment scale (AIS) sensory assessment of spinal cord injury
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Background:
Quantitative sensory tests (QST) are increasingly being promoted to augment the clinical AIS light touch (LT) and pinprick (PP) tests of cutaneous sensibilities in spinal cord injury (SCI). Since AIS LT and PP (and QST) assess different modalities of sensation and have the potential to reveal the integrity of anatomically distinct pathways, we wished to see how well the LT and PP test scores are matched in a cohort of SCI subjects with a variety of levels and degrees of injury.

Methods:
A retrospective analysis of LT and PP scores of 99 SCI subjects at the time of release (1.5 weeks to 15 months, median 5 months) from acute care in the London Spinal Injuries Centre was conducted. Demographically the group were aged 10-88 yrs (median 44 yrs; 78 male, 21 female; 74 traumatic, 25 non-traumatic) and consisted of 40 AIS A, 7 B, 18 C and 34 D.

Results:
LT was well correlated with PP (R = 0.87, P<0.001) but was significantly higher than PP (LT 64.5 ±3.2, PP 54.7 ±2.9, mean ±SE, P<0.001). A similar difference in score (LT>PP) was registered both for traumatic and non-traumatic injury, but was greater for incomplete (LT 76.2 ±3.8, PP 63.1 ±3.7, P<0.001) and less for complete (LT 47.1 ±4.1, PP 42.3 ±4.1, P<0.001) subjects.

Conclusions:
Literature search has also shown the LT score to be consistently higher than PP. The reason for the discrepancy could be: (1) technical, related to the relatively greater difficulty in applying or discriminating stimuli with PP (blunt versus sharp), or (2) it could reflect a general difference in the impact made by injury or disease on the two anatomically separate tracts that convey LT (posterior columns) and PP (anterolateral spinothalamic) sensation.
Education program for individuals with spinal cord injury and family caregivers
Fizzotti, Gabriella; Castagna, Erica; Mazzucchelli, Veronica; Cremascoli, Sonia; Pistarini, Caterina
Spinal Unit, Italy

Introduction:
Life after a spinal cord injury (SCI) often means a loss of independence for the injured person, and to function in everyday life, patients often need caregivers. Family members or friends who take on the role of caregiver after a loved one is injured often find themselves serving in many different roles: supporter, teacher, supervisor, coach, and nurse.

Objective:
The goal of the study was to investigate daily difficulties experienced by caregivers who providing care for a seriously spinal cord injured patient.

Method and Materials:
The sample consisted of 7 caregivers: 5 females and 2 males. An extensive questionnaire regarding daily living problems (conditions, posture, transfers, use of wheelchair, personal hygiene, clothing, home management) was administered to caregivers who agreed to participate in the study.

Results:
Caregivers indicated particular problems related to transfers, use of the wheelchair and daily living activities. Regarding the use of the wheelchair the most common problems concerned the wheelchair – car and car-wheelchair transfers; proportions rose (70%) when they had to move from the wheelchair to wc and viceversa, and from wheelchair to bath and viceversa; more than 80% of caregivers indicated the wheelchair-shower transfer as the most demanding.

Conclusion:
With appropriate education of caregivers it is possible to obtain an appropriate follow up following a SCI. The patients should be expected to maintain their own health and well-being. This study helped to confirm our belief that life and its functions continue after paralysis. Clinicians who care for patients with SCIs play an important role in facilitating the education of caregiver. Staff members are to be involved and Occupational therapists should use their skills and imagination to develop a program for this outcome.

Dietary intervention for individuals with spinal cord injuries – a 2 year report on the Spinal Clinic for Obese Out-patient Project (SCOOP)
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1Nutrition and Dietetics, United Kingdom; 2National Spinal Injuries Centre, United Kingdom; 3Centre for Gastroenterology and Clinical Nutrition, United Kingdom

Obesity is common after spinal cord injuries (SCI) (1) and it is associated with chronic nutrition related complications. We previously reported that a simple dietetic-intervention can help SCI patients to lose weight without compromising lean body mass.(2) The present study aimed to assess the effectiveness of a dietitian led weight management clinic. Thirty-one individuals (52.4 + 11.5 years; body mass index (BMI): 32.9kg/m2; 41% female) with SCI were referred for consultation to include nutritional advice and cognitive behaviour therapy in three consultations over 4 months. Outcomes measures included body composition from anthropometric measurements of BMI, mid upper-arm circumference (MUAC), triceps skinfold thickness (TSF) and mid-arm muscle circumference (MAMC), sitting blood pressure and dietary assessment of nutrient intake by 7-d food diary. Of the thirty-one individuals, 15 (48.4%) reported one or more co-morbidities. Mean weight loss was 4.5kg (s.d. 6.2) at week 16. Analysis of the pre- to post-intervention difference (using paired t-test) showed a significant reduction in weight (104.2 v 100.4kg, p=0.001), BMI (34 v 33.1kg/m2, p=0.004), total energy intake (6.84 v 5.62 MJ/d, p=0.029), total fat (p=0.005), saturated fat (p=0.001) and alcohol (p=0.003). No significant changes were found in MUAC, TSF, MAMC and sitting blood pressure post intervention. We noted a significant reduction in MAMC at 1 year follow up (30.2 v 27.1cm, p<0.001). The 7-d food diary showed an average energy intake of 7.65 MJ/d, which is 15% below the estimated requirement. The findings of this study suggest that current guidance overestimates nutritional requirements in the SCI population, and that simple dietetic-intervention could help overweight SCI patients to achieve weight loss, but that it may not be sufficient to stimulate / maintain muscle mass long term. Further research is warranted to test whether combining lifestyle and intensive physical therapy could reduce long-term muscle wasting.

References:
Micronutrient intake in overweight adults with spinal cord injury: analysis before and after dietetic intervention

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There is currently limited evidence reporting the nutritional status of patients with spinal cord injury (SCI) (1,2). This study aims (i) to describe micronutrient intake with reference to the UK Lower Reference Nutrient Intake (LRNI) (3) and the national survey data4 and (ii) to compare the micronutrient intake of overweight SCI adults, before and after dietetic intervention. Thirty-two SCI patients’ (52.4±11.5 years; BMI: 32.9±4.7kg/m2; 41% female) 7-day food diaries were analysed at baseline and follow-up. The average weight loss was 3.7% after dietetic intervention. A significant reduction was found for zinc (p=0.005) and folate (p=0.05) intake in women and riboflavin (p=0.05) in men after intervention. Male and female participants failed to meet the LRNI for selenium before intervention, and females failed to meet the LRNI for potassium and selenium after intervention. In addition, our data show disparity when compared to findings of the national survey. Individuals are likely to have reduced physical activity and become institutionalised after SCI. Currently there is no generally recommended vitamin D intake for individuals less than 65 years old. Of participants aged 65 or above, 80% and 100% did not meet the LRNI for Vitamin D at initial assessment and follow-up respectively. The low vitamin D intake may be associated with an increased risk of complication such as osteoporosis. This study reveals possible micronutrient deficiencies in relation to the UK standards despite participants’ diets containing excess energy, suggesting that their diets contain nutritionally poor quality food. With the exception of Zn, folate and riboflavin, there was no significant difference in micronutrient intake following dietetic intervention, suggesting that the quality of the diet was, in general, improved without severely compromising the micronutrient profile. When working with overweight SCI patients, clinicians must be aware of pre-existing dietary inadequacies of micronutrients and facilitate improvements in the quality of the diet as well as reducing energy intake. Further research on nutrient intake in this group of vulnerable patients is warranted.

Is nutritional risk associated with adverse clinical outcomes such as length of stay and mortality in spinal cord injured patients?

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1Nutrition and Dietetics, United Kingdom; 2National Spinal Injuries Centre, United Kingdom; 3School of Community and Health Science, United Kingdom; 4Centre for Gastroenterology and Clinical Nutrition, United Kingdom

Malnutrition is common in patients with spinal cord injuries (SCI), but its impact on clinical outcome may be underestimated. A disease specific nutrition screening tool (NST): the Spinal Nutrition Screening Tool (SNST) has been developed for use in patients with SCI but its predictive validity requires further investigation2. A multicentre (n=4), prospective, cross sectional and longitudinal study was therefore performed to evaluate whether undernutrition risk, measured using a simple validated nutrition screening tool (NST): the Spinal Nutrition Screening Tool (SNST), is associated with clinical outcomes such as the duration of in-patient stay (LOS) and 12 month mortality. Multivariate regression analysis was used. One-hundred and fifty SCI patients (aged 18-88, median: 16.9, 30.7 % female) were studied in 4 UK SCI centres (SCIC) between July 2009 and March 2010. The median LOS was 101 days (s.d: 94.1) and the 12 month mortality rate was 4.7%. 44.6% were at risk of undernutrition and these individuals had a significantly longer LOS [median LOS (s.d): 129 (102.1) v 85 days (84.6); p=0.012] and greater 12 month mortality [9.2% v 1.4%; p=0.036]. Multivariate regression identified acute admission and serum albumin level are independent predictors for long hospital LOS.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Un-standardised coefficient (B)</th>
<th>Standard error</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>197.41</td>
<td>72.42</td>
<td>0.007</td>
</tr>
<tr>
<td>Risk of malnutrition (SNST)</td>
<td>1.15</td>
<td>20.66</td>
<td>0.956</td>
</tr>
<tr>
<td>Risk of malnutrition (MUST)</td>
<td>14.27</td>
<td>20.11</td>
<td>0.478</td>
</tr>
<tr>
<td>Type of admission</td>
<td>81.23</td>
<td>15.39</td>
<td>0.001</td>
</tr>
<tr>
<td>Previous ITU stay</td>
<td>25.35</td>
<td>17.41</td>
<td>0.145</td>
</tr>
<tr>
<td>Serum albumin</td>
<td>-3.62</td>
<td>1.461</td>
<td>0.013</td>
</tr>
<tr>
<td>Level of SCI</td>
<td>-18.31</td>
<td>14.91</td>
<td>0.219</td>
</tr>
<tr>
<td>Serum total protein</td>
<td>0.08</td>
<td>1.287</td>
<td>0.951</td>
</tr>
</tbody>
</table>

The present study suggests that nutrition risk identified by the SNST score is associated with adverse clinical outcomes. Serum albumin is an independent predictor for an adverse clinical outcome. Nutritional screening on admission and periodic repeating may be helpful in improving clinical outcomes if it is used to influence practice.

References:
Validity and reliability study of Turkish version of Spinal Cord Independence Measure (SCIM)-III

Unalan, H1; Ozekli Misirlioglu, T1; Erhan, B1; Akyuz, M1; Gunduz, B1; Ing, E1; Arslan, H1; Baltaci, A1; Aslan, S1; Palamar, D1; Kutlu, A1; Majlesi, J1; Akarimiak, U1; Karamehmetoglu, SS1
1Physical Medicine and Rehabilitation, Turkey; 2Neurology, Turkey

Objective:
To investigate the reliability and validity of Turkish version of Spinal Cord Independence Measure (SCIM)-III.

Methods:
Backward and forward translation was performed by native speakers in both languages. Patients with spinal cord injury (SCI) (204) were recruited in 3 different centers. In each center two different raters evaluated the patients using Turkish version of SCIM-III. SCIM-III was also analyzed for test-retest reliability with 48 patients' follow up evaluations whose clinical conditions would not be expected to change during this time. For measuring the validity of SCIM-III, scores were compared to patients' ASIA classifications, motor and/or sensory scores and SF-36 subscale scores.

Results:
Inter-rater reliability was evaluated with 204 patients and was analyzed using percent agreement between raters and kappa values. Total agreement values between raters changed between 75.9-91.1%; one item (respiration) had full agreement with 100%. Four items had a percent agreement below 80. Kappa values changed between 0.683-0.827 and were statistically significant for all tasks (p<0.001).

When the correlations between the two raters’ subscale scores were analyzed, it was observed that the Pearson correlation values were very high and statistically significant, and there was no significant difference between the mean values of subscales when tested with paired samples t-test.

When the correlations between total SCIM-III score and SF-36 physical health were analyzed, a Pearson correlation of 0.339 (p<0.005) was found.

In addition to the above mentioned validity analysis, SCIM-III scores of complete and incomplete patients were compared and results showed that incomplete patients scored significantly better than the complete patients, on all subscales of SCIM III. The Cronbach’s α values were calculated to measure the internal consistency of SCIM III. The Cronbach’s α values for the two raters were 0.865 and 0.896, respectively.

Conclusion:
Turkish version of SCIM-III was found to be valid and reliable.

In vivo tracing of neural tracts in twy mice by diffusion tensor tractography

Takano, Morito1; Komaki, Yuji2; Hikishima, Keigo2; Konomi, Tsunehiko1; Fujyoshi, Kanehiro1; Tsuji, Osahiko1; Toyama, Yoshiaki1; Okano, Hideyuki1; Nakamura, Masaya1
1Orthopaedics Surgery, Japan; 2Physiology, Japan

Introduction:
In cervical spondylotic myelopathy (CSM), axonal disruption results in motor and sensory function impairment. Twy mice develop spontaneous calcification in the cervical ligaments, thereby causing chronic compression of the spinal cords. Recently, we have reported that diffusion tensor tractography (DTT) is a powerful tool to examine in vivo tracing of neural pathway (Fujyoshi et al, J Neurosci 2008). The purpose of this study is to determine whether in vivo DTT can evaluate the axonal disruption of the chronic compressive spinal cords in twy mice.

Methods:
6, 15, 20 weeks old twy mice were chronologically subjected to DTT. MRI was performed using a 7.0-Tesla magnet (Biospec 70/16) with CryoProbe (Bruker biospin GmbH, Ettlingen, Germany). Diffusion tensor images were analyzed using TrackVis (Massachusetts General Hospital, MA, USA). Histological analysis was performed using HE staining, RT-97 and SMI31 DAB staining. Behavioral analysis was quantitatively estimated using Rotarod treadmill test and Digigait analysis.

Results:
We succeeded in depicting in vivo high resolution DTT of the twy mice. The progress of the ligamentous calcification was observed at C1/2 level in each twy mouse, and the number of RT-97 or SMI31 positive fibers was decreased depending on the severity of the compression of the spinal cord. Canal stenosis rate based on MRI was strongly correlated with the axial section area of the spinal cord. The tract fiber ratio (the number of tract fibers at C1/2 level / the number of tract fibers at the normal spinal cord x 100) was strongly correlated with MRI stenosis rate, RT-97/ SMI31 positive area, and motor function (Rotarod latency, stride length). Furthermore, two piece linear analysis showed that the canal stenosis over 50% caused sharp decrease of the tract fiber ratio.

Conclusion:
We conclude that DTT could be a useful method to make clear the pathology of chronically compressed spinal cord.

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We conclude that DTT could be a useful method to make clear the pathology of chronically compressed spinal cord.
P44

Hip (sub)luxation following spinal cord injury (SCI) in adults: a case-series and literature review

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Objectives:
The aim of this retrospective study is to clarify the pathogenesis, the functional consequences and possible treatment strategies for adults with hip instability due to paralysis of the lower limbs after spinal cord injury (SCI) and to match the findings with literature.

Methods:
9 hypertonic SCI patients with hip instability were enrolled: 8 with generalized increased muscle tone as a form of spasticity and 1 with only ankle clonus. The following variables were analyzed: sex, age at onset of SCI, Asia Impairment Scale (AIS), modified Ashworth scale, radiographic images of the pelvis, history of hip pathology prior to subluxation, signs of instability, time of diagnosis after SCI, unilateral or bilateral impairment, functional impact, treatment strategies and monitoring.

Results:
All patients were male and AIS A. The modified Ashworth scale ranged from 0/4 to 3/4. In 6/9 of the available radiographic images before (sub)luxation, there was no predisposition. In 6/9 patients there was a (sub)luxation within 2 years after SCI and 6/9 patients were bilaterally affected. Consequences were mainly intermittent spasticity and cessation of standing resulting in a development of talipes equinus and contractures. Also a painful discomfort in the hip and lumbar spine was mentioned in one patient. Two patients had a history of osteomyelitis around the hip prior to the (sub)luxation and in one patient bilateral neurogenic heterotopic ossifications were seen.

Conclusion:
Hip instability in adult SCI patients, especially prevalent in the population presenting with spasticity, has a significant functional impairment. The incidence and pathogenesis are still unknown. Additional prospective studies with a thorough history of trauma or infection, a standardised clinical examination of hip and pelvic girdle and radiographic imagery are necessary to bring further clarification. Presumably, the spasticity is an important cause. Literature on treatment options in this population group is limited.

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Three cases of spontaneous spinal epidural hematoma - An examination of pathogenic mechanisms

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1Department of Neurosurgery, Japan; 2Japan

Objective:
Spontaneous spinal epidural hematoma (SSEH) is a relatively rare disease, with a reported annual incidence of 0.1 per 100,000 people. One postulate for the source of bleeding is that a rise in pressure within the thoracic or abdominal cavity leads to increased pressure in the epidural venous plexus, causing bleeding. Another possible source of hemorrhage is rupture of the free epidural artery. Here, we report three cases of cervical SSEH in which changes in cervical alignment during retroflexion are thought to be involved.

Material and method:
We encountered three cases of cervical SSEH. They were 2 female and one male cases and age ranged from 53 to 73 years (averaging 65.3 years). In 2 cases, there were hematomas at the right side of the spinal epidural space, and one case were at the left side.

Result:
All cases experienced severe neck or shoulder pain. One case showed severe hemiparesis. Cervical MRI imaging revealed the epidural hematoma had compressed the spinal cord posterolaterally. Cervical 3D-CT was performed in the neutral and retroflexive positions in all cases. As what should be mentioned especially, comparison of the alignment on frontal images revealed a large deviation in the retroflexive position, corresponding with the location of the epidural hematoma. One case were operated on by removal of the hematoma with open-door laminoplasty because of severe paresis. The two cases who had only pain without paresis were treated conservatively. All cases recovered neurologically.

Conclusion:
We believe that changes in alignment during cervical retroflexion may have caused the hemorrhage. Changes in cervical alignment in the retroflexive position may have caused lateral asymmetry in the pressure within the spinal epidural venous plexus, leading to blood vessel rupture. We believe that this is a valuable finding, as there have been no reports about the relation between idiopathic cervical epidural hematoma and changes in cervical alignment.
Rigid-body model of the upper body for kinematic and kinetic analysis of gait with crutches

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Biomechanics and Technical Aids Department, Spain

Background:
In gait with assistive devices, studies based on biomechanical rigid body models of the lower limb provide valuable kinetic and kinematic information. Furthermore, such data can provide information about device use-strategy and the influence of device position and load-transmission on a subject’s gait parameters. Recent studies that have analyzed the difference between walking with or without crutches show that the benefits of the use of walking aids, improve joint load transfer and muscle fatigue in legs and an increase in gait speed. Obviously, changes in lower limb load can affect upper extremity movement and weight-bearing forces. As such, the impact of the use of these aids on upper limb function should be analyzed.

Methods:
It is only possible to study the kinematics and kinetics of the upper body with the aid of canes or walkers, if there is a rigid body model designed specifically for this purpose, that includes the upper limbs and the transfer of load from the technical aid to the corresponding rigid body. Here we present a biomechanical model which consists of the following rigid solids: trunk, forearm, arm, hand and an instrumented Lofstrand crutch, which measure the reaction forces and moments at the tip of the assistive aid. We describe the coordinate systems of each rigid body, the joint centers and the setup of real and virtual markers. This model is already implemented and data are collected from an active marker photogrammetry device capable of acquiring the forces and moments acting on a cane in a synchronized way.

Results:
With the above configuration we are able to calculate the kinematic and kinetic joint data and the spatio-temporal upper limb parameters with regard to Lofstrand crutch-assisted gait.

Effects of different bladder management methods on the quality of life in patients with traumatic spinal cord injury

Akkoc, Y; Ersöz, M; Yildiz, N; Erhan, B; Alaca, R; Gok, H; Zinnuroglu, M; Ozcete, ZA; Tunç, H; Kaya, K; Alemdaroğlu, E; Sarıyüklü, M; Konukçu, S; Gunduz, B; Bardak, AN; Ozcetin, S; Demir, Y; Güneş, S; Uygunol, K
Turkey

Purpose:
To investigate the effects of different bladder management methods on the quality of life (QoL) in patients with spinal cord injury (SCI).

Methods:
Patients (n=195, 74.4% males) from 7 different centers were evaluated in five groups according to bladder management method: normal spontaneous micturition (NSM), micturition with assisted maneuvers (MAM), clean intermittent catheterization by patient (CIC-P), CIC by an attendant/caregiver (CIC-A), indwelling catheterization (IC). The King's Health Questionnaire was used for QoL.

Results:
The bladder management groups were similar regarding age, injury duration, education level, marital and occupational status. There was no difference among the groups in general health perception, personal relationship and sleep/energy domain scores. The social limitations score of the MAM group, the symptom severity and incontinence impact scores of the CIC-P group, the incontinence impact scores, role limitations, physical limitations, social limitation, emotions and symptom severity scores of the CIC-A group, and the social limitations scores of the IC group were significantly higher than the respective scores of the NSM group. In the CIC-A group, scores in all domains were significantly higher than those in the CIC-P group and the difference in physical limitations domain was significant. The symptom severity score of the CIC-A group was significantly higher than that of the IC group.

Conclusion:
The QoL was notably affected in SCI patients in CIC-A group and negative effects on emotional status, physical and social activity limitations were observed, as well.
Motor and Bladder Dysfunctions in Patients with Vertebral Fractures at the Thoraco-lumbar Junction  
Chen, SL1; Huang, YH2; Huang, KM2; Wei, TY2; Ho, SH2; Bih, LI2  
1Department of Urology, Taiwan; 2Department of Physical Medicine & Rehabilitation, Taiwan  

Background:  
The position of the terminal part of spinal cord (conus medullaris) in spinal canal varies in an adult population, and the range span extends from T11 to L3. Fractures at the thoracolumbar junction may cause damage to cord, conus medullaris or cauda equina (spinal roots) and result in upper motor neuron (UMN), or lower motor neuron (LMN) or mixed lesions over bladder. The purposes of this study were to present the motor deficits and type of neurogenic bladder dysfunction (NBD) in patients with vertebral fractures at thoracolumbar junction and the values of leg spasticity in predicting NBD types.  

Methods:  
Fifty-two patients with single level vertebra fracture over T11-L2 with onset duration of longer than 3 years were enrolled. The NBD types and neurologic injury sites were determined according to neurologic examinations and urodynamic studies. The differences in distribution of NBD types, neurologic injury sites and functional walkers in patients with different levels of vertebral injury were analyzed. The cut off value of lower extremities motor score (LEMS) in functional walker were calculated.  

Results:  
The injured levels were T11 in 3, T12 in 21, L1 in 22, and L2 in 6 patients. Eight (15.4%) patients had upper lumbar cord lesions, 26 (50.0%) had epiconus and lumbar roots lesions, 18 (34.6%) had conus medullaris or/and cauda equina lesions. Mean LEMS was 0,b0, 5.4"b7.7, 11.1"b10.2, and 28.0"b11.0 for patients with T11, T12, L1, and L2 fractures, respectively, with significant difference between L2 and other levels (p<0.001). The cutoff value of LEMS for functional walking set at 20, and both the sensitivity and specificity was 100%. Thirty-one (59.6%) patients had spastic NBD, 18 (35.6%) had flaccid NBD, and 3 (5.8%) had mixed type NBD. Positive prediction value (PPV) of ankle spasticity for bladder and sphincter spasticity was 95.2% and 100%, respectively.
Participation in physical activity in persons with spinal cord injury - A comprehensive perspective and insights into gender differences

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1Switzerland; 2Department of Medical Informatics, Biometry and Epidemiology, Germany; 3Institute of Epidemiology, Social Medicine and Health Systems Research, Germany

Background:
Persons with chronic spinal cord injury (SCI) suffer from multiple problems in functioning that lead to an increased risk for secondary conditions. To improve and maintain health, regular physical activity (PA) is recommended as an important component of a health-promoting lifestyle. However, participation in PA is low in persons with SCI, especially in women who are significantly less engaged in PA than men.

Objective:
The objective of this investigation is to identify (1) categories of functioning, the environment and personal factors that influence participation in PA in persons with SCI in general and (2) gender differences within those influencing factors.

Methods:
An explorative qualitative study design using both focus groups and individual interviews based on a semi-structured interview guide was used. Statements were linked to the International Classification of Functioning, Disability and Health (ICF) and a recently developed list of psychological personal factors. An in-depth analysis of the statements was performed to identify the most relevant associations and gender differences.

Results:
Sixty-seven ICF categories, four ICF chapters from all components of functioning and environmental factors, and 33 subdivisions of personal factors were identified to be associated with PA in persons with SCI. Gender differences identified in this study could be assigned to areas of gender roles, social support, athletic identity, interests, and general behavioral patterns.

Conclusion:
This study contributes to a comprehensive understanding of participation in PA in persons with SCI and presents a first step towards the identification of gender related differences. The results necessitate further research to validate the findings as a prerequisite to adapt programs to fit with the needs of women.

Association between lifestyle and body mass index in people with spinal cord injury the first 5 years after discharge of inpatient rehabilitation

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1Amsterdam Rehabilitation Research Center, Netherlands; 2Netherlands; 3Center for Human Movement Sciences, Netherlands

Background:
People with a spinal cord injury (SCI) often have a sedentary lifestyle due to, among others, paralysis. This inactive lifestyle may lead to an increase in body mass, often expressed by the body mass index (BMI; weight (kg)/height (m²)). The objective of this study was to investigate the course of the BMI from discharge up to 5 years after discharge of inpatient SCI rehabilitation, and to determine which lifestyle characteristics influence the BMI.

Methods:
People with a SCI (N= 130) were included in a prospective cohort study. BMI was determined at discharge of inpatient rehabilitation and 1- and 5 years after discharge. Using multi-level regression models, the effects of lifestyle (drinking alcohol, smoking, active lifestyle, self-care related to fitness, smoking, alcohol, body mass and low-fat diet) on the BMI was determined.

Results:
The BMI increased significantly in the 5 years after discharge with 1.8 kg/m². Persons who often or always avoid drinking alcohol had a significantly higher BMI. Smokers had a 1.8 kg/m² lower BMI than non-smokers.

Conclusion:
BMI increased after discharge of inpatient rehabilitation. Lifestyle factors associated with BMI could be identified.

Support:
Zon-Mw Rehabilitation program, grant no. 1435.0003 and 1435.0025.
Active LifestyLe Rehabilitation Interventions in aging Spinal Cord injury (ALLRISC): a research program
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1Amsterdam Rehabilitation Research Center, Netherlands; 2Netherlands; 3Department of Rehabilitation Medicine & Physical Therapy, Netherlands; 4Faculty of Human Movement Sciences, Netherlands; 5Center for Human Movement Sciences, Netherlands

Background:
Life expectancy of persons with a spinal cord injury (SCI) has dramatically improved as a consequence of improved medical care. This has considerably changed the focus of today’s rehabilitation: from the initial life-saving approach towards strategies focusing on long-term optimum quality of life. Maintaining an active lifestyle and minimizing secondary conditions play a central role in long-term quality of life of persons with SCI. Therefore, the objective of our research program is to study active lifestyle, fitness and secondary health complications in people aging with a SCI.

Methods:
One cross-sectional study and three randomized-controlled trials (RCT). Eight SCI-specialized rehabilitation centers participate in this study. Study 1 is a descriptive study on secondary conditions, fitness, active lifestyle, and quality of life among 300 persons with long-standing SCI. In the intervention studies, individuals with inactive lifestyle will be invited for one of 3 RCTs focusing on improvement of their activity level and prevention of secondary complications through self-management (Study 2; n=80), low-intensity wheelchair exercise (Study 3; n=40), or hybrid exercise (handcycling combined with electrical stimulation-induced leg exercise; Study 4; n=40). All 4 studies share outcome measures on active lifestyle, fitness, and health besides their specific outcome measures on these issues. It is hypothesized that self-management and physical exercise will be effective interventions to enhance active lifestyle and fitness and prevent secondary complications.

Results:
Medical ethics approval has been obtained for all studies. Patient inclusion started in 2011 and is ongoing.

Conclusion:
This research program will advance knowledge on long-term health and functioning and on effective interventions in aging persons with chronic SCI, and will benefit the definition of SCI rehabilitation follow-up care.

Support:
Zon-Mw Rehabilitation program and Fonds NutsOhra, grant no. 89000006.

Renal growth in children with spinal cord injuries
wastakaran, claire
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Background:
Children with Spinal Cord Injury (SCI) are at risk of renal disease as a result of their injury. These children require regular assessment of upper tract anatomy and renal growth for optimal urological management.

Aims:
• Determine if existing renal growth curves should be modified to better conform to the pattern of renal growth in children with SCI.
• Investigate whether any resultant variation on renal growth correlates with renal dysfunction.

Methodology:
Patients on the National Spinal Injuries Centre register at Stoke Mandeville Hospital who suffered a spinal cord injury before their eighteenth birthday were eligible for inclusion in the study. Renal length was measured for both kidneys using ultrasound. Their data was compared with those of age-matched controls reported in the 1984 study by Rosenbaum et al.

Results:
160 patients were followed. The average number of scans per patient was 3.7. The rate of growth was found to slow to an average of 0.07 cm/year for approximately two years following injury before entering a period of catch-up growth of 0.27 cm/year, this compared to uninjured children where kidneys growth occurred at a constant rate of 0.22 cm/year.

Conclusions:
This study has shown preliminary evidence that spinal cord injury in childhood impacts on renal growth and renal growth charts used need to be specific to this patient population. Regular renal length measurement has an important role in identifying early, a child who is at increased risk of developing renal disease.
**Pathogenesis of obstructive sleep apnoea in quadriplegia**

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Australia

**Introduction:**
Obstructive sleep apnoea (OSA) is estimated to be two to five times higher in quadriplegia than in the able-bodied (AB). To better understand the causes of OSA in quadriplegia we aim to investigate the upper airway function in quadriplegia.

High upper airway resistance can predispose to OSA. In quadriplegia, spinal sympathetic circuits lose tonic control and induce vascular engorgement of the airway causing the nasal (and possibly pharyngeal) mucosa to thicken, likely increasing upper airway resistance. We hypothesized that nasal and pharyngeal resistance will be 1) elevated in patients with quadriplegia and OSA compared to AB individuals with and without OSA, and 2) reduced to AB levels with phenylephrine (restores vasoconstriction of the blood vessels).

**Methods:**
Subjects are instrumented with epiglottic and choanal pressure catheters, a nasal mask and pneumotachograph. All measurements are performed supine during wakefulness. Nasal and pharyngeal resistance (at a flow rate of 200mL/s, in cmH₂O/L/s), are determined for 5 minutes, before and 10 minutes immediately after application of decongestant (0.5ml of phenylephrine 0.5%).

**Results:**
Six participants with quadriplegia and OSA, and one AB control without OSA have been studied to date. The participants with quadriplegia and OSA have elevated nasal resistance (Rna) at baseline (2.61, 3.03, 3.61, 6.26, 11.05 and 21.14, compared to 2.44 in the AB), which is decreased to AB levels after decongestion, Rna=1.06 on average, and Rna=0.72 in the AB. Pharyngeal resistance data were more variable but showed similar trends.

**Conclusions:**
These data suggest that after quadriplegia the nasal resistance is elevated and that it can be returned to near normal levels with pharmacotherapy. The results to date, highlight the high nasal and pharyngeal resistance as potential risk factors for obstructive sleep apnea in quadriplegia, however, further data are required.

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**Development of an integrated, distributed clinical research database for spinal cord injury**

Berlowitz, DJ; Brown, DJ; Cameron, P; Sinnott, R; Graco, M

Australia; Victorian Spinal Cord Service, Australia; Department of Epidemiology and Preventative Medicine, Australia; eResearch, Australia

**Background:**
Spinal cord injury is a catastrophic injury that predominantly affects young men, most of whom then live for a further 50 years with substantial disability. Although thankfully the injury is relatively uncommon, the lifetime care costs are staggering. In 2010, the cost of spinal cord injury in Australia was estimated as $2.0 billion annually, $5 million per case of paraplegia (lifetime) and almost double that ($9.5 million) for quadriplegia. In fields of research such as spinal cord injury, where the number of patients is low, but the personal and societal impact is high, it is increasingly clear that integrated clinical research data are vital to enable discovery, facilitate investigation and to test treatments.

**Methods:**
We will develop an integrated clinical research registry for traumatic spinal cord injury and the process of registry data collection will be embedded into routine clinical care. We will build on a number of recent local, national and international developments which, when taken together, support these aims. Briefly, these developments are
1) the international spinal community has established the domains of disability in spinal cord injury and has expressed these in a manner consistent with the World Health Organization International Classification of Function (the Core Sets);
2) the Australian Spinal Cord Injury Register, a comprehensive registry of spinal cord injury across Australia could be readily extended to the Core Sets;
3) the Rick Hansen Foundation is an international spinal charity that supports the established Canadian registry. The Core Sets are a mechanism for international collaboration and data aggregation;
4) a body of software engineering systems encompassed through eResearch now exists that will directly support this approach.

**Results:**
The primary data we require to measure the effect of novel therapeutic approaches and to improve patient outcomes in spinal cord injury are clinical. These phenotypic and outcome data are rich and complex but it is also the information that nurses, doctors and others accrue about people living with spinal cord injury as they pass through their care. This project will take these clinical process, map them to international standards and provide federated aggregation to facilitate research globally and to improve patient outcomes locally. This paper will report progress on our local implementation of this model.
Spinal cord injury caused by hemorrhage from intramedullary cavernoma
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Introduction:
To elucidate the proper management of intramedullary cavernomas, 17 surgical cases were re-viewed retrospectively.

Patients and method:
Seventeen patients (3 males and 14 females, mean age of 45.8) underwent total removal of a cavernoma between 2002 and 2011. Severity of the injury was determined by the American Spinal Injury Association (ASIA) Impairment Score. ASIA score A was assigned to one patient, score B to 2 patients, score C to 2 patients, score D to 8 patients, and score E to 4 patients. During surgery, brownish gliotic tissue indicating previous hemorrhage was observed around a cavernoma in all patients. However, liquid and/or gelatinous hematoma was observed in 6 patients. Patients were classified into 2 groups, with hematoma (group A, 6 patients) and without hematoma (group B, 11 patients).

Result:
Patients in group A had severer ASIA score than patients in group B before surgery; patients in group B had ASIA score D or E exclusively. After surgery, 5 patients in group A (83%) demon-strated an improved ASIA score. In contrast, only one patient in group B (9%) showed an improved ASIA score.

Discussion:
Some intramedullary cavernomas cause spinal cord hematoma and severe spinal cord injury. In these cases, surgical treatment should be considered because removal of hematoma and a tumor exerts spinal cord decompression and ameliorates neurological symptoms. In contrast, surgical intervention may not be mandatory in cases without hematoma because neurological improvement is rare and the natural course of an intramedullary cavernoma is not clearly elucidated.

Efficacy of combined antimuscarinic treatment as second-line therapy in neurogenic detrusor overactivity
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Background:
Neurogenic detrusor overactivity (NDO) is a frequent consequence of suprasacral spinal cord inju-ries (SCI). To our knowledge, no reports exist correlating the efficacy of combined antimuscarinic using different routes of administration or new generation of drugs. The aim of our pilot study was to evaluate the efficacy of a combined standard-dosed therapy with oxybutynin TDS 3.9 mg/d and trospium chloride 40 mg/die in patients non responding to a standard mono-therapy.

Methods:
We prospectively enrolled patients (n = 20) with SCI treated with a standard dosage antimuscarinic monotherapy (oxybutynin 15 mg/d) whose initial symptoms did not resolve. All patients were treat-ed with a combined therapy using trospium chloride 40 mg/d and oxybutynin TDS 3.9 mg/d. A first urodynamic evaluation was performed at the time of the enrolment. A second urodynamic study was performed after 12 weeks of combined therapy. Patients were considered subjective respond-ers when asking no further treatment and objective responders when showed safety urodynamic parameters. Student t-test was used for statistical analysis.

Results:
All patients completed the study. Our findings show that combined therapy improved urodynamic parameters in NDO in comparison with monotherapy with oral oxybutinin. Sixteen out of 20 patients showed a significant increase of cystometric capacity (P= 0.001). Six of out 20 patients (30%) reported a subjective improvement, but two of them failed to show safety urodynamic pa-rameters. Thus, only 4 out of 20 (20%) could be considered objective responders and did not need any further treatment (e.g. botulinum neurotoxin A).

Conclusions:
Future research should be performed to find positive prognostic factors for success of antimusca-rinic combined therapy, in patients non responding to the standard monotherapy, and to compare the economic impact of combination therapy with botulinum neurotoxin A.
Does a low friction bed sheet optimize the skin, resistance and physiology and reduce the risk for pressure ulcer?
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1Switzerland; 2Clinical Trial Unit, Switzerland

Introduction:
It is known that people with spinal cord injury (SCI) bear a considerably increased risk of developing pressure ulcer, whereby frictional forces and shear forces are recognized as risk factors. It was the aim of the study to examine the effects of a specially developed low-friction hospital bed sheet (Schoeller Textil, CH) on skin physiology as well as it's acceptance by patients with SCI.

Method:
Prospective, randomised crossover study. Patients with a subacute spinal cord injury were recruited. Each patient spent five consecutive nights on the new, respectively, conventional bed sheet. After the five nights, patients were asked to complete a linear questionnaire (VAS) concerning well-being, odour, perspiration and wrinkling. In addition, the patients were examined daily while still fasting, for skin redness, skin moisture, skin elasticity and skin blood circulation in the parasacral region.

Results:
A total of twenty patients were recruited for the study. Their well-being was significantly better on the new bed sheet (p=0.044), perspiration significantly less unpleasant (p=0.024) and wrinkling was considered to be significantly less (p=0.014). Odour was judged similarly in both textiles (p=0.108). Concerning skin physiology, there were no statistically significant differences in the measured skin parameters between bed sheets. However, on the new bed sheet, tendentially lower skin moisture levels and higher blood circulation levels were measured (2.8%).

Conclusion:
Concerning the subjective evaluation of the patients, the new low-friction textile showed positive aspects. However, one must take into consideration that the patients could not be „blinded“. The physiological skin examinations show certain tendencies that underline the positive effects of the new low-friction hospital textile. Due to the pilot nature of the study, the effect of low-friction textile on decubitus development must be studied further. It remains to be discussed how far assessment methods for skin physiological changes are helpful in estimating the risk of pressure ulcer.

Respiratory motor control disrupted by spinal cord injury: physiological evaluation and evidence-based restoration
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Background:
When control of accessory respiratory muscles, innervated from within and below a level of spinal cord injury (SCI), is altered, it leads to paresis, paralysis, spasticity and respiratory function deficits that significantly impede recovery and cause respiratory complications which are the leading causes of death in individuals with chronic SCI. However, current rehabilitative techniques for the restoration of respiratory motor control have not been proven to be effective in this population. This study was undertaken to characterize respiratory muscle control and to evaluate the application of physiologically-based rehabilitation strategies.

Methods:
Standard spirometrical pulmonary function measures were obtained along with surface electromyographic (sEMG) recording from respiratory muscles using our original Respiratory Motor Control Assessment (Ovechkin et al., 2010) to qualitatively and quantitatively evaluate the respiratory muscle activation patterns from 16 individuals with chronic C3 to T12 SCI. Two matched groups were evaluated before and after: 1) 62±10 sessions of manually assisted locomotor step training with body weight support and 2) 24±3 sessions of resistive respiratory muscle training.

Results:
Pulmonary function outcomes, overall sEMG magnitude and initial raising slope, a measure of the rate of motor unit recruitment during maximum respiratory efforts, were significantly increased in both groups (p<0.05). The distribution of activation across multiple muscles was not significantly changed following locomotor training. In contrast, task-specific training through loaded breathing brought a significantly improved respiratory muscle activation patterns.

Conclusion:
Electrocardiographic findings in spinal cord injured patients: Clues for the autonomic cardiac dysfunction

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Background:
The autonomic nervous system modulates cardiac electrophysiology and abnormalities of autonomic function are known to increase the risk of cardiac morbidity. The abnormal and unstable autonomic control of the cardiovascular system following spinal cord injury (SCI) is well known and therefore individuals with SCI are at high risk for cardiovascular morbidity and mortality. This finding may be related to decline in cardiovascular autonomic control after spinal cord injury (SCI) and incline in risk factors of cardiac morbidity such as sedantary life style, lack of aerobic fitness, hyperension, hyperlipidemia, obesity, diabetes, cigarette smoking.

Methods:
The purpose of our study was to evaluate the cardiac risk factors, and assess the cardiovascular autonomic function in SCI patients and compare with able bodied controls. Twenty-four-hour cardiovascular function was assessed by time domain parameters of heart rate variability (HRV); the standard deviation of the 5-minute average R-R intervals (SDANN; milliseconds/ms), and the root-mean square of the standard deviation of the R-R intervals (rMSSD; ms). Subjects wore 24-hour ambulatory monitors to record heart rate (HR), HRV, and blood pressure. We recruited 43 SCI patients (27 male, 16 male) and 20 controls (12 male, 8 female) consecutively in the study. The mean age of the SCI group was 33.7±1.9 (min: 15, max: 63), and the control group was 32.4±1.7 (min:15, max: 60) years. According yo ASIA scale, 19 patients were A, 19 patients were complete injury. Of the SCI group 10 patients (23.2%) were higher paraplegic -T6 and above, and 16 patients (37.2%) were tetraplegic -C8 and above.

Results:
Individuals with a higher level of injury (tetraplegia>higher paraplegia>lower paraplegia) had a significantly higher HRV, BPV and complexity (tetraplegia>higher paraplegia>lower paraplegia) (p<0.05). Both tetraplegic and higher paraplegic subjects demonstrated significant loss of low frequency 24-hour HRV compared to able-bodied controls (p<0.05). We also found not only ventricular arrhytmias but also supraventricular arrhythmias in all group of SCI patients.

Conclusion:
Individuals with SCI have unstable and arterial pressure and heart rate due to profound changes in the cardiovascular autonomic system and SCI may alter cardiac electrophysiology and increase the risk of cardiac morbidity.

Hyponatremia among in-patients with spinal cord lesions

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Background:
Hyponatremia has been described in patients with spinal cord lesions (SCL), but information about its frequency and its relationship with patient characteristics is lacking.

Objective:
Examine the frequency of hyponatremia and related factors in SCL patients during rehabilitation.

Method:
Sodium levels of 510 SCL patients were retrospectively reviewed from hospital records. The patients (171 traumatic, 339 non traumatic, 62.5% male, mean age of 50.3 years) were admitted for first rehabilitation between 2000 and 2004. The frequency of Na<135mg/100ml and its relationship with age, SCL severity and level, and urinary tract infection (UTI) were examined. The statistical significance of the relationships was assessed using the Chi-square test.

Results:
Hyponatremia was found in 55 patients (10.8%). It was second in frequency among SCL complication, following UTI. It appeared more frequently in older patients (p<0.01) and in patients with AIS grades A or B (19.6%, and 25% respectively, versus 8.8% and 9.4% in patients with AIS grades C or D; p<0.04). It was evident in 13.6% of the patients with cervical, 9.2% with thoracic, and 9.3% with lumbar SCL. Seventeen of the patients with hyponatremia (31%) also had UTI. The combination of UTI and hyponatremia was found in 47% of the patients with cervical, 24% with thoracic, and 29% with lumbar SCL.

Conclusion:
Hyponatremia is relatively frequent after SCL. It is related to SCL severity, and in more than two thirds of patients it is not related to UTI, which may provide support for a relationship with autonomic denervation.
**Objective:**
To examine the sexual function in individuals at least 10 years after a traumatic spinal cord injury (SCI).

**Setting:**
Clinic for Spinal Cord Injuries, Glostrup hospital, Copenhagen University hospital, Denmark. Uptake area 2.5 million inhabitants. Study design and methods: Cross-sectional questionnaire follow-up and retro- and prospective data from medical files.

**Material:**
Individuals with traumatic SCI before 1st of January 1991, and in regular follow-up. 279 were included, and 236 (84.6%) answered (193 men and 43 women) a follow-up questionnaire. Mean age at follow-up 50.5 years, and mean follow-up time since SCI 24.1 years, 21 years for women and 25 years for men (p=0.019). 126 were paraplegic and 110 tetraplegic. Responders and non-responders were comparable.

**Results:**
Among SCI women 94% had no problems with impaired vaginal lubrication (mean age 48 years), 22% reported having given birth after the injury, and 68% reported being satisfied with their sexual life.

For SCI men 75% could achieve erection (mean age 48 years). Among those who could not achieve erection the mean age was 57 years. 35% used aid(s) for erection. 44% could have ejaculation (mean age 46 years), for those who could not achieve ejaculation the mean age was 54 years. 56 % used aid(s) for ejaculation. 54% reported being satisfied with their sexual life. There was reported 78-94% effect using vibration, drugs and intracavernous injection for erection. 54% reported being satisfied with their sexual life. There was reported 78-94% effect using vibration, drugs and intracavernous injection for erection. 19% had fathered a child.

SCI related problems with bladder- and bowel management, pressure ulcers, spasticity and pain were related to less satisfaction with sexual life. Increasing age at injury and increasing age at follow-up were likewise related to less satisfaction with sexual life in women.

**Discussion:**
In the present study, we suggested that misconception of the entry point was a major factor of pedicle screw malposition. The advantage of this technique was exact determination of entry points. Insertion of pedicle screw under the antero-posterior fluoroscopy for the difficult cases, such as narrow pedicle or rotated vertebra, was effective methods to avoid pedicle screw malposition.
Different Analgesic Effects of Adenosine between Postoperative and Neuropathic Pain
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Adenosine is an endogenous neuromodulator both in peripheral and central nervous system. Adenosine inhibits pain signals by the hyperpolarization of neuronal membrane. To clarify the effects of adenosine on pain signals, we tested the intrathecal adenosine injection in two neuropathic pains (spinal cord compression and chronic constriction of sciatic nerve) and a postoperative pain (plantar incision). In addition, change of adenosine receptor in the spinal cord was assessed by real-time PCR and immunohistochemistry.

In all three kinds of pain models, significant shortening of the withdrawal latencies to thermal stimulation were detected from 24 hrs to 1 week after the surgery. Significant improvements of pain sensation were observed in all the three models by intrathecal injection of Cl-adenosine at 24 hrs after surgery. At 72 hrs from after the surgery, intrathecal Cl-adenosine injection inhibited hyperalgesia in the two neuropathic pain model, but did not inhibit in postoperative pain model. Adenosine A1R mRNA expression significantly decreased in plantar incision model. Adenosine A1R protein was also decreased compared to the other two models and normal control. The results of the present study suggest that differential working mechanisms of adenosine in the pain modulation were existed in postoperative and neuropathic pain conditions. The working mechanism of adenosine on pain signals has been believed to inhibit pain signals by hyperpolarization of neuronal membrane. In the present study, we found that adenosine receptor agonist did not inhibit hyperalgesia three days after plantar incision. Using the real-time PCR method and immunohistochemistry, we detected that adenosine A1 receptor expression in the spinal cord was remarkably inhibited in the plantar incision model. These results suggest that adenosine effectively inhibit pain signals in neuropatic pain but less effective in postoperative pain because of decreasing in adenosine A1 receptor.

Brachial plexus repair after traumatic avulsion in patients, by direct re-implantation into the spinal cord: long-term outcome
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Objective:
Brachial plexus re-implantation surgery is a novel technique in which avulsed ventral roots are placed back into the spinal cord via small incisions in the pia mater of the lateral aspect of the spinal cord. Here, we present the long-term results of re-implantation surgery in patients with complete brachial plexus avulsion injuries.

Methods:
We evaluated the clinical and neurophysiological recovery of fifteen patients who have had re-implantation surgery following complete brachial plexus avulsion injury between 1999 and 2004. All patients were assessed clinically with MRC grade to determine muscle strength, clinical outcome questionnaires, nerve conduction studies and electromyography. The clinical assessment was compared to seven control patients with complete brachial plexus avulsion injury who did not undergo surgical repair. Statistical analysis was performed using STATA 12.

Results:
All 15 patients were men. There was a statistical difference in shoulder flexion and shoulder abduction in re-implanted patients when compared to the control group (z=-2.72, p = 0.007 and z=-2.08, p=0.03 respectively). Global arm power was statistically significant in re-implanted patients compared to controls (z=-2.17, p<0.03).

We recorded voluntary EMG activity from the deltoid, biceps and triceps in all 12 patients analyzed and the infraspinatus in 4. Ongoing reinnervation of proximal shoulder muscles (deltoid muscle in 3 patients, biceps in 7, triceps in 5 and infraspinatus in 4 patients) was observed in a total of 8 patients as indicated by the presence of nascent units. Single unit firing of units distal to the needle was also observed from the flexor digitorum superficialis muscle in one patient.

Conclusion:
Re-implantation surgery is a promising surgical strategy for traumatic brachial plexus avulsion. However, improvements after surgery are still limited, and additional work is currently underway to determine if growth factors or combination cellular therapies may produce further gain.
INTRA-EXTRAMEDULLARY DRAINAGE AS AN EFFECTIVE OPTION FOR TREATMENT OF INTRAMEDULLARY EPENDYMAL CYST OF THORACIC SPINE: TECHNICAL NOTE
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Background:
Intramedullary neuroepithelial cysts are extremely rare and only 15 cases have been reported in the literature. Clinico-radiological features are not indicative of a specific diagnosis; for this reason, diagnosis is based mainly on the histological features. In the literature, total surgical removal is considered the treatment of choice. The risk of recurrence is higher after partial removal and in case of occlusion of intra-extramedullary shunt. For this reason, a surgical strategy that ensures the shunt patency in case of incomplete removal of the cyst, becomes a really safe option for treatment of this pathology.

Materials and methods:
We report the case of a 51 years-old woman, who was found to have a dorsal (D9) intramedullary neuroepithelial cyst. She underwent surgical treatment with partial removal and placement of a Nelaton drainage device (8 French) inside the intra-extramedullary shunt.

Results:
The patient experienced a complete regression of preoperative symptoms and MRI follow-up showed no radiological evidence of recurrence 24 months after surgical treatment.

Conclusion:
Spinal ependymal cysts show a high frequency of recurrence, especially in case of partial removal of the cyst wall. Unfortunately, frequently the cyst walls are closely adherent to the spinal cord, making total removal not possible. Intra-extramedullary shunting is a viable option, although there is a high frequency of recurrence in case of obstruction of the shunt. Placing an 8 Ch nelaton drain between the dorsal columns is a reliable technique, especially in cases of partial removal. In fact, it allows continuous drainage of cyst fluid and subsequent resolution of symptoms and decreases the incidence of recurrences due to obstruction of the shunt.

Prediction models for functional recovery in individuals with traumatic cervical SCI
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Japan

Objective:
To develop statistical models to predict the chronic phase functional recovery in individuals with acute traumatic cervical SCI.

Design and Setting:
Prospective single spinal injuries center study

Participants/methods:
530 patients were registered in our database since 2005. In this study, 114 subjects with traumatic cervical SCI were fulfilled a criteria to be admitted within 72 hours after injury and hospitalized more than 6 months. Subjects were evaluated on admission, 72 hours, 2, 4, 6 weeks, 3 months post-injury and at the time of discharge. 9 parameters as independent variable were age, sex, BMI, fracture, ASIA impairment scale (AIS), Spinal Cord Independence Measure ‡V score (SCIM‡V), modified Ashworth scale (MAS), ASIA motor score U/E (AMS-UE) and ASIA motor score L/E (AMS-L/E). The SCIM‡V at the time of discharge was as dependent variable. These data were analyzed by multiple regression analysis at the point of each evaluation.

Results:
Predictor variables for the SCIM‡V at the time of discharge, derived from this analysis, were Age, AMS-UE and AMS-LE. Coefficient of determination was steadily increased at the each point (R² was between 0.680 and 0.933). A maximum difference of it was observed between 2weeks and 4weeks.

Conclusions:
Our data suggested that Age, AMS-UE and AMS-LE could be predictors for SCIM‡V at the time of discharge and 4weeks post-injury might be a suitable time-point to evaluate the patients.
Short/long term effects of KinesioTaping on spasticity, balance, gait and electromyographic activity in chronic incomplete spinal cord injury subjects

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Background:
KinesioTaping Method (TNM) provides extended soft tissue manipulation to prolong the benefits of manual therapy and reduces H-reflex in subjects with spasticity. No studies address its efficacy in spinal cord injury (SCI) patients. The objective of this cross-over case-control study is to evaluate the effects on spasticity, muscle activity (EMG), balance and walking in SCI subjects after 24 hours (T1) and one month (T2) of TNM application, in comparison with a non-elastic tape (PLACEBO).

Methods:
11 subjects with chronic (at least 12 months post-injury) incomplete SCI, ASIA impairment scale grade D, with spasticity localized to soleus/gastrocnemius muscles (S/G) were evaluated at enrolment (T0), T1 and T2. Tape was applied to S/G from T0 until T2 every 5 days with a de-compressive muscle technique using, in a randomized order, TNM and PLACEBO one. Following data have been collected and statistically compared T0 vs T1/T2 and TNM vs Placebo:
- ankle Range of motion (ROM), Modified Ashworth Scale, Spasm Frequency and Reflex Scale,
- Global Pain and Berg Balance Scale; 6 Minute Walking, 10 Meters Walk and Timed up and go test.
- Weight distribution and balance performance were assessed with stabilometric platform. Kinematic spatio-temporal gait parameters were collected using a two-dimensional motion system. In 5 subjects, a wireless surface EMG system assessed dorsi/plantiflexor muscles activity.

Results:
Results underlined significant enhancements only for TNM application. Yet from T1 clinical scales/tests improved and dorsiflexor muscles increased EMG activity with a reduction of S/G spasticity. Balance performances improved already at T1, while weight distribution, velocity and step length become more physiological only at T2.

Conclusions:
TNM can be a valid technique in SCI patients to reduce spasticity, pain, spasms and for improving ROM and balance performances already after 24 hours. For an enhancement of weight distribution and locomotion pattern it's useful to maintain TNM one month.

Biomechanical analysis of the activity of drinking in patients with cervical spinal cord injury

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Objectives:
The aim of this study was to analyze the differences, from the biomechanical point of view, in the execution of an Activity of Daily Living (ADL) such as drinking from a glass between two different groups of patients with tetraplegia and a control group (CG).

Methodology:
A total of 19 subjects were separated into three groups: 8 in the CG, 7 with C6 tetraplegia and 4 with C7 tetraplegia. We used an equipment of three-dimensional analysis of movement and a system of surface electromyography (EMG). Twenty-three active markers and nine canals of EMG were positioned on the upper limb of the subjects. Two scanning units were used to record the sessions. The activity of drinking from a glass was broken down into a several phases to facilitate the analysis. The variables analyzed were movement times, velocities, the joint angles of the shoulder, elbow and wrist in the three spatial planes and the contraction of muscles during the activity as a percentage of maximum voluntary contraction.

Results:
The most relevant outcomes of this research suggest that subjects with C6 tetraplegia perform the ADL at a slower velocity and with more prolonged phases. The most important differences between the three groups, both kinematic and EMG data, were in the wrist joint. The wrist palmar flexion angle was greater in the two tetraplegia groups than in CG (p<0.05).

Conclusions:
Biomechanic analysis can be very usefull to help physician in making therapeutic recommendations and to evaluate such treatments. In addition, data obtained from ADL analysis can be useful in designing wearable robots in people with cervical spinal cord injury.
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Spinal Cord Injury in Polytraumatized Patients; Prospective Study to Optimize Surgery Timing

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Background:
Injury is the leading cause of death and disability among people less than 45 years of age in the United States, placing a staggering public health burden on our society. We feel polytrauma patients account for a large portion of this burden. This project was begun with the hope of optimally treating this patient population.

Methods:
We established an Early Appropriate Care (EAC) protocol from analyzing a historical cohort of 1200 polytrauma patients. All of these patients had an injury severity score of > 16. The EAC protocol is based on adequate resuscitation based on acidosis and definitive fixation of certain fractures within 36 hours of injury. We present here a portion of the first 200 patients who sustained a spinal cord injury as part of their polytrauma injury.

Results:
Since the start of the study, 214 patients have been prospectively enrolled. Of these patients, 74 had an operative spine injury, 36 of which had a spinal cord injury classified as any injury above ASIA E. The cervical spine (occiput- C7) was involve in 12 cases and 24 involving the lower spine segments. There were 11 protocol violations, the most consistent reason being surgeon choice in 8 of these cases, all 8 being definitely fixed after the 36 hours. The patients’ spectrum of complications is given in the attached chart with a nonstatistically significant trend toward fewer complications in the group definitively fixed within the parameters of the protocol.

Discussion:
Treating polytrauma patients is a highly specialized multi-disciplinary practice. We have instituted a treatment algorithm based on objective data to more appropriately treat this unique population. We hope this protocol will avoid early surgery when the patient is not adequately resuscitated and encourage trauma providers to definitively fix these patients when they meet protocol criteria.

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Secondary health conditions and spinal cord injury: An uphill battle in the journey of care

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Objective:
To understand the journey of care in the prevention and management of secondary health conditions (SHCs) following spinal cord injury (SCI).

Methods:
This was a case study design with “Ontario” as the case. The network episode model was used as the conceptual framework. Data sources included in depth interviews with persons with SCI, care providers, and policy and decision makers. Document analysis was also conducted on relevant materials and policies. Key informants were selected by purposeful sampling as well as snowball sampling to provide maximum variation. Data analysis was an iterative process and involved descriptive and interpretive analyses. A coding structure was developed based on the conceptual framework which allowed for free nodes when emerging ideas or themes were identified.

Results:
Twenty-eight individuals were interviewed (14 persons with SCI and 14 persons representing care providers, community advocacy organization representatives, system service delivery administrators and policy makers). A major over-arching domain that emerged from the data was the concept of “fighting”. Eleven themes were identified: at the micro-individual level- (1) Social isolation and system abandonment, (2) Funding and equitable care, (3) Bounded freedom and self-management; at the meso care provider level- (4) gender and caregiving strain, (5) help versus disempowerment, (6) holistic care thinking outside the box, (7) poor communication and coordination of care; and at the macro health system level- (8) fight for access and availability, (9) models of care tensions, (10) private versus public tensions and (11) rigid rules and policies.

Conclusions:
Findings suggest that the journey is challenging and an uphill struggle for persons with SCI, care providers, and community-based advocates. If we are to make significant gains in minimizing the incidence and severity of SHCs, we need to tailor efforts at the health system level.
Is the emergency department an appropriate substitute for primary care for persons with traumatic spinal cord injury?
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Background:
Persons with disabilities, such as those with traumatic spinal cord injury (TSCI), face numerous challenges in navigation through the primary care system. Emergency department (ED) utilization has been used as an indicator of insufficient access to primary care.

Methods:
Using a retrospective cohort with administrative data, rates of ED utilization and reasons for ED visits were calculated between the fiscal years 2003-2009 for persons with TSCI. Reasons for visits were categorized by acuity level: potentially preventable visits were defined as visits related to ambulatory sensitive conditions; low acuity and high acuity visits were defined by the Canadian Triage and Acuity Scale.

Results:
The total number of ED visits for the six year period is 4403 (n=1217). Of these visits, 752 (17%) were classified as potentially preventable, 1443 (33%) as low acuity and 2208 (50%) as high acuity. The majority of patients, regardless of acuity level, did not see a family/general practitioner on the day of the ED visit. The majority of ED visits occurred during the weekday (Mon-Fri 07:00-16:59). ED use was highest in the first year following injury but remained high over the subsequent years. For potentially preventable visits, the majority of visits were related to urinary tract infections (n=385 visits, 51.2%), followed by pneumonia (n=91, 12.1%).

Interpretation:
Given the high rates of ED use for low acuity and potentially preventable conditions, these results suggest that the ED is being used as an inappropriate substitute for primary care for individuals with TSCI.

The diagnostic value of flexible nasendoscopy in the management of dysphagia in spinal cord injury
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Background:
Direct view of the pharynx and larynx via flexible nasendoscopy has been used in the critical care setting with patients with high cervical spinal cord injury, to help diagnose laryngeal and swallowing problems and plan a safe return to oral intake. These patients are often compromised nutritionally and with their respiratory function. The risk of aspiration pneumonia is likely to extend hospital stay, particularly in the ICU and add to medication costs and interventions. The bedside procedure of flexible nasendoscopy allows the patient to be assessed in their natural eating position, whether this is supine, side lying or upright. Foods of varying consistencies are given to the patient and the swallow movements are viewed on a monitor. The pharynx and larynx are observed for anatomical variations and the pattern of swallowing and residue provides the clinician with information about the sensory and motor impairment, which helps to plan therapeutic interventions.

Case Studies:
The following are five case studies that were diagnosed and resolved using flexible nasendoscopy. (Film clips available for presentation)
- sub-glottic obstruction
- foreign body in airway
- oesophageal regurgitation
- unilateral vocal cord palsy
- narrowed pharynx
Therapeutic Interventions include facial oral tract therapy, chewing therapy, modified diets and swallow stimulation. Surgical intervention from an ENT specialist may also be required to correct anatomical problems.

Conclusions:
Flexible nasendoscopy is well tolerated by patients, is of low risk and can be repeated at bedside to monitor progress. Patients and staff can view the recordings, which helps them to understand their condition and participate in therapy.
**P74**

**Life satisfaction in Swedish men and women aging with a spinal cord injury**

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**Background:**
One major rehabilitation goal after spinal cord injury (SCI) is attaining a high quality of life (QoL). The subjective part of QoL includes life satisfaction, referring to the personal evaluation of how well the life situation meets the individual's aspirations. Life satisfaction in people with SCI is lower than in the nondisabled population but there is limited knowledge of how SCI in combination with old age influences life satisfaction. The aim of this study was to investigate global and domain-specific life satisfaction in older Swedish individuals with SCI.

**Methods:**
A questionnaire including the Satisfaction with Life Scale (SWLS) and the Life Satisfaction Questionnaire (LiSat-11) was sent to 54 individuals (mean age 62 years), on average 27 years post-SCI. The level of satisfaction was compared with nationwide Swedish reference samples for both SWLS and LiSat-11.

**Results:**
Life satisfaction in this SCI population was lower than in the reference samples. The study population was less satisfied with life as a whole, vocation, leisure, contacts with friends, sexual life, ADL, family life, partner relationship and somatic and psychological health, but more satisfied with economy. There were no significant correlations between age, sex, time post injury, level/severity of injury, age at time of injury, use of mobility aids and global life satisfaction. Being in a relationship was positively associated with satisfaction with life as a whole and life satisfaction as measured by the SWLS.

**Conclusion:**
Older Swedish men and women more than ten years post-SCI experience a reduced global life satisfaction compared to an able-bodied population. The results indicate that life satisfaction in people with SCI is neither dependent on injury-related factors nor age, but influenced by marital status. The study emphasises the need to implement appropriate rehabilitation interventions to enhance life satisfaction in older persons with a long-standing SCI.

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**P75**

**Anxiety and depression among patients with traumatic spinal cord injuries**

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**Objective:**
To investigate anxiety and depression in patients with traumatic spinal cord injuries (TSCI) in a Norwegian cohort and compare with normative data from the general population, and to investigate relationships between anxiety and depression with demographic and clinical variables.

**Design:**
Data were obtained through telephone interviews using the Hospital Anxiety and Depression Scale (HADS) from a Norwegian cohort injured in the period 1982-2001. Age and sex specific expected scores representative for the population were obtained using prediction equations from normative data from the general Norwegian population, HUNT II.

**Participants/methods:**
119 patients, 24 women and 95 men were included in the study. Mean age was 49.0 years at time of interview, and mean time since injury was 13.0 years. Multiple linear regression analysis was applied to determine the variables affecting deviance from expected anxiety and depression among the patients. The variables included were age, gender, level and completeness of injury, pain, spasticity, marital status, education, employment, work place, living condition social status and economy.

**Results:**
There was no significant increase in anxiety, depression and overall HADS score in patients with TSCI patients compared to Norwegian norms. There was a trend of increased mean scores for anxiety, depression and overall HADS for patients with incomplete thoracolumbosacral injuries, and for anxiety and overall HADS among patients with complete cervical injuries. The regression analysis showed that pain was significantly related to increased levels of anxiety, depression and overall HADS, while good economy was significantly related to lower levels of overall HADS.

**Conclusion:**
TSCI patients with pain have increased levels of anxiety and depression. Recognition and treatment of pain is important in the effort to reduce anxiety and depression. Social factors related to economy may also be of importance.
Experiences of intimacy and relationship maintenance in acute Spinal Cord Injury rehabilitation: An Interpretative Phenomenological Analysis

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Objective:

to explore the couple’s experience of intimacy and relationship maintenance following a SCI within the newly implemented Transitional Rehabilitation Programme, a second-stage rehabilitation programme at Burwood Spinal Unit in New Zealand. A core element of the transitional programme is addressing relationship maintenance concerns; we specifically sought the couple’s experience of this.

Methods:

A purposive sample of five couples participated in dyadic interviews of 60-90 minutes. Audio-recordings were transcribed verbatim and analysed with Interpretative Phenomenological Analysis. Three main stages of analysis were: (a) detailed thematic summary of each individual transcript; (b) collation of themes across the transcripts, incorporating commonality and divergence in accounts; (c) deriving the super-ordinate themes to describe participant experience.

Results:

All couples were heterosexual, in each the man was the person with the SCI, and participants were aged 25 to 70 years. The four main themes were ‘I/we, he/she’ (describing the couple relationship), ‘Grief and loss’ (covering the effects of the injury for both partners), ‘Loss of autonomy’ (being a bodily and felt disempowerment in the rehabilitation environment) and ‘Transitioning forward’ (encapsulating the future). The couple offered each other unrivalled support. Communication was the most important facilitator of relationship maintenance. Health professionals without sufficient sensitivity to the importance of communicating with the ‘we’ (rather than just the person with SCI), the couple’s need for time and space to communicate, and genuine privacy for the spousal relationship impeded the couples’ efforts to maintain their relationship. Couples wanted to know more about the medical aspects of sex after a SCI, recognising this expertise would be lost to them once they left the transitional programme, but the culture and hospital environment were not conducive to exploring sexual expressions of intimacy. It is suggested these barriers to relationship maintenance and intimacy are addressed through creation of openly client-centred rehabilitation environments.

Risk factors for neurological worsening after open reduction of subaxial cervical dislocation - pre-reduction magnetic resonance imaging analysis

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Background:

Treatment of facet interlocking of the subaxial cervical spine, through open or closed reduction, has occasionally resulted in neurological worsening. Although an intervertebral disc herniation has been implicated as the cause of neurological deterioration in some patients, prediction of this complication by pre-reduction magnetic resonance imaging (MRI) has yet been difficult. In this study, we conducted a pre-reduction MRI analysis of risk factors for neurological worsening after posterior open reduction of subaxial cervical dislocation.

Materials and Methods:

From 2006 to 2011, we performed posterior open reduction and fusion on 54 patients for subaxial cervical flexion-distraction stage 2 or 3 injury. Among 54 patients, 6 patients showed post-reduction neurological worsening which required secondary anterior cervical disectomy and fusion (PA-group). Thorough pre-reduction MRI analysis was possible in 5 of 6 patients in PA-group, and in 25 of 48 patients who did not show neurological deterioration after posterior open reduction and fusion (P-group). All PA-group patients had Frankel A paralysis before reduction, and various degrees of cranial extension of paralysis were observed after reduction. There was no statistical difference in patient’s age, Frankel classification, and level of injury between the two groups.

Results:

There was no significant difference in the area of protruded disc material between the two groups (p=0.24), although patients in PA-group tended to have larger intervertebral area at the dislocated segment (p=0.08). In PA-group, maximum spinal cord compression and maximum spinal canal compromise at the dislocated site before reduction were significantly greater than those in P-group (p<0.005, p<0.01). No difference was found in a degree of vertebral translation and disc angle between the two groups.

Conclusions:

Patient whose spinal canal is severely compromised before reduction has significantly higher risk of neurological worsening after reduction. Size of protruded disc material detected on pre-reduction MRI has less predictive value.
P78
Retrograde vasal sperm aspiration (ReVSA) for the patients with anejaculation due to spinal cord injury
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Aim:
Anejaculation in men presenting with spinal cord injury (SCI) leading to male infertility is a serious problem. In the recent advances in assisted reproductive technology (ART), utility of intracytoplasmic sperm injection (ICSI) undoubtedly provides the best chance of pregnancy in SCI couples. We present our experience with retrograde vasal sperm aspiration (ReVSA) in anejaculatory patients with spinal cord injury.

Methods:
We performed retrograde vasal sperm aspiration (ReVSA) twenty-five patients presenting with neurogenic anejaculation associated with spinal cord injury at our institute. This procedure underwent under local anesthesia with spermatic block. A 24G needle was inserted into the vas in retrograde fashion. Sperm washing medium was gently injected to the proximal vas several times and collected. Aspirated sperm was cryopreserved for intracytoplasmic sperm injection (ICSI).

Results:
Adequate motile sperm was obtained in twelve patients. All couples underwent ICSI; 10 healthy deliveries and one ongoing pregnancy were achieved.

Conclusion:
ReVSA is a reliable method for the consistent recovery of sperm of sufficient quality so as to afford a high pregnancy rate and in sufficient quantity so as to permit cryopreservation of excess sperm for future use.

P79
Comprehension and compliance of medication of spinal cord injured patients who visited to outpatient clinic
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South Korea

Background:
To investigate the drug compliance and factors that have an influence on drug compliance of spinal cord injured patients.

Methods:
From January to June in 2011, spinal cord injured patients who visited our hospital for regular prescription were asked to fill out questionnaires about demographic data, comprehension and compliance of medication.

Results:
Forty-eight patients completed questionnaires. Thirty-three were male and the rest were female. Twenty were tetraplegic and 26 paraplegic. Twenty-two were completely injured and 26 had incomplete injuries. The level of awareness of names, shapes and effects of medication were 70.8 %, 87.5 % and 77.1 %, respectively. The compliant group that had more than 80 % of drug compliance was 38 patients. The non-compliant group that had less than 80 % compliance had 10 patients. In respect of compliance of medication, the patients tended to miss the time of administration more than the number of administration. Twenty patients didn’t tell their doctors that they hadn’t been taking their medication properly. There were no statistically significant differences between drug compliance and the following: patient’s age, sex, spinal cord injury type, education level, time elapsed since the injury, number of medication per day, and comprehension of name, shapes and effects of medication.

Conclusion:
Drug compliance of spinal cord injured patients was high. Education on necessity, side effects and usage of medication may be needed to maintain high drug compliance. To investigate the drug compliance and factors that have an influence on drug compliance of spinal cord injured patients.
The effect from leg functional electrical stimulation isometric contractions on arm cycling peak oxygen uptake in spinal cord injured individuals

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Background:
Functional electrical stimulation (FES) cycling augment arm cycling (ACE) peak oxygen uptake (VO2peak) in spinal cord injured (SCI) individuals, but high resource demands limits its access. Thus, the present study set out to measure the effect from portable FES lower extremity isometric muscle contractions on ACE VO2peak in SCI individuals.

Methods:
A repeated measures design where fifteen SCI individuals with ASIA Impairment scale A, injury level between C4 to T12, were recruited and divided according to level of injury; above (SCI-high n=8) or below (SCI-low n=7) the T6 level. To determine whether FES isometric contractions augment ACE VO2peak, VO2peak was measured and compared between: 1) ACE combined with FES isometric contractions, 2) ACE combined with FES cycling, and 3) ACE alone.

Results:
In the SCI-high group, ACE combined with FES isometric contractions increased VO2peak and peak ventilation compared to ACE alone from 17.6 (±5.0) to 23.6 (±3.6) mL•kg-1•min-1 (P = 0.001) and 50.4 (±20.8) to 58.2 (±20.7) vs. L•min-1 (P=0.034) respectively. In the SCI-high group, ACE combined with FES isometric contractions resulted in a 6.8 mL•kg-1•min-1 higher VO2peak and a 10.5 higher ACE watt compared to ACE alone. No difference in VO2peak and related parameters between FES iso hybrid and FES hybrid cycling were found. In the SCI-low group, there were no differences in any VO2peak related parameters between the three test modalities.

Conclusions: Arm cycling peak oxygen uptake increase when combined with FES isometric contractions and FES cycling in spinal cord injured above the T6 level. Portable FES isometric contractions may serve as an easier accessible and less resource demanding alternative to stationary FES cycling. These findings may have important implications for exercise prescription for SCI.

Functional Electric Stimulation for Walking Improvement in Incomplete SCI

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Background:
Peroneal stimulation is applied unilaterally in hemiplegic subjects to improve walking, by evoking foot dorsiflexion on the paretic side. A peroneal Functional Electric Stimulation (FES) instrument with one stimulation canal controlled by a foot switch is available: Ness L-300. In the present work we illustrate the experience of utilizing this FES instrument for improving walking in incomplete SCI subjects.

Methods:
The skin stimulating electrode was positioned near the tibialis capital to evoke, through the nerve stimulation, a foot dorsiflexion and/or a flexor reflex to obtain the ankle flexion, when it was weak or absent. Six incomplete SCI subjects were enrolled: 5 ASIA D (C6, C7, C8, L1 and L3) and 1 ASIA C (L1); the FES was applied in one side only, in subjects with great motor strength asymmetry (4 cases) or bilaterally (2 cases). All subjects were evaluated both at the beginning and the end of a FES walking training and after 3 – 6 months with: neurologic and functional examinations, 10 Meters Walking Test (10MWT), 6 Minutes Walking Test (6MWT) and Time Up and Go (TUG). The walking training with FES application was done in the hospital on the physiotherapist supervision (at list 10 applications), than the FES instrument was given to the trained subject to be used at home.

Results:
In 4 cases we recorded an increased walking velocity (10MWT), increased resistance (6MWT) and decreased time of TUG. In one subject the walking test was not applied, because he walked with a good velocity and resistance on regular ground, but he showed many difficulties on walking outside, on accidental ground with falling risks due to the weakness of left foot dorsiflexion. In this subject, left peroneal FES application, improved especially the quality of walking.

Conclusions: This experience shows that a one canal FES instrument, with a foot switch control, can be useful for improving incomplete SCI walking.
A study of the effects evoked by the poly(ADP-ribose)polymerase (PARP-1) inhibitor, PJ-34, on locomotor-like activity of rat spinal cord

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Background:
PARP-1 overactivity is thought to play a prominent role in the neurological damage following spinal cord injury. Although PARP-1 is activated to repair DNA, its excessive activation leads to build-up of the metabolite PAR and cell energy collapse, developing within the first hour from the primary event. It was, thus, interesting to explore the effect of a PARP-1 inhibitor on an intrinsic neuronal network, the central pattern generator, which sets the timing and pattern of locomotion.

Methods:
We investigated if the PARP-1 inhibitor PJ-34 [N-6-Oxo-5,6-dihydrophenanthridin-2-yl)N,N-dimethylacetamide] applied 30 min after the excitotoxic glutamate analog kainate could protect spinal networks 24 h later and if the drug per se could change the excitability of the neuronal network. Network activity was measured by recording spontaneous discharges, fictive locomotion (evoked by dorsal root stimulation or neurochemicals application) and reflexes from lumbar ventral roots of the neonatal rat isolated spinal cord.

Results:
Our data showed when the excitotoxic stimulus was moderate, fictive locomotion was retained in more than 50 % of preparations with good recovery in reflex amplitude. Interestingly, we discovered that beside the protective effect of PJ-34 on cell survival and locomotor activity, the drug per se strongly increased spontaneous network discharges. These discharges occurred synchronously on lumbar ventral roots, continuing for 24 h and persisting after PJ-34 washout. The main pattern of locomotor activity, fictive locomotion, could be elicited even one day after starting PJ-34 application. Glutamate ionotropic receptor blockers suppressed this phenomenon reversibly. Likewise, applying the glutamate uptake blocker TBOA evoked very similar long lasting discharges without neurotoxic consequences.

Conclusion:
Our data suggest that pharmacological inhibition of PARP-1 could prevent damage to the locomotor networks if this procedure had been implemented early after the initial lesion and when the lesion was limited. Caution should be applied when using PJ-34 in view of its ability to persistently facilitate spontaneous circuit discharges. Our data, however, indicate that the neonatal rat spinal cord could withstand a strong, long-lasting rise in network excitability without compromising locomotor pattern generation or circuit structure. Supported by grant of Friuli Venezia Giulia government.

Pain experienced by those with new & established spinal cord injury: a pilot study of change in pain according to time, posture & activity

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Background:
Pain after spinal cord injury (SCI) is common, contributing to a reduced quality of life. Few pain measures show changes in pain according to time and activity.

Study objectives:
1) Describe variation in pain intensity experienced by SCI patients throughout the day
2) Explore its relation to posture or activity.

Methods:
16 consecutive patients admitted to the London Spinal Cord Injury Centre (LSCIC) participated to assess their pain experience over the course of one day. At four separate time intervals throughout the day patients recorded: site of pain using 2-D diagrams, intensity using 0-9 VAS. 33% change in VAS was deemed of clinical significance. Clinical staff assessed the level of injury & type of pain and analgesic use.

Results:
10 new patients, 4 with established SCI (age range 28-75) experienced some pain during the study period: 7 mainly neuropathic, 7 mainly musculoskeletal. 13 patients related pain to prolonged static posture, in lying, sitting or standing; 7 related pain to bodily movement e.g. dressing; 2 to bowel/bladder care and 2 of the 3 walkers reported pain walking. 10 patients reported pain eased changing position, 8 with rest & 3 by application of ice/heat. 2 were unable to relieve their pain at all and 13 used analgesia. 11 patients demonstrated clinically significant changes in either maximum or overall level of pain.

Clinical Points:
High levels of pain were documented early in the morning & this probably is multifactorial e.g. static sleeping posture, inadequate overnight analgesia. These findings offer therapeutic potential e.g. use of long-acting medication. This study demonstrates clinically significant changes in pain during the day. Greater variability was seen in those with musculoskeletal pain, offering therapeutic potential either in technique when undertaking tasks or for medication. The expected pattern of pain progression due to prolonged sitting was not demonstrated.
Implementation of the Lokomat in 2 specialized SCI rehabilitation centers in the Netherlands

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Background:
In research, robotic-assisted gait training has yet to show superiority to conventional gait training after SCI. In everyday clinical practice however the Lokomat is more and more commonly used. However, literature on systematic implementation of the Lokomat in clinical practice is limited.

Objectives:
To implement daily use of the Lokomat for patients with SCI in two specialized SCI rehabilitation centers in the Netherlands.

Methods:
A structured implementation process consisting of three phases was initiated, including:
(1) Development of eligibility and exclusion criteria based on recent evidence and clinical experience,
(2) Definition of goals,
(3) Definition of a set of relevant outcome measures,
(4) Development of training strategies,

Results:
Inpatients with SCI ASIA B, C and D are considered eligible for inclusion. Outpatients with ASIA C and D are considered eligible for inclusion. Within 3 sessions with the Lokomat the main goals of treatment have to be defined. The development of a set of goals for treatment (eg, certain aspects of the gait pattern, influence on spasticity) and a set of outcome measures for in-and outpatients (eg, WISCI and SCIM) is ongoing. Therapists apply the Lokomat in daily practice and are positive about working with the Lokomat. Different types of training strategies are being explored. However, discussions on the benefit of the Lokomat for the individual patient compared to conventional gait training continue. Standardized clinimetrics is being developed.

Conclusion:
Therapists now work with the Lokomat on a daily basis. Our structured approach showed how Lokomat therapy can be implemented in the daily busy schedules. Key barrier for implementation is the lack of outcome measures that show potential clinical benefit beyond walking alone. Key facilitator is the benefit for patients to have clear focus on gait training in a standardized environment.

Epidemiology and long-term outcome of concomitant traumatic brain and spinal cord injury

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Background:
The presence of a concomitant traumatic brain-injury(TBI) complicates spinal-cord-injury(SCI) patient’s rehabilitation; outcome relies on early recognition of presence and nature of associated cognitive deficits.

Methods:
Epidemiological observational study of patients with concomitant TBI and SCI. All subjects with first time admissions to Midlands-Centre-for-Spinal-Injuries between Jan-2003 to Dec-2005 with traumatic SCI with concomitant TBI with at least 5-years follow-up were included. Data was collected on demographic information, aetiology of injury, severity of TBI by GCS, duration of posttraumatic-amnesia(PTA), neuroradiology, SCI based on IScoS-ASIA, discharge venue & length-of-stay. Outcome was evaluated based on FIM scores on admission, discharge and last follow-up. Premorbid conditions including alcohol excess and details of neuropsychological assessment were collected. The data was collected on a purpose-designed-proforma, from medical notes and Electronic Patient Records(EPR). Data collated in Microsoft-Excel; Statistical significance was tested using student-t test.

Results:
N=27(total-269) patients had concomitant injuries. Male:female ratio was 1:4. Mean age was 42.4 years (range14-83). Mean value, referral to admission was 25 days (range 1-125 days). Road-Traffic-Injury(55%) was commonest followed by Falls(37%) and Sports-Related-Injury(7%). 5 patients had Severe-Head-Injury(GCS<8) rest had mild TBI. Cervical level was commonest (14) followed by Thoracic(12) and Lumbar level( 2). AIS-A was commonest in 9, followed by C, D & B at 7, 4 & 3 respectively. 25%(7) had PTA, 4<24hrs, 2 up-to7days & 1>7days. 14 had intracranial-bleed and skull-fractures. 5 had neuro-psychological-assessments, 1 had problem with executive function. 6 had excess-alcohol & 1 bipolar-disorder. 78%(21) were discharged to own homes, 15%(4) to interim hospital facility, 2 to nursing homes. Statistically significant difference noted between FIM on-admission and last follow-up(p< 0.0018). Length-of-stay and FIM-scores gained were not statistically significant (P<0.14) & (P<0.46) respectively also didn’t correlate with severity of TBI.

Conclusion:
Length of stay and change in FIM were not affected by the TBI severity in this study.
Outcome data at the start and finish of SCI rehabilitation. A comparison using the Spinal Cord Independence Measure and the Needs Assessment Checklist

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Background:
Increasing focus is being placed on outcomes in SCI management rather than the measurement of activity. In the UK, the Strategy Board for National Standards in SCI treatment has produced its draught recommendations which support the Spinal Cord Independence Measure (SCIM(3)) (Katz and Itzkovich (2007) as a means of quantifying success in rehabilitation.

Method:
At the Midlands Centre for Spinal Injuries (MCSI), it has long been the practice that achievements in rehabilitation are assessed using our own tool, the Needs Assessment Checklist (NAC), (Berry and Kennedy (2003), in an ongoing audit of all patients’ rehabilitation outcomes within our own goal planning process(Goodwin-Wilson et al.(2010). It was decided to routinely apply the SCIM(3) as well as the NAC, at the first and last goal planning meetings which defined the period of rehabilitation for all our patients. This would enable a comparison of our local measure with the internationally recognised and widely adopted SCIM(3). It also allowed assessment of patient outcomes when they could be accurately and reliably documented because, at each goal planning meeting, the multidisciplinary team members working most closely with that particular patient, are most likely to be present to make that assessment.

Results:
To enable this comparison, measurement of functional outcomes using these two tools was made for the first 30 patients starting and completing their rehabilitation at our centre since March 2011.

Conclusions:
As well as measuring functional outcomes in everyday activities, as the SCIM (3) does, the NAC attempts to assess independence through knowledge to direct others to conduct their personal care. This could be used to achieve subjective independence among those with higher lesions. Education plays a large part in SCI rehabilitation but the contribution of this acquired knowledge, remains mainly unevaluated.

Intensive physical therapy and exercise for persons with spinal cord injury - a pilot study

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Background:
Research reports that physical exercise enhances physical function in persons with spinal cord injury (SCI). At CatoSenteret we have started a program of intensive physical therapy and exercise which focuses on weight bearing, functional activities and exercises in different positions of activities of daily living (ADL). The main concept of exercises was inspired by the Ted Dardzinski method from Project Walk Clinic in California, USA. In order to gain more knowledge about the effects of intensive physical therapy and exercise in persons with SCI we designed a pilot study evaluating 6 weeks of intensive physical therapy and exercise.

Methods:
Intensive physical therapy and exercise over totally 20 days, with an intensity of 4 hours per day, 5 days a week, totally 6 weeks of intervention. Participants are trained by physical therapists or sports therapists. The first two weeks of intervention are based on an in-patient clinic. Then the participants continue their exercise with their local physical therapist at home. Finally they return to two more weeks of intensive exercise in the in-patient clinic. Before/after evaluation of effects were performed regarding physical ability and function. Persons with sub acute or chronic SCI AIS A-D, who are motivated for intensive exercises, were invited to participate.

Results:
In total, 6 participants have finished the intervention. The intensive physical therapy program is still ongoing and developing. The preliminary results indicated improved general function in some of the participants.

Conclusion:
The preliminary results seemed to be positive. CatoSenteret will continue to develop a research-protocol in order to evidence-base this therapy.
**Autonomic dysreflexia during bowel evacuation and bladder filling in high spinal cord injury**

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**Background:**
Bladder filling and procedures for bowel evacuation may cause severe autonomic dysreflexia (AD) in subjects with high spinal cord injury (SCI).

**Purpose:**
To compare autonomic response to a) digital evacuation of the rectum (DE), b) transanal irrigation (TAI) and c) bladder filling in subjects with high complete SCI.

**Methods:**
Eight subjects with SCI (AIS A) at or above Th6 (six male, age: 41-69 years (median 52), time since injury: 3-27 years (median 17)) with a previous history of AD were included. In randomised order and in a standardized setting DE, TAI and filling cystometry were done. To avoid an empty rectosigmoid before investigations, DE and TAI were done on separate days. During procedures beat-to-beat variations and systolic blood pressures (sBP) were recorded. AD was defined as a rapid rise in sBP of 30 mmHg or more. Examinations were terminated after standard stimulation, when symptoms of AD occurred, or when sBP increased by 75 % of resting.

**Results:**
During DE median sBP increased from 127 mmHg (range: 86-154) to a maximum of 188 mmHg (range: 140-206) (p<0.02). During TAI median sBP increased from 126 mmHg (range: 91-146) to 163 (range: 130-188) mmHg (p<0.02). During filling cystometry median sBP increased from 125 mmHg (range: 106-149) to a maximum of 200 (range: 179-220) mmHg (p<0.01). According to our definition, AD occurred in all subjects during all three procedures. Median increase in sBP during TAI (36 mmHg (range 29-63)) was lower than during DE (57 mmHg (range 41-75)) (p<0.05) or filling cystometry (61 mmHg (range 56-100)) (p<0.02). The difference between DE and filling cystometry was non significant (p=0.09).

**Conclusion:**
In subjects with high complete SCI, AD is common during DE, TAI and bladder filling. However, AD is less severe during TAI than with the other procedures.

**Mobility potential realization after spinal cord lesions**

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**Background:**
SCI-ARMI values reflect the realization of the functional potential in patients with spinal cord lesions (SCL), which is defined as the actual functional performance as a percent of the maximal performance achieved by 95% of SCL patients with a similar ASIA motor score. The difference between SCI-ARMI values at discharge and admission for rehabilitation reflects primarily the contribution of rehabilitation to the improvement in function, isolating the effect of motor neurological recovery. Recently developed SCI-ARMI formulas allow quantification of the contribution of rehabilitation to functional improvement in specific functional areas.

**Objective:**
Examine the improvement in mobility potential realization of SCL patients during rehabilitation.

**Method:**
Admission and discharge SCI-ARMI mobility values were examined in 224 SCL patients who were in rehabilitation at Loewenstein Hospital between 2004 and 2010. SCL was traumatic in 38.9% of the patients. Sixty five percent of patients were male, mean age was 51.3 years, 48.2% had tetraplegia, and AIS grade was A in 19%, B in 2.7%, C in 23.9%, and D in 54.4% of cases. The formula used for the calculation of SCI-ARMI values was: MOB SCI-ARMI=100(MOB SCIMIIIobs/(-4.293−0.002AMS2+0.625AMS)).

**Results:**
The patients’ mean total SCIM III score was 35.18 (SD=21.86) at admission and 70.73 (sd=19.58) at discharge. The mean mobility SCI-ARMI score was 30.21 (SD=26.07) at admission and 74.57 (SD=26.04) at discharge.

**Conclusion:**
A prominent improvement in the mobility potential realization was evident during rehabilitation. On average, however, the patients realized only about 75% of their maximal ability in the area of mobility, which means that in many patients rehabilitation did not achieve full realization of the functional capacity that the motor deficit allows. This probably reflects the effect of such factors as sensory or psychological impairments on function.
Recent Experience in The Evaluation of Exoskeletal Robotic Prosthetics in Persons With Spinal Cord Injury and other Neurological Disorders
Leslie, Donald
Medical Director, USA

In the past year, at Shepherd Center we have evaluated the use of exoskeletal robotic prosthetics in persons with chronic spinal cord injury and other neurological disorders. While the majority of patients at Shepherd have spinal cord injuries, there are others with multiple sclerosis, Guillain Barre syndrome and other neurological disorders who may benefit from this technology. We have selected patients from our program, screened, measured and fitted them with three separate systems including ekso Bionics (formerly eLEGS), ReWalk (Argo Medical Technologies in Israel), and the Vanderbilt exoskeletal system (Vanderbilt University). We have undertaken a two year research project with Vanderbilt and are currently assessing the other commercially available systems for further use in the spinal cord injured population. We have included complete and incomplete paraplegics. Our program evaluates patient selection, screening, measuring and fitting, exercise, wellness, gait training, preparation for personal device, and potential future clinical research. The devices will be submitted for FDA approval for prescription and personal use. It is hoped that these devices may be available for home and community use in the future and that they may open new possibilities for persons with spinal cord injury. It is also possible that the users may be able to operate the exoskeletal robots independently of clinicians. The user requirements, contraindications and clinical experiences are discussed.

Acceptance of disability and its association to quality of life among Taiwanese suffered from spinal cord injuries
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Acceptance of loss influences the way of coping that individuals who have acquired disabilities would act in their actual lives. Theoretically, this action further affects their quality of life. This study investigates the validation of this hypothesis by explore the association of acceptance to disability and quality of life among working age Taiwanese of spinal cord injuries who live in community. A total of 216 respondents with spinal cord injury were collected from ten county level associations of spinal cord injury around Taiwan, with a respondent rate of 43.2%. The questionnaire consisted of the 32-item Adaptation to Disability Scale-Revised (ADS-R) based on Beatrice Wright (1983) theory (Groomes & Linkowski, 2007) and the 28-item World Health Organization Quality of Life-Brief (WHOQOL-BREF), Taiwanese version. There is no statistical difference between respondents who fill out the questionnaire by themselves and by others, except on severity of injury and employment status. Those who have greater injury and were unemployed tended to need others to fill out the questionnaire for them. The mean score of the ADS-R was 82.19 (SD=11.99), with mode score of 77. According to the manual of the ADS-R, majority of this sample were at moderate level of adaptation. Subscales on Enlargement, Subordination, Containment and Transformation, which reflect on Wright's procedure of value change, as well as the total ADS-R score were significantly correlated to the total WHOQOL-BREF score. Other than Subordination, which was mildly correlated, it showed moderate level of correlation. Using stepwise multiple regression analysis, it further showed that Enlargement and Containment were the predictors of quality of life (R² = .52, p < .000).
Similar to previous studies in the western world (Elfstrom, Ryden, Kreuter, Taft, & Sullivan, 2005; Mortenson, Noreau, & Miller, 2010; Warren, Wrigley, Yoels, & Fine, 1996), acceptance of disability does positively correlated to quality of life. Positive thinking also correlates to better adjustment to community living (Berry, Elliot, & Rivera, 2007; Mayer & Andrews, 1981; Sneed & Davis, 2002). This study provides additional evidence to support the importance of acceptance of disability toward quality of life for individuals suffered from spinal cord injuries, despite different ethnics and cultures.
The Boberg Quality Score (BobScore)

Thietje, Roland; Hirschfeld, S
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Introduction:
The Boberg Quality Score (in short: BobScore) is a study to develop a new Score for rehabilitation of people with SCI. These are the guidelines of the BobScore. The quality of hospital rehabilitation is not defined only by the outcome immediately after demission, but by the ability to maintain and even enhance the results especially concerning social and vocational (re) integration. The patients behaviour during and after rehabilitation is not uni dimensionally determined by the state of health, but also depends on individual
- Motivation
- Knowledge
- Independency
- Social support

Materials and methods:
309 people who suffered acute SC were included. The time frame of the study was 3 years. Following standard measurements were required to get the data for the BobScore
- ASIA-classification
- SCIM-II
- Communication-part of the FIM
- NHP as assessment tool for quality of life
Further self-management- and self-confident competences were measured.

Results:
215 people took part at the study for more than 3 months. The dropout was 18 %. 30 months after demission 46 % had a complete dataset. The SCIM II over all was increasing from the beginning of rehab to the 30th month after discharge, 6 months after discharge there was no more improvement of the SCIM detectable. Over all there we saw rising competence for self-management-skills and constant competence for self-confidence-skills.

Discussion:
There are just a few parameter who have major impact as predictor for social reintegration:
1. SCIM II
2. Self-management-competence measured by RPF
3. Self-confidence-competence measured by RPF.
The predictor quality of the BobScore regarding social reintegration is higher than the SCIM II. Possibly parts of the BobScore could be a reasonable addition to the SCIM II or another Score in the future.

Does 6 weeks of maximal strength training improve spinal cord injured individuals performance measured by wheelchair ergometry?

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Background:
To investigate whether maximal upper body strength training, thrice weekly for 6 weeks improves strength and work economy measured by wheelchair ergometry.

Study Design:
Experimental cross-sectional, single subject design.

Setting:
Tertiary rehabilitation at Dept. of Spinal Cord Injuries at St. Olavs University Hospital / Norwegian University of Science and Technology, Faculty of Medicine, Department of Neuroscience, Trondheim, Norway (2009-11)

Methods:
8 SCI subjects in stable neurological recovery performed progressive maximal strength training (MST) in 4 times 4 sets, starting at 85% of their pre-test 1 repetition maximum (1RMpre). Force development (FD) was measured at 70% of 1 RMpre -post. Pre and post measurements of oxygen uptake (VO2) was obtained during wheelchair ergometry (WCE) at submaximal ( WCE30w, and WCE50w) and peak intensities (WCEpeak) to allow calculation of gross mechanical work efficiency (ME) indices and peak power output (POpeak). Results: SCI individuals who performed MST significantly improved their RFD (10 %), 1 RM (10 %), POpeak. (7%) and WE (5 %). Neither VO2peak or body mass changed.

Conclusion:
These findings supports a therapeutic role of the maximal bench press strength training (MST) modality as a simple mean to improve work economy during handrimmed wheelchair propulsion in SCI individuals.
Long term complications after rehabilitation in SCI patients

Hirschfeld, S; Thietje, R
SCI Centre Hamburg, Germany

Study Design:
Monocentric cohort study

Objective:
To investigate quantity and quality of complications after SCI

Setting:
Level 1 trauma center

Methods:
Patients after complete SCI rehabilitation with traumatic and non traumatic SCI were included. Data were collected from 1998 to 2010 and stored in the Hamburg Database for readmission. All patients were comprehensive care patients with unexceptional stationary treatment. Data were calculated by using ÷2 –Test (Fisher's exact-Test) and Student’s t-test.

Results:
2876 patients were included, 83% vs. 17% male : female, 83% vs. 17% traumatic : non traumatic. 39% tetraplegic patients with ASIA:
A: 19%
B: 3%
C: 10%
D: 7%
and 61% paraplegic patients with ASIA:
A: 46%
B: 3%
C: 5%
D: 7%
The ranking of typical SCI complications was as following:
1. Decubitus: 40%
2. Uro-complication (UTI, haemorrhage): 17%
3. Pain (inpatient nowadays not paid): 7%
4. Fracture: 5%
5. Bowels / ileus: 4,5%
6. Pneumonia: 4%
7. Spasm: 3,5%

In more detail the results for different AIS, gender and types of SCI are:
1. Tetraplegic patients suffer significantly more from Pneumonia, ileus and spasm, however paraplegic patients are afflicted with decubitus and fractures
2. An incomplete lesion comes along with a higher grade of pain and spasm
3. Intensive home nursing can help providing complications (pressure sores) but may otherwise imply a risk for incidents (urological problems)
4. Traumatic and non-traumatic SCI do not differ within all groups of complications

Conclusion:
SCI patients do suffer from typical complications. The treatment is required within specialised centers. Therefore a rapid transfer in case of a severe complication is highly recommended. Life-long comprehensive care and appropriate ambulant nursing is furthermore needed to avoid the described complications and also to reduce the costs of inpatient treatment.
Early decompression in a setting of acute cervical spinal cord injury
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Introduction:
The importance and timing of decompression after acute spinal cord injury (SCI) remains one of the most controversial issues related to spinal surgery. Acute SCI is a significant cause of mortality and disability, reaching 9-10 thousand cases in Russia. There is experimental evidence that persistent compression of the spinal cord is potentially reversible form of secondary injury. But the presence and duration of therapeutic window during which decompression can reduce the effects of secondary injury remains unclear.

Objective:
To determine whether the time from injury to decompression procedure is a significant factor of neurological improvement in patients with acute SCI.

Methods:
A retrospective cohort study was performed. Medical records of patients with acute cervical SCI were carefully examined. Criteria of inclusion were the fact of spinal cord compression, severity of SCI according to the ASIA neurological impairment scale (grades from A to D), and performed decompression surgery. We divided this group into two subgroups depending on the presence of neurological improvement within two weeks after injury and determined mean time from injury to decompression in each group.

Results:
Improvement in neurological deficit was observed in 10 patients which accounted for 27% of the total group. Mean time from injury to surgery was 5.8 ± 3.2 hours in the subgroup of patients with neurological improvement, and 14.9 ± 18.1 hours in the subgroup of patients without improvement.

Conclusion:
Based on our findings, the time from injury to decompression plays a definite role in improving neurological function in this group of patients. The obtained facts give a reason to perform this procedure as early as possible. In addition, we got better results of early decompression in the group of patients with neurogenic shock, and this observation will be a subject for our further study.

Road collisions as a cause of traumatic spinal cord injury in Ireland, 2001-2010
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1Rehabilitation Medicine (Spinal Cord Systems of Care), Ireland; 2Research & Education, Ireland; 3Spinal & Orthopaedic Surgery, Ireland

Background:
World-wide, road collisions remain the leading cause of traumatic spinal cord injury (TSCI). Half of all TSCIs in Ireland in 2000 were due to road collisions. From the beginning of this century, there has been a steady downward trend in road fatalities in Ireland, from 110 per million population in 2000 to 53 per million population in 2009. High-profile campaigns by the Road Safety Authority (RSA) of Ireland have been clearly evident in the national media over the same time period. The objective of this study was to examine the incidence of TSCI resulting from road collisions during the first decade of the 21st century.

Methods:
This was a retrospective study using the hospital in-patient enquiry database of the tertiary referral centre, which houses the national spinal injuries unit. Information retrieved included total numbers of patients with TSCI and numbers due to road collisions for the period 2001 through to 2010, age groups affected by both & gender balance.

Results:
Over the 10 year period studied, the proportion of TSCIs resulting from road collisions fell from 43.3% to 19%. The 20-29 year age category accounted for the largest number of all TSCIs & TSCIs due to road collisions. Male to female ratio of those affected was higher in those who sustained TSCI due to road collisions than in all patients with TSCI.

Conclusions:
As mortality figures, due to road collisions, declined so too did the number of TSCIs of the same aetiology. An impactful road safety campaign delivered through the national media is likely to have influenced these trends.
Objective: Spinal tumors account for 4.6% of all bone tumors. American Association for Cancer Research reported 5% to 30% detection rate of spinal metastases in patients with malignant tumors per year. Russian data assume this rate to be 70%.

Material and Methods: Ninety patients with spinal tumors were operated on during 2007-2011. Malignant tumors were diagnosed in 27, and metastatic – in 32 patients, with mean age of 51 years. We used Tomita scoring system to classify tumor localization and extent, ASIA scale for neurological deficit, Watkins scale for pain syndrome intensity, and Tokuhashi survival prognosis scale. Tumor types 5 (n=13) and 6 (n=7) prevailed. Metastases originated from lung (n=8), prostate (n=5), breast (n=8), and kidney (n=3), and an undetermined primary site (n=8). Primary malignant tumors were classified as type 3,4 (27 patients). Surgery treatment included decompression and stabilization in 27 patients (Tomita type 3,4), spondylectomy and stabilization with NiTi implant in 13 (type 5), and spondylectomy and posterior stabilization of the operated segment – in 7 patients (type 6).

Results: Decompression and stabilization procedures allowed reducing pain and early postoperative mobilization. Single-stage spondylectomy in type 5 patients proved to be effective treatment technique, though type 6 patients spondylectomy with posterior fixation did not changed neurological status. Average survival in patients with metastasis from kidney was 11.2 months, from breast 16 months, from lung 2.2 months, and from an undetermined site 7.8 months. Pain was relieved in 51% and neurological deficit reduced in 31% of patients.

Conclusion: Principal components of therapeutic approach in patients with primary spinal tumors should include early diagnosis of the tumor, determining its histological affinity before treatment, and radical resection, if it may improve the quality of life. Surgical intervention should be planned in view of patient’s life expectancy.

Introduction: Cervical spinal cord injury (CSCI) without bone and disc injury sometimes occurs in patients with OPLL, although it is unclear whether either static or dynamic factors are important in determining the severity of paralysis. The aim of this study was to identify the clinical characteristics of CSCI associated with OPLL.

Methods: This study included 43 patients presenting with CSCI associated with OPLL. The level of spinal cord injury and the rate of spinal cord compression were measured by sagittal view MRI. The neurological outcomes were assessed with the ASIA motor score and ASIA impairment scale at 3 days and 3 months after injury. The ossification type was evaluated by a sagittal view of multiplanar reconstruction CT (MPR-CT). The grade of traumatic force (high or low energy) was determined according to the mechanism of trauma (i.e., high energy: motor vehicle accident, falling from a height, etc.; low energy: falling on a flat surface, etc.). All patients were treated conservatively.

Results: CSCI was found in spinal segments exhibiting a range of motion, and not in the ankylosic segments, even if the spinal cord was severely compressed by massive OPLL. The severity of paralysis in the acute phase was not solely affected by the grade of spinal cord compression or by the grade of traumatic force, but rather was determined by the correlation between these two factors. On the other hand, the severity of paralysis in the chronic phase was not affected by residual spinal cord compression, the ossification type, and the pre-existing range of motion in the cervical spine, but only by the severity observed in the acute phase.

Conclusion: The severity of paralysis in CSCI patients with OPLL was determined based on the correlation between the grade of spinal cord compression and the grade of traumatic force.
Arm ergometry exercise stress testing after acute SCI at University clinical institute for rehabilitation of Republica Slovenija

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Introduction:
Exercise stress testing was used in patients with spinal cord injury to identify their physical abilities at the conclusion of primary rehabilitation. On the basis of the testing, suitable aerobic exercising is suggested to patients after the discharge. With systematic follow-up we intend to encourage the patients to increase their physical activity and thus diminish the incidence of cardiovascular diseases. The article presents the results of exercise stress testing at the end of the primary rehabilitation.

Patients and methods:
The testing included 20 patients after traumatic spinal cord injury at the conclusion of primary rehabilitation. The subjects were divided into three groups according to the height of the lesion. The stress testing was performed with an arm ergometer by discontinuous protocol and increased stress of 10W (or 25 W). The oxygen consumption was measured continuously with a direct measurement method (Oxicon Mobile), the heart frequency was monitored with ECG. Average values for each test group were calculated and compared with healthy population standard values.

Results:
The group with low spinal cord injury: the achieved level of stress was 91.7 W, max. VO2 47.2 % of the expected, max. heart frequency 82.2% of the expected. The group with high thoracic injury: the achieved level of stress was 88 W, max. VO2 46.5 %, max. heart frequency 82.1 % of the expected. The group with high cervical injury: 2 subjects reached the stress 25 W or 50 W, max. VO2 was 25.5 % and max. heart frequency 67% of the expected.

Conclusions:
The achieved level of stress was in negative correlation with the height of the impairment. Statistically significant were the differences between the subjects with cervical impairment and the other two groups (p >0.001). The difference between the two thoracic groups in the achieved stress and maximal oxygen consumption was not significant, however, the number of the subjects was too low for the exact statistical analysis. Control testing will be performed 3 months after the discharge.

Anterior Spinal Reconstruction Surgery with Iliac Autograft for Osteoporotic Vertebral Collapse for Patients with Adjacent Old Vertebral Fractures

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Summary:
There have been a few reports regarding surgical outcomes of anterior spinal reconstruction surgery (ASRS) using iliac autograft for osteoporotic vertebral collapse (OVC). Our results from 42 cases indicated that ASRS is a favorable surgical procedure for OVC even in patients with adjacent old vertebral fracture(s).

Introduction:
Surgical intervention is indicated for patients with OVC presenting with intractable back pain and/or neurological deficits. There are several surgical options for OVC, but the optimal surgical method remains to be clarified, especially in patients with multiple vertebral fractures, which is often the case with osteoporosis. As surgical approach for OVC, we have primarily chosen ASRS using autologous iliac bone rather than titanium cages. Here we retrospectively investigated surgical outcomes of ASRS for OVC, focusing on its efficacy in patients with adjacent old vertebral fractures.

Methods:
Forty-two cases of OVC treated by ASRS (12 men, 29 women; mean age 68.6; mean follow-up 41 months) were included. ASRS consisted of subtotal corpectomy of a single collapsed vertebra with instrumented reconstruction using autologous iliac crest. Twenty of the 42 cases had adjacent old vertebral fractures (47.6%) (group O), and 22 did not (group N). The mean number of old vertebral fractures in group O was 1.9 vertebrates per patient. We compared the outcomes and complications of ASRS between the two groups.

Results:
Pre-operative symptoms, such as back pain and/or neurological deficits including paraplegia, were improved and bone fusion was observed in all the cases in both groups. The average number of new vertebral fractures developed after ASRS was 1.9 per patient in group O, and 0.7 per patient in group N. However the cases which needed a revision surgery was only 2 in group N and none in group O. Troubles related to the instrumentation were observed in none of the cases in either group.

Conclusion:
The outcomes of ASRS for OVC were favorable even in patients with adjacent old vertebral fractures.
Neuropathic pain the first year after traumatic SCI
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Introduction:
Neuropathic pain (NP) after traumatic SCI (TSCI) is a major challenge in SCI rehabilitation and affects quality of life. The aim of the present study was to study prospectively the presence, character and intensity of NP.

Methods:
Prospective inclusion of study subjects was carried out in two university hospital SCI clinics, with a baseline neurological examination within three month after injury and recording of age, gender, AIS grade, the NL and pain. The patients filled-out pain questionnaires at baseline, 6 and 12 month after injury. When pain was present it was classified as neuropathic, visceral or nociceptive. NP was classified at, below or above the NL.

Results:
In total 40 Swedish and 50 Danish patients were included (89% males). Falls and traffic accidents were the most common causes (85%). Forty percent had a complete SCI at baseline and 50% had a cervical NL. NP pain was present in 26%, 45% and 54% at baseline, 6 and 12 month after injury. When pain was present it was classified as neuropathic, visceral or nociceptive. NP was classified at, below or above the NL.

Conclusion:
We find a substantial increase in the occurrence of NP several months after injury, with may represent a wind of opportunity for potential therapeutical targeting of secondary mechanisms, which, however, need to be better defined.

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Results of social work counselling from a spinal cord injury rehabilitation unit in Istanbul
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The role of a social worker in a spinal cord injury (SCI) rehabilitation unit is to assist the patients and their families in dealing with the trauma and its consequences which affect their lives by counselling.

The aim of this study was to give a descriptive data about social work done in a SCI rehabilitation unit in Istanbul between June 2010–June 2011 and to stress the importance of this counselling.

One hundred twenty SCI patients who received social counselling were enrolled in the study. Among these patients 50% of them received financial planning and income maintenance support, 20% received psychosocial supportive counselling where 18% of them received family support counselling, 7% received vocational counselling and 2.5% received nursing home facility.

Social work research in the area of spinal cord injury is lacking. To our knowledge this is the first report about the social work done among SCI patients from Turkey. Although social workers are important members of the rehabilitation team, their numbers are very limited at rehabilitation units in our country. Social work practice should be encouraged in order to promote social and economic justice.
P103
Health Problems of persons with spinal cord injury living in the community and reasons for rehospitalisation
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People with SCI are at greater risk than the general population for medical complications that may necessitate rehospitalisation through their lifetime. Increasing our understanding of the incidence and reasons for hospitalisation is important for the developments of preventative strategies.

Rehospitalisation has been reported to be more frequently within the first year after discharge from the initial care and rehabilitation and becomes less frequent as post injury time increases (Devivo et al 1995)

**Purpose:**
- To investigate the prevalence of health complications among persons with spinal cord injury (SCI) living in the community
- To examine the frequency and reasons for rehospitalisation in persons with acute traumatic spinal cord injury (SCI) during the follow up years

**Methods:**
A retrospective audit design reviewing patients' files at outpatient department, study conducted National Spinal Injuries Centre at Stoke Mandeville Hospital outpatient departments. Medical notes of 500 patients reviewed, the mean age of patients was 34years. The percentage of female patients were 22% while male patients 78%. Time since admission was 2 months to 5 years at the time of first admission. The level of injury was cervical 23%, thoracic 48% and lumbosacral in 29%. The aetiologies of the injuries were road traffic accident 38.8, Falls 41.7, sport 11.6, knocked over/ collision/ and lifting 4.2, 3.3 not specified and 2.7 traumas due to assault. The neurological level of these patients were ASIA A 51.8%, ASIA B 16.1%, ASIA C 21.4%, ASIA D 10.7%.motor lesion complete 51.8%, incomplete 48.2%.

Pressure ulcer reported by patients to be one of the complications post discharge 36% of patients reported skin problems, grade one pressure ulcer 21%, 12%reported grade two pressure ulcers, 18% reported grade three and7% reported grade four pressure ulcers. Locations of pressure ulcers reported as: were located sacrum 27%, heel 22%..

The presence of a wide range variety of problems implied that there was an important need to have a continuous follow up care to prevent complications development and rehospitalisation.

P104
Exercise capacity and life satisfaction 5 years after discharge of inpatient rehabilitation in spinal cord injury in the Netherlands
van Koppenhagen, Casper; de Groot, S; Post, MWM; van Asbeck, FWA; Lindeman, E; van der Woude, LHV
Netherlands

**Objective:**
Wheelchair exercise capacity is an important determinant of health status of SCI subjects especially on the long term, because a low wheelchair exercise capacity exposes them to increased risk of complications and is related to a reduced level of functioning, a reduced level of activities and participation and quality of life. Aim of the study was to determine the association between exercise capacity and life satisfaction five years after discharge of inpatient rehabilitation.

**Design:**
Cross sectional study five years after discharge that was part of a prospective cohort study into restoration of mobility and physical capacity after SCI. A maximal wheelchair exercise test on a treadmill was performed and life satisfaction was measured with the self-report Life Satisfaction Questionnaire (LiSat-9).

**Setting:**
Eight rehabilitation centres in The Netherlands.

**Participants:**
Subjects were 73 persons with SCI, aged 18-65, and wheelchair-dependent at least for long distances.

**Main outcome measures:**
Peak Power Outcome (POpeak), Peak Oxygen uptake (VO2peak), LiSat-9.

**Results:**
73 persons were tested with a mean age of 41.2 years, 69% had a complete injury, 64% a paraplegic lesion. We found a significant and moderate Pearson correlation between POpeak and LiSat-9 of 0.30 (p < 0.05). We found no significant correlation for VO2peak.

**Conclusion:**
Exercise capacity and life satisfaction in spinal cord injury are correlated at 5 years after discharge of inpatient rehabilitation. Analysis of the longitudinal association between exercise capacity and life satisfaction is ongoing and will be presented at the conference.

**Recommendation:**
People need to be encouraged by professionals to exercise to maintain their fitness in order to prevent lower life satisfaction.
**P105**

**Effective Management of Pressure Sores in the Community**

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**Introduction:**
With the aim of reducing pressure sore admissions to hospital and prevention of their development in the community, we looked at the current pressure sore prevalence. We worked to prevent them using a comprehensive outreach and education programme. There are three goals of raising awareness, education and support, to both the patient and multi disciplinary team.

**Methods:**
A community liaison nurse post working 11 hours a week introduced to facilitate visiting patients in their homes. Patients were selected when they had pressure sores of grade 2 or higher. 45 patients were reviewed during an 8 month period, with pressure sores grade ranging from 2-4. This assessment consisted of full wound assessment, including date sore developed and grading, measurements, culture swabs and photographs. The patient’s general health was assessed including nutritional requirements and recent blood results. Assessment of equipment and facilities at the patient’s residence is essential in diagnosis of cause and prevention of further pressure sores. All of this information is then collated and the best course of action is decided upon and a care plan is devised and sent to the multi disciplinary team.

**Results:**
Of the 45 patients seen, all patients, carers and district nurses were given education. 18 pressure sores healed in the community. 4 patients were removed from the pressure sore waiting list. 6 patients required surgical intervention. 27 patients were seen in outpatient clinic. 48 patients received home visits.

**Conclusion:**
The key in reducing the time frame of healing is early intervention and education from the spinal injuries team. It concluded that the need for surgical intervention in hospital admissions and outpatient attendance was reduced and also showed that this education helped in the prevention of further pressure sore development. It highlights the need for additional education for community teams of the specific requirements of spinal injured patients.

**P106**

**Integration of the spinal cord injury centre in the training of medical students: evaluation of the grade of satisfaction of 1112 students**

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**Objective:**
In many ways, the medical students are brought in touch with the topic spinal cord injury (SCI) in the SCI centre of the Orthopaedic Department in Ulm. A mandatory block internship for 4 to 6 students gives every fifth year student the opportunity to visit the SCI centre. An evaluation of their grade of satisfaction with this teaching program should be of interest.

**Design:**
Prospective questionnaire surveys.

**Participants/methods:**
A questionnaire was given to 1112 medical students in the end of the special teaching week in the SCI centre.

**Results:**
67% of the students had got so far some information about the topic SCI during their medical training. More than 800 participants were very content with the block internship regarding the topics SCI and spinal cord disease, special treatment of the paralyzed patient, complications and direct patient contact. The topic interdisciplinary rehabilitation team and functional hand was not explained enough. 611 students gave the school mark very good, 372 the mark good. 58% wanted to have more information about SCI during the medical training in general.

**Conclusion:**
Most of the students were impressed with the teaching in the SCI centre. The teaching contents will be improved partially.
Activity-based therapy for recovery of walking in individuals with chronic spinal cord injury: Results from a randomized clinical trial
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Background:
“Activity-based” therapy is growing in popularity as an approach to promote neurologic recovery after spinal cord injury (SCI). It involves “interventions that target activation of the neuromuscular system below the level of the lesion, with the goal of retraining the nervous system to recover a specific motor task” (Behrman & Harkema, 2007). While intense physical activity has been shown to improve physiological function and health outcomes in individuals with chronic (> one year post-injury) SCI, the impact on neurologic recovery is not well documented.

Methods:
In 2009, the investigators initiated a prospective clinical trial to evaluate empirically the effects of participation in an activity-based therapy program for 50 individuals with chronic, motor incomplete SCI (AIS C or D). Using a delayed-treatment, randomized control-group design, the trial examined the effectiveness of an intensive (9-hours/week), 24-week ABT program targeting recovery of walking.

Results
This presentation will present results of the trial in three primary areas: 1) effects of activity-based therapy on recovery of walking and community participation, 2) analysis of “responders” and “non-responders” to provide insight into factors that may help predict who is likely to benefit from activity-based therapy; and 3) analysis of 6 and 12-month follow-up data to identify factors associated with the preservation of any gains achieved in recovery of walking.

Discussion:
The presentation will conclude with a discussion of the implications of study findings with respect to: 1) future research, 2) role of activity-based therapy in long term recovery of SCI, and 3) recommendations for individuals with SCI who may be interested in activity-based therapy for recovery of walking.


Delivering teaching skills to the multidisciplinary team
Green, Debbie
United Kingdom

Background:
The staff of the National Spinal Injuries Centre are experts in the care of patients with spinal cord injury, with a wealth of skills and knowledge; teaching patients, carers and other staff is part of everyday practice for them. The Centre recently embarked on a collaboration with a local university to deliver a Masters level course entitled ‘Advancing Spinal Cord Rehabilitation and Management’. It was essential that all clinical staff involved in delivering the taught element of the course had appropriate teaching skills.

Method:
Options to provide a course to update teaching skills were considered; the ‘Preparing to Teach in the Lifelong Sector’ course was selected. The course is a nationally recognised academic course consisting of 10 weekly evening sessions delivered by the university. The aims of the course were for learners to be able to:
- Understand own role, responsibilities and boundaries in relation to teaching.
- Understand appropriate teaching and learning approaches in a specialist area.
- Demonstrate planning skills.
- Understand how to deliver inclusive sessions which motivate learners.
- Understand the use of different assessment methods and the needs for record keeping.

Results:
Fifteen members of staff participated in the course – 5 nurses, 2 physiotherapists, 3 occupational therapists, 1 each of doctor, dietician, rehabilitation lead, patient education officer and psychosexual counsellor. All participants completed the course successfully, achieving the stated aims. In addition, the opportunity for staff interaction outside the clinical environment allowed valuable team-building between the participants.

Whilst the focus of the course was on preparing staff to teach on the Masters course, the importance of education in the Centre’s everyday work was highlighted. The opportunity to reflect on delivery of patient education in various formats and situations, for individuals and groups with varying needs, and the importance of evaluation of learning was valuable.
**P109**

**Combination therapy for rats with spinal cord injury | Collagen filaments as a scaffold and NT-3**

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**Introduction:**
Histological examination of traumatically injured spinal cord reveals structural damage including discontinuity of long tracts in white matter and cavitations in gray matter. For functional recovery after spinal cord injury, axonal regrowth beyond the injured lesion is required. Here we report the use of artificial collagen-filaments (CF) scaffold for gap between transected spinal cords and continuous NT-3 injection in rat.

**Purpose:**
The aim of this study is to examine the treatment effect of CF transplantation and NT-3 injection.

**Materials and Methods:**
8 week old female Fisher rats, weighing approximately 150g, were used. After Th11th laminectomy, spinal cord was completely transected with a sharp thin blade. Spinal cord, 5 mm in thickness was removed. Artificial collagen-filaments scaffold (SPINE 28, 2346 51, 2003) was placed between the stumps, parallel to the axis of the spinal cord. In addition, NT-3 was continuously injected into CF using an osmotic pump in two weeks. Electrophysiological examination of motor evoked potential (MEP) was performed at intervals of 1 week.

**Results:**
Histological examination of spinal cords adjacent to the scaffold showed no cavity formation and little gial scar. 1 week after implantation, the scaffold was filled with host-origin cells and many regenerated axons. Only a small number of inflammatory cells were observed. 2 weeks after implantation, more regenerated axons existed in the scaffold.

**Conclusions:**
These results support the potential of artificial collagen-filaments scaffold and NT-3 therapy as a future therapeutic to treat patients with spinal cord injury. Because the simple collagen structure doesn’t have side-effect on humans and high regeneration rate was effective on regeneration therapy of spinal cord.

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**P110**

**Exploring the use of an iPad by persons with tetraplegia C5 or C6 in a Dutch rehabilitation center: functional gain in independence**

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**Background:**
Tablets are more and more used by disabled persons. Light touch wireless tablets have many advantages compared to laptop or desktop computer. For persons with spinal cord injury (SCI), tablets may serve as a multifunctional tool to gain independence in communication, mobility and self-care.

**Objectives:**
To explore the functional benefit of the use of an iPad for persons with SCI, devices needed to handle the iPad, and the development of software.

**Methods:**
In 2011, persons with tetraplegia admitted to the SCI unit of rehabilitation center De Hoogstraat were given the opportunity to explore the use of an iPad. The rehabilitation technology department and a software company evaluated applications and devices for the iPad to support communication and environmental control in the rehabilitation center and at the home.

**Results:**
Ten persons with tetraplegia C5 or C6 explored possibilities of the iPad. Adaptive devices to use the touch screen, handle the iPad, use it fixed on a wheelchair, a table, or in bed were developed. Software was developed for the iPad and Smartphone to serve as an environmental control unit in the rehabilitation center and at home. The software is available as an App (Recontrol). One room at the rehabilitation technology department and one at the SCI department are now iPad driven. Patients, partners and professionals are enthusiastic about the functional gains of using the iPad. Positive side-effect of the iPad as an assistive device is the fun factor of such a modern gadget, bringing together the ambitions and demands of the abled and disabled in our technology-driven world.

**Conclusion:**
The use of an iPad can contribute to the independence of a person with a tetraplegia in communication, mobility, and self-care activities. Compared to conventional systems for environmental control at ones home the iPad is easier in use and price affordable.
SpinalHub.com.au - Connecting and collaborating: The future of spinal cord injury information and education
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Background and Aims:
In early 2010 a collaborative group was formed from across the Victorian health, disability and community sectors to address the lack of targeted information and education available for individuals with spinal cord injury (SCI). One off funding from the Department of Health Victoria was committed to develop a new SCI educational resource as part of the Victorian Spinal Cord Injury Program.

Persons with SCI have a lifelong need for information and education to support effective community integration. The purpose of this project was to design, develop and implement a web-based resource that would help people with SCI:
- learn about their injury,
- talk to each other,
- connect with their community.

Methods:
Following initial phase of site development and launch, the second phase of development included implementation of a social media strategy, video production and supplementary learning tools. Objective assessment of the site's effectiveness in engaging and sustaining interest was conducted through website statistics and analytics. Focus groups and on-line surveys were conducted pre and post full site development.

Results:
Phase one objectives have been met. The SCI community are active in the site, using it as a way of sharing experiences and as a means of mutual support, especially for those newly returned to the community. Empirical results from phase two evaluation obtained through website analytics, account statistics, focus groups and on-line surveys will be presented. Recommendations for future research will also be presented.

Conclusion:
SpinalHub has highlighted the value and strength in cross-sectoral collaboration. SpinalHub has demonstrated the benefits of everyday technology in enabling people to connect with their communities and access SCI information at any time in a way that meets their individual needs. SpinalHub provides the foundations for a richer, more engaging and effective learning experience for people with SCI in Victoria.

Spinal cord hemangioblastoma; clinical aspect and surgical outcome.
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1Department of Orthopaedic Surgery, Japan; 2Department of Advanced Therapy for Spine and Spinal Cord Disorders, Japan

Study Design:
Retrospective case series.

Objective:
To evaluate our treatment strategy for spinal cord hemangioblastoma (scHB).

Background:
Although complete resection is curative for scHB, the location of feeding artery sometimes made it difficult to achieve en bloc removal.

Method:
We reviewed 37 cases of scHBs (including 8 cases of von Hippel-Lindau disease), treated surgically between 1989-2011. The mean follow-up period was 5.0 years. The investigated items were as follows; location of scHBs, localization of feeding artery, distribution of spinal cord syrinx, and surgical outcomes evaluated using Japanese Orthopaedic Association (JOA) scoring systems.

Result:
The tumors were intramedullary in 30 cases, intramedullary and extramedullary in 3, and intradural-extramedullary in 4. The tumors existed at the cervical level in 16 cases, at the cervico-thoracic level in one at the conus-equina level in 5. Of 33 cases with intramedullary tumor, there was a posterior feeding artery in 25 cases (P-group), an anterior feeding artery in 8 cases (A-group). In all the cases, complete tumor resection was performed except one case of A-group, in which partial resection was performed. In all the cases with intramedullary tumor, there was syrinx on pre-operative MRI, which disappeared or diminished after complete resection. However, in the cases with partial resection or recurrence of tumor syrinx still existed postoperatively. The patients in P-group showed significantly better functional recovery than those in A-group. Most of the cases showed improvement of pain, whereas 28 out of 37 cases was suffering from remaining numbness at the final point of examination.

Discussion:
When feeding vessels existed at the ventral side of spinal cord, tumor dissecting from normal spinal cord tissue preceded the coagulation of feeder vessels. Therefore, the intraoperative dissection could aggravate and worse the outcomes in A-group. Pre-operative anatomical evaluation and intraoperative proper handling of feeding vessels under microsurgical technique are mandatory for surgical treatment of scHBs.
Factors affecting surgical outcome of lumbosacral spinal lipoma
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Background:
The purpose of surgery for lumbosacral spinal lipoma (LSSL) is to prevent the progression of potential or explicit symptoms. However, it is difficult to predict functional prognosis after surgery. The purpose of this study is to examine factors affecting surgical outcome of LSSL.

Methods:
Twenty-seven patients with LSSL who underwent surgical treatment at our institute were retrospectively analyzed. The investigated items were as follows; age at surgery, duration of symptoms before surgery, type of lipoma based on Chapman’s classification. There were 12 cases of the dorsal type, 10 of the caudal type and 5 of the transitional type. Subtotal resection of lipoma with dural plasty was performed in all cases. The average of follow-up period was 6 years. The patients’ clinical symptoms were evaluated with Hoffmann’s classification.

Results:
Seven patients showed the postoperative improvement of bladder dysfunction, whereas none of the patients recovered from the muscle atrophy, sensory disturbance and foot deformity. The younger patients (the age at surgery below 12 y/o) showed significantly better recovery of bladder dysfunction compared to the older group (age at surgery over 12 y/o). There was no significant correlation between the duration of disease and the improvement of bladder dysfunction. In terms of the type of tumor, postoperative functional recovery was observed in 5 of 12 patients with the dorsal type and 2 of 9 patients with the caudal type. In contrast, there was no improvement in all the patients with transitional type.

Discussion:
When determining the surgery indication for LSSL, it is important to take the patient’s age and the type of lipoma into consideration. Surgical treatment should be applied before the deterioration of clinical symptoms such as muscle atrophy and foot deformity, especially in young patients with dorsal type LSSL.

Treadmill training-induced fatigue loading of osteopaenic bone increases susceptibility for insufficiency fracture
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Background:
Spinal cord injury has pleiotropic detrimental consequences, which include severe bone loss in the lower limbs. There has been a recent appreciation of the central role of osteocytes (OYs) in healthy bone function, and of a central mediating role of these cells in fatigue-induced micro-damage; although the involvement of OYs in SCI bone pathology remains to be explored.

Aims:
To report the clinical consequences of repetitive fatigue loading of osteopaenic lower extremity bone.

Design:
Prospective, double blind, controlled (case report)

Methods:
Patients with traumatic SCI >6 months post injury, ASIA A-D, C6-T12 were eligible. The protocol required the exclusion of medically complex patients. The exercise protocol consisted of three, 3 hour sessions per week for 12 weeks of body weight supported (BWS) treadmill training, FES-elicited cycling and plinth exercise. Sixty-minute BWS treadmill sessions were disposed as repetitive 3-5 minute bouts of dynamic limb loading alternating with static limb loading.

Results:
A 31 year old male patient (SCI 5 years, ASIA A, T3) agreed to participate and was randomised to the BWS treadmill training group. His baseline laboratory reports were unremarkable, as was a whole body bone study (CT/SPECT), which excluded bony abnormality. At week three, he presented with a 48 hour history of episodes of autonomic dysreflexia and bilateral knee effusion. Plain X-rays were unremarkable and diagnostic ultrasound findings were inconclusive. MRI confirmed the diagnosis of bilateral insufficiency fractures of the distal medial femoral condyles and lateral tibial plateaux.

Discussion:
Fatigue loading of bone can have detrimental consequences, which include induction of OY-related micro-damage and osteoclastic bone resorption. The present case report is indicative of a causal relationship between lack of sufficient loading of bone early after injury, and between subsequent bone fatigue loading and susceptibility for insufficiency fracture and might indicate a central mediating role for OY-induced micro-damage.
Revisiting neurogenic shock, blood pressure control in acute period of spinal cord injury

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Background:
Cardiovascular problems during acute period of spinal cord injury (SCI), including neurogenic shock, are common manifestations of autonomic nervous system dysfunction. Unfortunately, the expected time course of blood pressure parameters recovery among newly injured individuals is not well known. Furthermore, an appreciation of the full extent of changes in arterial blood pressure on neurological recovery following this injury requires investigation. The primary goal of this study is to investigate the occurrence of neurogenic shock and the natural progression and degree of recovery of cardiovascular function during the acute period following SCI. The secondary goal is to establish the potential relationship between changes in arterial blood pressure in initial period of SCI and the degree of neurological recovery following traumatic SCI.

Methods:
A retrospective chart analysis was performed for all cases admitted with acute SCI to a tertiary care center in a three-year period. Data on demographic, neurological injury, and cardiovascular parameters including blood pressures (systolic and diastolic [SBP, DBP], heart rate [HR]) were extracted daily from the time of injury for a period of one month.

Results:
Preliminary analysis has a total of 34 charts reviewed. Vasopressor or aggressive fluid resuscitation therapies were needed on admission to Emergency Department in 10 patients (29%), the majority (90%) sustained cervical complete (AIS A) SCI. On average, the SBP documented from first assessment of this group was estimated at 76 mmHg. An average length of pressor therapy was for 10 days (ranging from 3 to 43 days).

Conclusion:
Approximately 30% of the cohort examined exhibited neurogenic shock that required administration of pressor therapy and volume resuscitation. Although this group was homogenous with respect to level and completeness of SCI, there was significant variation in length of need for pressor therapy. There is a possibility that the extent of spinal autonomic circuit damage varies significantly with SCI, which was reflected by the necessity of various durations of pressor therapy. Further studies are required to fully elucidate the need for inclusion of detailed autonomic assessment in acute period of SCI.
Leisure repertoire among persons after a spinal cord injury: interests, performance and well-being

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Background:
Leisure activities are the essence of life for many of us, and we engage in them by choice, not out of necessity. Persons who recently suffered a spinal cord injury (SCI) or persons who have been living with SCI for many years, can experience a change in their leisure repertoire which can result in feelings of reduced well-being. The purpose was therefore to explore and describe the leisure repertoire among persons with traumatic spinal cord injury and how this repertoire relates to interest, performance and well-being.

Method:
This research was designed as a cross-sectional study. Data were collected through a postal survey, which consisted of two parts. The first comprised questions of socio-demographic variables and injury characteristics and the second part the NPS-interest checklist. A total of 97 persons with a traumatic SCI participated.

Results:
The respondents were mostly engaged in social and cultural activities that consisted of both calm and active leisure activities. Social activities were also the activities that they experienced the greatest performance change in. Watching TV/DVD/video/movies was also important in their leisure repertoire and contributed to their well-being. Furthermore, leisure activities varied due to gender, age, injury level, time since injury and living conditions.

Conclusion:
The results implicates that persons with SCI need a balance in their leisure repertoire between calm and active leisure activities to experience well-being and that factors such as gender, age and time since injury have a greater impact on which leisure activities they chose, compared to injury level. This is important knowledge to consider for professionals in their clinical work when they meet clients, so they focus on the individual instead of the SCI when planning for interventions regarding leisure activities.

Using of hydrophilic-coated catheters for intermittent catheterization in the conditions of spinal cord unit

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Background:
Clean intermittent catheterization (CIC) is now a standard method for emptying of the urinary bladder in the treatment of lower urinary tract dysfunction after a spinal cord injury. The most common complications of CIC are urinary tract infection (UTI), trauma or urethral stricture formation. Hydrophilic-coated catheters should minimize the complications.

Material and methods:
This is a randomized, open label, prospective study monitoring the incidence of symptomatic infection and urethral injury. Since March 2009 to December 2011 were enrolled a total of 78 patients (males) after spinal cord injury. Patients admitted to the spinal cord unit were randomized into two groups. Group A used hydrophilic catheters and group B used standard PVC catheters, the length of study was three months. Patients urine culture was performed at weekly intervals. Episodes of symptomatic infection and complications of catheterization were monitored during the study. Patients in this study did not use antibiotic prophylaxis. The endpoint was the incidence of symptomatic UTI and episodes of hematuria or urethrorrhagia.

Results:
Before enrolling in the study only 38% of patients used the technique of CIC, the rest of patients with this technique began. The incidence of asymptomatic bacteriuria was high in both groups, 91% with hydrophilic catheters vs. 96% of patients in the group with PVC catheters. The incidence of symptomatic UTI was lower in the group of patients with hydrophilic-coated catheters (p<0,05). We did not observe a statistical significant difference in urethral trauma between both groups.

Conclusions:
Intermittent catheterization is a safe method in the treatment of lower urinary tract dysfunctions after spinal cord injury. We did not observed the difference in the incidence of asymptomatic bacteriuria and urethral injury when using hydrophilic and standard PVC catheters. The use of hydrophilic-coated catheters significantly reduce the incidence of symptomatic UTI.
Gait disorders are a frequent symptom of cervical compression myelopathy. Recently, gait analysis using a three-dimensional analyzer has been reported. The gait analysis provides a quantitative measure that can be correlated with functional grade. The aim of this study is document alterations of gait with eyes open and closed in cervical compression myelopathy and to evaluate the effect of surgical decompression on walking. Ten patients with cervical compression myelopathy underwent gait analysis before and after surgery. The patients were tested at our gait laboratory using a motion analysis system which consisted of 8 cameras and a force plate. Twenty-two small reflecting markers were placed on trunk and extremities of the patients. Factors related to time and distance (speed, cadence, step length, and single standing phase duration), and factors related to style of walking (symmetry, reappearance, smoothness, away, rhythm, and impact) were analyzed. Before surgery, the patients with spastic pareses showed prolonged stance phase duration and decreased single stance phase during walking, compared to postoperative patients. They also showed increased step width and decreased step length. In association with slow walking speed, they showed decreased maximal flexion angle of the knee joint during the swing phase and decreased plantar flexion angle of the ankle in the stance phase. The patients with eyes closed were difficult to keep balance at standing and walking compared to eyes open. Neurological improvement after surgery was associated with increased single-stance phase duration and increased step length as well as natural gait speed. To increase the step length, patients need to show prolongation of the single-stance phase duration. However, the gait improvement was better in the patients with eyes open rather than eyes closed. The patients with eye closed tended to lose postural control, resulting in swaying and feeling instability. Gait analysis, especially for the patients with eyes closed, sharply detect the degree of spasticity and severity, and reflect the functional improvement after surgery in cervical myelopathy. This means that walking with eyes closed reflect the pure dorsal column function without visual input. The gait analysis is an objective tool to document functional recovery after decompressive surgery.

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**Workshop as a tool in rehabilitation to improve mastery and quality of life for persons with incomplete spinal cord injury and cauda equine syndrome**

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**Norway**

**Background:**

The number of persons with an incomplete SCI is increasing. Their impairments are not always obvious. However, they struggle within all the domains of the International Classification of Functioning, Disability and Health (ICF), and often lack a sense of belonging to the SCI support organizations. Workshops are run in order to increase participations’ knowledge, encourage new attitudes and develop skills which contribute to improved quality of life.

**Methods:**

Since 2009 the hospital has held a five day workshop twice a year for approximately ten persons. The participations must have an incomplete SCI or cauda equine syndrome and be able to walk. They are recruited from the hospital's database and through social media. The workshop consists of lectures, social gatherings and physical activities led by the multidisciplinary team. Sharing of experiences within the group is the main focus.

**Results:**

Feedback from the participants has been very positive. They highlight an increased knowledge, that their challenges are recognized an that they feel a sense of belonging. The workshops are efficient as they cater to several people’s needs simultaneously and effective as they trigger changes to participants’ lives.

**Conclusion:**

In order to achieve an optimal outcome for the participants, the level of physical function within the group needs to be as equal as possible. However, age, gender and time of injury should vary. To persons from the multidisciplinary team need to be responsible for planning and organizing the workshop. This allows the workshop and the group dynamics to be monitored from different perspectives.
Increases of capillary blood pressure in men with cervical cord injuries
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Background:
Cervical spinal cord injuries (CSCI) subjects have hypotension and most of physicians have believed that capillary pressure in CSCI would be decreased and easily formed pressure ulcers. Systemic blood pressure (BP) decreases are mainly caused by attenuated total peripheral resistance in CSCI. We hypothesized that the measurement of peripheral pressure such as arteriole pressure and capillary pressure could be a simple and efficient means of expecting to occur with lasting tissue damage for CSCI. However, BP in capillary was not measured in CSCI. The purpose of the present study was to investigate capillary BP in CSCI.

Methods:
Eleven male CSCI individuals with a lesion between C6 and C7 (ASIA A, age, 32.5 +/- 9.4 y) and 13 healthy subjects (age, 40.1 +/- 12.6 y) participated in the present study. To measure Capillary BP, Doppler blood flow velocimeter fixed a pressure transducer was softly attached to the pretibial skin and the probe was gently and continually compressed. The increase of the probe compression decreased the output signals of Doppler blood flow velocimeter. When the output of the velocimeter showed constant values, the pressure of the probe compression should mean the Capillary BP. Because the termination of capillary blood flow demonstrated constant signals of velocimeter and at the time the compression pressure should be the capillary pressure. Simultaneously, mean blood pressure (MBP) was measured.

Results:
A significant lower MBP was observed in CSCI (78.7 +/- 15.8 mm Hg) than in healthy subjects (98.1 +/- 13.5 mm Hg). Capillary BP in CSCI (55.7 +/- 7.1 mm Hg) was significantly greater than in control subjects (45.9 +/- 7.8 mm Hg).

Conclusion:
We demonstrated here that transection of sympathetic nervous system from medulla to peripheral nerves in CSCI resulted in the increase of capillary pressure. We suggested that the cervical spinal transection diminished tonic impulses of sympathetic nerves to resistant vessels in CSCI.

Extended community interventions to maximise benefits of rehabilitation of Spinal Cord Injuries with severe irreversible paralysis
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Shanta Memorial Rehabilitation Centre, a NGO in Bhubaneswar, Orissa, India established a post acute SCI care unit funded by Government and voluntary organizations. A pilot study of “extended community rehabilitation” for SCI patients funded by Action Aid began in 1996. The goal was to enable the patients to utilize the techniques of independent living in the community and continue to practice preventive care. Planning sessions for post discharge “needs” were initiated with the carers, soon after admission to the institution. This included training of family carers, home visits to assess the environment for wheelchair access and mobility; consultation with community leaders to help modify or build accessible homes, toilets and a place for economic activity. Financial assistance was included in the programme, for building material, mattresses, disposable urinary catheters and seed capital for business.

Method:
Sixty SCI patients with paralysis received “extended community rehabilitation” in the years 1996-8. The ongoing study will review these patients after a 10 year interval to assess mortality, morbidity, participation and economic impact. A similar cohort of SCI patients who fended for themselves following institutional discharge and did not have community rehabilitation will be the comparison.

Primary Outcome:
1. Mortality
2. Morbidity
3. Mobility (Craig criteria)
4. Participation scale (Craig)

Secondary outcomes:
1. Poverty
2. Expenditure for care
3. Days lost from work
4. Opportunity costs
5. Quality of life

Analysis:
The results will demonstrate whether interventions which offers transition back into the community, even for a short period of time for patients with severe disabilities improves survival, reduces complications, limits cost of care, improves economic productivity, social participation and integration. If so, financial support in the form of cash transfers or disability benefits at an early phase of rehabilitation will impact quality of life, improve life expectancy and alleviate poverty of SCI patients in developing countries lacking social security. It could also be a meaningful finding to justify programmes for individuals with spinal injuries even if a country or community cannot yet afford long term, expensive and extensive programmes.
Mortality after traumatic spinal cord injury in Western Norway and Estonia
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Objective:
To compare mortality and life expectancy after traumatic spinal cord injury (TSCI) in Western Norway and Estonia from 1997 to 2001.

Design:
Retrospective population-based study
Patients and Methods: Medical records of patients with TSCI from two Norwegian counties and Estonia from the period 1997-2001 were retrospectively reviewed. The date of death was obtained from Norwegian and Estonian Population Registers. All TSCI patients were followed up until death or until 14th October 2011. Standardized mortality ratios (SMR) for the TSCI patients in both countries were calculated.

Results:
Seventy-one TSCI patients in Norway and 244 in Estonia were identified between 1997 and 2001. By 14th October 2011 36.6% in Norway and 35.3% in Estonia had died. TSCI patients had increased mortality in both Norway (SMR 2.25) and Estonia (SMR 3.72). Among the deceased patients, median survival time was 3.4 years in Norway and 2.8 years in Estonia. The mean age at injury was 48.9 ± 23.0 years in Norway and 38.9 ± 17.3 years in Estonia. The mean age at death was 70.3 years in Western Norway and 48.6 years in Estonia (P<0.001). In both countries the most frequent cause of TSCI was fall (53.9% in Norway and 45.4% in Estonia), followed by motor vehicle accident (34.6% in Norway and 30.2% in Estonia).
In Norway 80.8% of deceased patients had tetraplegia compared to 59.3% in Estonia. Concomitant brain injury was diagnosed among 50.0% and 44.2% in Norwegian and Estonian, respectively.

Conclusion:
The TSCI patients had an overall significantly increased mortality rate in both countries. Although the survival of patients with TSCI was similar in Norway and Estonia, the mean age at death was significantly higher in Norway, due to a high incidence rate of TSCI among elderly in Western Norway.

Robot-assisted treadmill training in spinal cord injury: a pilot study on bowel, bladder and sexual function
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Background
In Spinal Cord Injury (SCI) problems with bowel, bladder and sexual function are known to have a negative effect on quality of life. Literature suggests that increased physical activity may help improve bowel and bladder function. To our knowledge no studies examined the possible effect of robot-assisted treadmill training in patients with SCI. The aim of this pilot study is to explore the effect of robot-assisted treadmill training on bowel, bladder and sexual function in patients with SCI.

Methods
Fourteen patients were included with incomplete tetraplegia (8) or paraplegia (6), ASIA B, C and D, 6 patients <1y post-injury, 8 patients ≥2y post-injury. Robot assisted treadmill training (on Lokomat) was administered twice a week for 30–45 minutes, combined with conventional physical therapy twice a week 30 minutes for a period of 12 weeks. Self-reported questionnaires and VAS score on satisfaction with bowel, bladder and sexual function were filled out before (T0) and after completion (T1).

Results
VAS scores on all 3 functions improved, but only significantly in bowel function in patients with SCI ≥2y (53.13 (SE 5.52) to 66.75 (SE 4.89), p=0.031). There were no significant differences in frequency of obstipation, faecal incontinence or laxation methods. In bladder function VAS scores on T0 resp T1 were 69.00 (SE 10.41) and 76.88 (SE 7.96) for SCI≥2y. In sexual function VAS scores on T0 resp T1 were 50.75 (SE 10.61) to 52.63 (SE 10.40) for SCI≥2y. Regarding bladder and sexual function no differences were found.

Conclusions
This pilot study showed an increase in satisfaction on bowel, bladder and sexual function, with bowel function being significantly improved. Future research with more responsive outcome measures, a larger group of patients and controls should be conducted to gain more insight in the effect of robot-assisted treadmill training on these functions.
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Ischemia-like conditions damage spinal cord networks via complex cell death mechanisms

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Background:
In addition to typical traumatic causes of spinal cord injury (SCI), there is growing importance for non-traumatic, often incomplete, injuries among which those of vascular origin are an important component. As the pathophysiological mechanisms of SCI remain largely unknown, the aim of our study is identifying the molecular and cellular processes mechanisms underlying this acute pathology.

Methods:
Using an in vitro neonatal rat spinal cord model, an experimental protocol (pathological medium, PM) has been developed to mimic non-traumatic, incomplete SCI by introducing the profound metabolic perturbation (hypoxia, aglycemia, oxidative stress, acidosis, toxic free radicals) occurring in vivo after ischemic SCI, a condition surprisingly worsened by extracellular Mg2+ (1 mM). The current study sought to identify the cells affected by PM (with Mg2+), and the associated molecular death pathways. Our focus was on the spinal lumbar region which contains the locomotor networks for the hindlimbs.

Results:
One h PM+Mg2+ application primarily damaged the spinal white matter with rapid-onset (3 h) caspase 3-dependent apoptosis leading to nuclear pyknosis. Grey matter damage was less intense and associated with hyperactivity of poly (ADP-ribose) polymerase 1 (PARP1) that indicated localized cell death via the process of parthanatos. Unlike premotoneurons that were relatively unscathed, nuclei of motoneurons became immunoreactive for the mitochondrial apoptosis-inducing factor (AIF; the intracellular effector of parthanatos), that was translocated to induce chromatin condensation and DNA fragmentation. AIF immunopositivity appeared immediately after PM+Mg2+ washout, peaked 24 h later, and lacked the canonical markers of apoptosis.

Discussion:
Through a mechanism still under investigation, extracellular Mg2+ amplified the consequences of dysmetabolic SCI to comprise not only white matter apoptosis, but also motoneuronal degeneration via PARP1-dependent pathways. In conclusion, simulating acute ischemic-like damage in vitro produced discrete lesion to the white matter and motoneurons through distinct biochemical pathways, all concurring to loss of locomotor activity.

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LONG TERM FOLLOW UP OF NEUROPATHIC BOWEL AND BLADDER DYSFUNCTION IN PATIENTS WITH CHRONIC SPINAL CORD INJURY

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Background:
Life-expectancy after spinal cord injury(SCI) has increased. A life-long follow up is important for early diagnosis and management of deterioration of neurogenic bladder and bowel function. This is a study of the parameters of appropriated bladder and bowel management in long-term follow up of SCI patients.

Materials and methods:
We studied 118 patients with chronic traumatic SCI, mean time since injury 6,45 years (SD=6,90), 32 women and 86 men, mean age 36 years. Patients were regularly followed up in an outpatient basis in the Neuropathic Bladder Unit and have been underwent clinical examination, urodynamic studies at least twice, dynamic cystography, ultrasound of bladder/kidneys. The level and completeness of spinal cord injury was determined according to American Spinal Injury Association Impairment Scale(AIS); 34 tetraplegics (9 AIS A) & 84 paraplegics (61 AIS A) and the type of neurogenic bladder dysfunction was classified according to the terminology of International Continence Society(ICS).

Results:
Overactive detrusor in 79,7% & underactive in 16,9%, dyssynergia in 76,3%. Parameters of appropriated neuropathic bladder management: 1)bladder capacity >300ml: 69,5% patients, 2)detrusor pressure(Pdet)<40cmH2O: 52,5%, 3)symptomatic urinary tract infection<2 episodes/year: 72%, 4) compliance>10ml/cmH2O: 93,2%, 5)continence: 52,5%.

Parameters of appropriated neuropathic bowel management: 1)bowel evacuation time<30min in 59,1%, 2)frequency of bowel evacuation ¡Ü3days in 88,8%, 3)stool continence in 92,2%, 4)no rectal bleeding in 61,3%, 5)stool consistency type 3 & 4 of Bristol visual scale in 55,9%. Long standing SCI is significantly correlated with Pdet>40cmH2O, dyssynergia, bowel frequency >4days, type 1&2 or 5&6 of Bristol visual scale, more episodes of urine incontinence and less of stool incontinence.

Conclusions:
The long term follow up of patients with SCI is necessary in order to maintain proper management of neuropathic bladder and bowel and the well-being of the patients.
P127

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1Dept. of Neurology, Spinal Cord Unit., Denmark; 2Rehabilitationcenter, Denmark

Background:
Approximately 60 persons in Denmark sustain a traumatic SCI every year.
The purpose of this study was to identify, to which degree and how soon after the injury persons with SCI return to work or education in Denmark

Methods:
A historic follow-up study, using retrospective data from the SCI databases and postal questionnaires. All persons (age 18 – 64) registered as traumatically spinal cord injured with a primary submission to one of the two Danish spinal rehabilitation centers between 1.7.2005 and 30.6.2010 were included.

Results:
A total of 219 questionnaires were sent. 160 responded (73 %). Mean age of respondents was 42 years. Male/female ratio 5:1. Paraplegia/tetraplegia 1:1. Most common causes of injuries were transportation and falls.
At the time of the accident 70 % of the respondents were working, 11% were in training or education. At the time of our study 32 % of the total population was working and 8 % was in training or education. The average time before initiating work or education was approximately one year, range 3 to 38 months. Most persons, who returned to work or education, were young, had higher level of education and less severe injuries. Of those returning to work, 75 % returned to their pre-injury employer, and this was associated with shorter interval to initiation of employment.

Discussion:
Persons in Denmark, who sustained a traumatic SCI within the period 2005 to 2010 show a lower employment rate than in other western countries. Findings emphasize the importance of implementing issues as future employment or education, early in the rehabilitation process.

P128

Review of spinal spasticity patients in whom cessation of ITB therapy was opted: Twenty years of experience
Nirmal, J; Oo, T; Soni, B
NorthWest England Regional Spinal Injuries Centre, United Kingdom

Background:
We treated 116 patients of spinal spasticity with intrathecal baclofen through programmable pump implants between 1992 and 2011. The ITB therapy was stopped in 13 patients during their treatment. We analysed the reasons for stopping ITB therapy in these patients.

Methods:
Retrospective analysis of patients was done in whom the ITB therapy was required to be stopped. Such 13 cases were identified from total of 116 patients treated over 20 years between 1992 and 2011.

Results:
There were 13 patients identified. Five were tetraplegia and 8 were paraplegia. Two of the tetraplegics were ventilator dependent. The reasons for stopping ITB were medical in 6 patients, delayed pump site infection in 5 patients and psychological in 2 patients.

Conclusion:
For medical reasons and clinical situations sometimes pump replacement may not be safe and in such cases oral medications and other measures can be opted for effective control of spasticity. When the pump needed to be removed for delayed infection, a replacement may not be suitable for medical reasons and risks. Psychological evaluation of the patient is important. Patients need to understand fully the commitment they are making while opting for ITB therapy.
ASSOCIATED INJURIES AFTER TRAUMATIC SCI
Werhagen, Lars; Trok, Katarzyna; Phiel, Fredrik
1Clinical sciences, rehabilitation medicine, Sweden; 2clinical neurosciences, Sweden; 3Neurosciences, Sweden

Setting:
university hospital setting

Introduction:
The study was performed at the neurological department, Karolinska University hospital, Stockholm Sweden.
Associated injuries are common after traumatic SCI (TSCI). TSCI are often high energy trauma and associated injuries can be life-threatening and can have a negative impact on the rehabilitation period. Minor brain trauma can cause cognitive dysfunction. Patients with severe brain injuries are usually not treated in a spinal unit.
The aim of the present study is to analyze the associated injuries after TSCI.

Methods:
The medical files of patient with TSCI at the Karolinska University hospital were studied. Studied data include AIS grade cause of injury, neurological level and presence of associated injuries. Associated injuries were divided into five groups 1. Fracture of upper extremities 2. fracture of lower extremities 3. thorax trauma 4. abdominal trauma 5. Head trauma

Results:
Included in the study were 40 patients with TSCI. The overall presence of associated injuries was 50%. The most common associated injury was thorax trauma followed by fractures. Head injury occurred in 25%.
Patients with TSCI after traffic accidents more often than other causes suffered from associated injuries.

Discussion:
Associated injuries occur in about half of the patients with TSCI. Fractures both to the upper and lower limb can restrict the patient's mobility. As head trauma can give a cognitive dysfunction which might affect the rehabilitation period. Acknowledgement: Funded by a ALF grant from the Stockholm County Council.
**P131**

**Imaging protocol for transfer of subacutely spinal cord injured patients from an acute centre to spinal unit**

Tom Meagher; Lopez de Heredia, L; Jamous, A; Hughes, RJ

National Spinal Injuries Centre, United Kingdom

**Background:**

Patients with subacute spinal cord injury remain at increased risk from a wide range of complications in the subacute period of injury including chest problems, problems with spinal fixation, deterioration of neurological level, sepsis and heterotopic ossification. The median age of patients is relatively young, so minimising imaging involving ionising radiation is important as is the avoidance of duplication of costly imaging.

**Method:**

We outline a protocol evolved over the last 10 years including detail of MRI sequences for spinal imaging and the temporal relation to initial injury. The protocol for imaging including rational behind, timing and indications for plain radiography comprising chest, spine and pelvic imaging.

**Results:**

A defined imaging protocol minimises repeat imaging while providing good imaging baseline to identify complications of spinal cord injury in the subacute period.

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**P132**

**Electrical stimulation-induced paralyzed muscle activity increases “resting” energy expenditure in individuals with spinal cord injuries**

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Netherlands

**Background:**

Obesity is a major problem in wheelchair users with spinal cord injuries (SCI), probably even more than in the general population as a result of diminished activity levels and a reduced resting metabolic rate. Increasing the metabolic rate by electrically activating the paralyzed leg and gluteal muscles while sitting in a wheelchair might assist in combating the development of obesity. However, it is currently not known whether this method results in marked increases in metabolic rate.

**Purpose:**

To evaluate if electrical activation of the paralyzed leg muscles results in a marked increase of energy expenditure and how duty cycle and amount of activated muscle mass affect this increase.

**Methods:**

Nine men with SCI (40±15 yrs; ASIA A/B) untrained for electrical stimulation received 4 different 10-min protocols while sitting still in their own wheelchair. Current amplitude (35-120 mA) was individually set to induce muscle contractions at comfortable levels. The amount of muscle mass (gluteus and hamstring vs gluteus, hamstring, quadriceps and calf) and duty cycle (1s-4s vs 1s-8s) varied among protocols. Energy expenditure was calculated from oxygen uptake measurements.

**Results:**

Energy expenditure increased (p<0.05) from rest (5.10±0.76 kJ/min) in all protocols, with the largest increase (+51%) in the protocol with more muscles activated and shorter rest periods (7.69±2.28 kJ/min) and the smallest (+26%) in that with fewer muscles and longer rest periods (6.43±1.43 kJ/min). Two hours of daily stimulation with the former protocol can be estimated to counteract the yearly 1.8-kg increase in body mass found in individuals with SCI (De Groot et al., J Rehab Med 2010).

**Conclusion:**

Electrical activation of paralyzed muscles can markedly increase energy expenditure in individuals with SCI while sitting in rest, with larger increases when activating more muscle mass and with a shorter duty cycle.
Secondary health conditions, care, and quality of life in Dutch persons with SCI: design of the long-term aftercare study within the ALLRISC-program
Post, MWM; Adriaansen, JJE; de Groot, S; van der Woude, LHV; van Asbeck, FWA
Netherlands

Background:
With increasing age and time since injury (TSI), more serious health problems may arise in persons with a spinal cord injury (SCI). These secondary health conditions (SHCs) hamper an active lifestyle and quality of life on top of the primary motor and sensory impairments due to the SCI.

Objectives:
- To assess the occurrence of SHCs and unmet needs in persons with long-term SCI;
- To analyze risk factors for SHCs, in particular TSI, and relationships between SHCs and fitness, active lifestyle, participation, and subjective well-being;
- To develop guidelines for long-term follow-up rehabilitation care.

Methods:
Nation-wide cross-sectional study. Subjects are 300 persons who suffered SCI at least 10 years ago, and were between 18 and 35 years of age at the time of SCI onset. They are invited in three strata: 10-20; 20-30; and >30 years post-SCI. Eligible persons are invited to visit a rehabilitation centre with a SCI specialty. The measurement protocol takes 4-5 hours and includes:
(1) Assessment by the local physiatrist of neurological impairment (ASIA standards), structured interview on SHCs and their management, and co-morbidity. In addition, blood sampling (i.a. glucose and lipoprotein profile), electrocardiogram, and an ultrasound of bladder and kidneys will be performed.
(2) Assessment by a research assistant of functional independence (SCIM III), respiratory function (spirometry), wheelchair skills (Wheelchair Circuit), and fitness (maximal exercise test).
(3) Self-report questionnaire including standardized instruments for hinder from SHCs, active lifestyle, participation, well-being, self-efficacy, and wheelchair and internet use.

Results:
Patient inclusion has recently started and, so far, the large majority of persons with SCI invited are willing to participate.

Conclusion:
With this study we expect to gain knowledge on the occurrence of SHCs and unmet care needs, leading to the development of guidelines for long-term rehabilitation care of persons with SCI.

Why is there not a single colostomy in China?
Wang, Dajue1; Wen, Jun2; Liu, Genlin3; Guo, Jidong4
1National Spinal Injuries Centre (retired), United Kingdom; 2China; 3Department of Functional Recovery, China; 4Orthopaedic Department, China

Introduction:
It is estimated that there are more than 2 million SCI persons in China. Never has a colostomy been observed or reported. In contrast, 3 centres in New Zealand and UK alone have recorded 71 patients with colostomy. What is behind this extreme difference? Does diet have anything to do with it?

Material and Methods:
Thirty SCI persons that JW (first author) knew particularly well about their eating habit were contacted online. M:F=23:7. Age:19-46 (mean±33.8, SD±6.44), Level: C=3, T=22, L=5. Incomplete/complete=17:13. They all had normal Chinese eating and bowel habit. A questionnaire based on ISCoS Bowel Function Data Set Draft was sent to them about their bowel habit in terms of frequency, time and method of care. Another 5 SCI persons were gathered at JW’s residence for 7 days and offered a normal Chinese menu and the contents were calculated. An average intake of various ingredients was calculated round the table. The analysis focused on roughage intake.

Results:

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Number of Patients</th>
<th>Time of bowel care (min)</th>
<th>Method of care</th>
<th>Number of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 per day</td>
<td>12</td>
<td>0-5</td>
<td>normal</td>
<td>4</td>
</tr>
<tr>
<td>&gt;2 per week</td>
<td>14</td>
<td>6-10</td>
<td>Valsalva/Crede</td>
<td>3</td>
</tr>
<tr>
<td>2 per week</td>
<td>4</td>
<td>11-20</td>
<td>Anal stimulation</td>
<td>9</td>
</tr>
<tr>
<td>1 per week</td>
<td>0</td>
<td>21-30</td>
<td>Digital evacuation</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30-60</td>
<td>Enemas&gt;150ml</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;60</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The test of 5 SCI patients had an average intake of roughage of 11.63g per day.

The average roughage intake of Chinese SCI persons is not higher than that of their counterparts of the developed world and well below the US and Chinese recommended standard of 20-35g per day. This indicates that there are many other factors that could have caused this extreme difference. It seems to the authors that culture difference plays key role that needs further detailed investigations.
Perceptions of family caregivers at discharge of spinal cord unit: a qualitative study of needs and emotional experiences

**Background/Objective:**
Spinal Cord Injury (SCI) generates deeply changes in people involved, not only on physical and functional, but also in psychosocial sphere, in family relationships and in workplace. In most cases the caregiver of a patient with SCI coincides with the closest family member, who has the opportunity of spending longer beside him, facing the great difficulties of returning home. Family caregivers encourage the adaptation process through emotional support, recognizing the aspects of need and promoting autonomy. Returning home implies the separation from a structure perceived as protective. Aim of the study is to explore the condition of caregivers of persons with SCI in discharge from a Spinal Cord Unit (SCU), related with needs, emotional experiences, difficulties and subsequent reactions to discharge.

**Methods:**
A purposeful sample of 8 family caregivers of patients in discharge from SCU was interviewed using a semi-structured interview schedule. Data were analyzed using the Giorgi method.

**Results:**
The themes emerged from our study are anger, discouragement, loss of certainty. It's evident a changing relationships, from the same level to different roles of bearer of care and assisted person, subsequently exists an awareness, with a strong desire to reach autonomy. A guide is required during hospitalization, helping in psychosocial rehabilitation, outside the hospital. There is an expectation in coming home, an everyday life return, in a condition as close as normal.

**Conclusions:**
Analysis of the family caregiver's perceptions revealed a wealth of details on their experience at discharge of the SCU. Family caregivers often identify themselves with what happens to their dear, hearing and feeling similar moods. Incorporating the caregiver’s perceptions into a care model could increase professional awareness of patient’s needs and provide a useful basis for constructing a personalized care plan.

Preliminary data from a service evaluation of a cauda equina specialist clinic

**Objective:**
A service evaluation of a Cauda Equina specialist clinic within a supra-regional spinal injuries unit.

**Study Design:**
We performed a retrospective analysis of patient notes and radiological data (where available) for new patients attending the clinic between November 2010 and November 2011. This yielded 39 patients. This evaluation aims to set criteria for practice within the clinic which can be used for future audit purposes and allow us to develop a prospective data capture tool.

**Results:**
This is preliminary data as this is the first service evaluation of a new nurse led clinic. We recorded a 3:1 female to male ratio with a higher proportion of patients at working age (20-40 yrs). Sixty six per cent had developed the syndrome secondary to a disc prolapse, thirteen per cent following trauma. There was a variety of bladder presentations with 28% straining to void and 31% reporting hesitancy/urgency; 74% were established on a regime of intermittent self-catheterization. Seventy seven per cent presented with constipation and 87% were established on a successful management regime after consultation. We found that of the available radiology (n=26) 39% had no evidence of cauda equina or significant cord compression. Forty nine per cent classified their pain as severe with 28% under the care of a specialist pain service.

**Conclusion:**
Further work is required to establish protocol for the management of these complex patients but this preliminary data indicates a good success rate at the management of bladder and bowel symptoms within the setting of a specialist clinic. Further work will aim to support the use of specialist clinics and early intervention in improving quality of life and outcome measures.
P137

Antibiotic use in an acute spinal cord injuries unit: a retrospective study

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United Kingdom

Background:
The National spinal injuries centre (NSIC) at Stoke Mandeville Hospital has the highest capacity in the UK for ventilated tetraplegic patients. It runs like a high dependency unit (HDU), with critically unwell patients. Many of these patients have complicated pneumonic processes or infective states requiring long-term antibiotics.
The incidence of hospital-acquired infections is 10 times higher on HDUs than general wards. Most HDUs have daily consultant-led microbiology ward rounds. Many perform regular non-bronchoscopic alveolar lavage on their ventilated patients. The discrepancy between their practice and ours and a recent near-fatal reaction to prolonged antibiotic exposure prompted us to examine our antibiotic use within the NSIC.

Method:
We analysed the antibiotic prescribing across all adult wards of the NSIC over a 3 month period. Patients on long-term antibiotic prophylaxis were excluded. 66 instances of antibiotic prescribing were identified.

Results:
Our study showed underperformance in our prescription and delivery of antibiotics. Only 56% of cases had a documented duration for antibiotic therapy. Of these, 54% received a different duration to that which was documented, mostly longer courses. Expert opinion does suggest that spinal injury patients require longer antibiotic courses than the general population. This highlights the need for department-specific antibiotic guidelines.

Only 62% of cases had samples sent for culture. Of those sent, 61% were positive. With regular microbiology input more stress would be put on the importance of obtaining samples. It is clear that outcome is significantly better when sensitivities are known.

Conclusions:
As a result of this study our acute ward now has regular consultant-led microbiology ward rounds. We recommend that this should be the standard across all units with ventilated patients. We are awaiting expert opinion regarding the introduction of non-bronchoscopic alveolar lavage within our unit. We are working alongside microbiology to develop NSIC-specific antibiotic guidelines.

P138

Physical exercise, stress, burnout and fatigue in persons with incomplete spinal cord injury

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Background:
The purpose the study was to examine the role of physical exercise and the degree of coping with disability-stress in the association between disability-stress and burnout or fatigue in a Norwegian sample of persons with incomplete SCI.

Methods:
The design of the study was cross sectional with a mailed questionnaire.

Results:
The final sample included 186 persons with incomplete SCI (AIS D) or with cauda equine injury. Of this sample, there were 142 men and 44 women, of which 85 persons with tetraplegia and 101 persons with paraplegia. The mean age was 48 (18 - 87) years, and mean duration of injury was 15 (2 – 55) years. The mean burnout score was 2.8 (SD = 1.2), and 26 persons, 15 % of those who completed the Pines burnout measure, scored above 4, the cut-off point for burnout. Mean score for fatigue severity scale was 4.4 (SD =1.5), which means borderline fatigue. Of the sample, 63 % scored 4 or above, whereas 43% scored 5 or above. The results of the mediation analyses demonstrated that disability stress was indirectly linked to perceived exercise mastery through physical exercise (R2adj = .28, F = 31.839, p < .001). Further, perceived exercise mastery was indirectly linked to burnout through degree of coping (R2adj = .51, F = 82.777, p < .001), and lastly, perceived exercise mastery was indirectly linked to fatigue through degree of coping (R2adj = .36, F = 45.808, p < .001).

Conclusion:
The study demonstrated that the sample of persons with incomplete SCI experienced burnout and fatigue more frequently than the general population. Physical exercise and degree of coping with disability-stress seemed to mediate the association between disability-stress and both burnout and fatigue.
Translation and pilot testing of the Swedish CHART-SF
Augustis, M1; Kreuter, M2
1Dept of Research and Development, Vasternorrland County Council, Sweden; 2Dept of Neuroscience and Rehabilitation, Sweden

Background:
The Craig Handicap Assessment and Reporting Technique – short form (CHART-SF) is designed to measure social participation. It is used by the Spinal Cord Injury (SCI) and Brain Injury Model systems in the US and has been translated into several languages. The aim of this study was to translate and validate the CHART-SF for use among Swedish adults with SCI.

Materials and Methods:
The CHART-SF was translated into Swedish following the standard forward/backward translation procedure, followed by cognitive debriefing individual interviews with five persons with spinal cord injuries. They found the questions easy to complete and identified few problems with the content except from the question Economic Self-Sufficiency. After excluding the question Yearly income, the questionnaire was sent by mail to 141 adults with SCI.

Results:
Ninety-six persons (68%) with a mean age of 51 years (SD, 17.1 years), 72 % males, completed the questionnaire. We found that the questions measuring Cognitive Independence were misinterpreted as Physical Independence by several of the participants. These questions therefore need to be clarified and revised especially if CHART-SF will be used as a self-reported questionnaire. Furthermore, according to the results, it also seems questionable if the questions “Hours of unpaid help” and “How many other relatives they live together with” are suitable in the Swedish socio-cultural context.

Conclusion:
The Swedish version of the CHART-SF needs to be revised and further tested before being applicable for research and follow-ups in the Swedish spinal cord injury population.

The importance of Work: A qualitative study of spinal cord injured persons in Norway
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1Norway; 2Switzerland; 3Netherlands

Background:
Contrary to general interpretations of work and disability in terms of loss, social marginalization and discrimination, this research focus upon how persons with spinal cord injury (SCI) are participating and integrated in various spheres of society. The data presented is part of an ongoing European project initially designed to study participation and integration of spinal cord injured persons within the theoretical framework of ICF.

The aim of this paper is to analyze the importance of and weight given to work and employment in interviews with spinal cord injured persons in Norway.

Method:
The data used is based upon 31 in depth interviews with SCI persons. The data have been analyzed with a computer assisted qualitative data text program, MAXQDA. The data have been coded twice by two to three researchers and are a result of consensus discussions. Additional reading of each interview allows us to give a systematic and comprehensive picture of the weight given to work and employment.

Results: In line with the patterns found in Eurostat statistics less than half of the interviewed were employed, or combining employment and financial support from the welfare state. The remaining half had a disability pension and in some cases an old age pension. The results suggest a strong emphasis on work in terms of participation and integration in society. Work is associated with self esteem, social recognition and moral duty among employed as well as those outside of employment. To be out of the labour market is not to say that this has been a permanent status. For some early retirement is morally justified with their achievements as workers in the past. For others, who have to withdraw from their jobs due to health problems before age 50, work is associated with a loss in terms of self esteem, their sense of contribution to society, and integration with other people. Combined strategies of pension and work can be seen as a way to maintain self-respect, social recognition and social bonds. 4 out of 5 in full time employment have middle class jobs.
Efficacy of “CareCall”: Randomized Controlled Trial of a Telehealth Intervention for Persons with Spinal Cord Dysfunction

Houlihan, BV; Jette, A; Friedman, RH; Paasche-Orlow, M; Ni, P; Wierbicky, J; Williams, K; Ducharme, S; Zazula, J; Cuevas, P; Rosenblum, D; Williams, S

1New England Regional SCI Center, USA; 2Health & Disability Research Institute, USA; 3Medical Information Systems Unit, USA; 4Section of General Internal Medicine, Department of Medicine, USA; 5Physical Medicine and Rehabilitation, USA

Background:
To evaluate the efficacy of a novel telehealth intervention, “CareCall”, on reducing pressure ulcers and depression, and enhancing use of appropriate health care.

Methods:
We employed a single blind randomized controlled trial design. Participants entailed a convenience sample of 142 persons with spinal cord dysfunction (SCD) living in the community and using a wheelchair at least 6 hours per day. This sample included both individuals with spinal cord injury (n=106) and individuals with multiple sclerosis (n=36).

We designed CareCall, an interactive voice response system, as a biopsychosocial intervention combining patient education, cognitive behavioral interventions, screening, and referrals. CareCall is designed to: 1) screen for pressure ulcers and depressive symptoms; 2) educate about prevention of depression and pressure ulcers and appropriate use of health care services; and 3) counsel and motivate users for behavioral change. CareCall also alerts a Nurse Telerehabilitation Coordinator to provide direct non-emergent phone follow up.

The intervention group received weekly automated calls from CareCall in their homes for six months. The control group received usual care. Both groups received an accompanying Resource Book.

Our main outcome measures were The Pressure Ulcer Scale for Healing Tool, Patient Health Questionnaire – 9 Depression Screener, Cornell Services Index, and Craig Hospital Inventory of Environmental Factors – Short Form Question 5.

Results:
CareCall had an overall positive impact on reducing the number of pressure ulcers at 6 months, controlling for baseline number of pressure ulcers, age, and gender (p<0.0001). However, no positive effect was seen for men (p>0.05) while the prevalence of pressure ulcers was eliminated for women at 6 months (p<0.05)

Impact on Number of Pressure Ulcers at 6-month Follow-Up Controlling for Baseline Number of Pressure Ulcers, Age, and Gender

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Regression Coefficient(SE)</th>
<th>t Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention Group Assignment</td>
<td>-2.28(0.65)</td>
<td>-3.5</td>
<td>0.0006*</td>
</tr>
<tr>
<td># of Pressure Ulcers at Baseline</td>
<td>0.37(0.12)</td>
<td>3.11</td>
<td>0.0023*</td>
</tr>
<tr>
<td>Age</td>
<td>0.10(0.02)</td>
<td>4.27</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Gender</td>
<td>-3.89(0.75)</td>
<td>-5.16</td>
<td>&lt;0.0001*</td>
</tr>
</tbody>
</table>

Among those with baseline depression, we observed a statistically significant reduction in 6-month severity of depression in the intervention group compared with controls (p<0.047). CareCall did not have a significant impact on health care utilization (OR=1.8, p=0.07), but did significantly improve participants’ report of health care availability (OR=2.03, p<0.04).

Conclusions:
This is the first study to demonstrate the efficacy of a largely automated telehealth intervention on pressure ulcers and depression for adults with SCD. Future research needs to address gender differences related to pressure ulcer outcomes, and to replicate this study in a larger, multi-site trial.
A retrospective study of recurrence rate of pressure ulcers following surgical repair in a tertiary care centre

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1The Princess Royal Spinal Injuries and Neurorehabilitation Centre, United Kingdom; 2Princess Royal Spinal Injuries and Rehabilitation Centre, United Kingdom

Background:
Pressure ulcers are a serious, costly and life-long complication of spinal cord injury. Pressure ulcer prevalence has been estimated at between 17 and 33% among persons with SCI residing in the community. A small percentage of patients with pressure ulcer require surgical management and this represents a very complex end of the spectrum. Epidemiological studies have found that 36-50% of all persons with SCI who develop pressure ulcers will develop a recurrence within the first year after initial healing. Recurrence rates have ranged from 21% to 79%, regardless of treatment. Pressure ulcer recurrence has been associated with many factors including previous pressure ulcer. Although little data exist describing the factors associated with recurrence following surgery, some investigators report recurrence rates of 11%-29% in cases with post-operative complications and 6% to 61% in cases without post-operative complications.

Objective:
The purpose of this study was to try to identify factors affecting the recurrence of pressure ulcers after surgical closure as well as the time frame in which recurrence most commonly occurs.

Methods:
Patients admitted with grade IV pressure ulcer were randomly assigned to a spinal injury consultant. We identified these patients using ORMIS (electronic theatre list system) who had pressure ulcer surgery done during May 2007 till January 2012.

Results:
Review of medical records of all patients undergoing surgery between May 2007 and January 2012 was carried out. 543 procedures in 288 patients were identified, 46 had recurrences. The factors analysed included premorbid status, nutritional status, haemoglobin level, mobility status, SCI level, type of cushion etc.

Conclusion:
We found that head injury, cognitive dysfunction and lack of appropriate social support played an important role specially showing a trend towards recurrence of pressure ulcers in this group. Once a patient had recurrence it was then a predictor of further recurrences.

Gainful employment and risk of mortality after spinal cord injury: Effects beyond that of demographic, injury, and socioeconomic factors

Saunders, L.; Krause, J.
USA

Background:
Our objective was to evaluate the association of 3 levels of gainful employment with risk of mortality after traumatic spinal cord injury (SCI), while controlling for known predictors of mortality status (including education and income).

Methods:
This prospective cohort study included 7955 adults with traumatic SCI. Participants were recruited from 20 federally funded SCI Model Systems of care in the United States of America. Preliminary assessments were conducted between 1995 and 2006. Mortality status was determined by the Social Security Death Index (1,308 deaths). A 2-stage logistic regression model was used to estimate the chance of dying in any given year. Life expectancy was calculated under different economic assumptions.

Results:
Compared to those who were working 30+ hours per week, the odds of mortality was 1.37 for those who worked 1-29 hours and 1.67 for those who were unemployed. The addition of gainful employment only modestly reduced the effects of household income and education, both of which remained significant. For instance, the odds of mortality for household income (referent $75,000+) decreased from 1.50 to 1.38 for $25,000-$75,000 and from 2.10 to 1.82 for less than $25,000. Life expectancy varied widely depending on socioeconomic characteristics, more than doubling under certain assumptions.

Conclusions:
Substantial variation in mortality is attributable to employment, above and beyond the effects of previously established demographic, injury, and socioeconomic predictors. Although some excess mortality may be the inevitable consequence of SCI, risk is substantially increased with poor socioeconomic characteristics.
P144
A review of clinical outcomes and complications of intrathecal baclofen pumps in the management of adult spasticity in Sheffield spinal injury centre
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The Princess Royal Spinal Injuries and Neurorehabilitation Centre, United Kingdom

Objective:
A service evaluation of surgically implanted intrathecal baclofen pumps for the management of adult spasticity.

Study Design:
A retrospective analysis of data was done of all patients who had a surgically implanted intrathecal baclofen pump for the management of spasticity in our centre.

Outcome measures:
Data for the review included diagnosis for the cause of spasticity, level of injury, grade of spasticity, acute complications, maximal baclofen dosage, catheter problems, pump problems, re-siting of pump, and explantation of the pumps.

Results:
This is a early analysis of a retrospective review of surgically implanted intrathecal baclofen pumps for the management of spasticity in our center. We recorded a total of 39 pumps being implanted in the last 5 years, of which 43.5% (n=17) were replaced due to low battery power in the pump, or change from mechanical to electronic pump, 5.1% (n=2)pumps were re-sited due to complications around the subcutaneous pouch. In 5.1% (n=2) patients pump was removed due to patient complications. Almost 100 % patients had significant relief in spasticity and were satisfied with the pump system. There was no incidence of intrathecal granuloma formation which has been reported as a common complication.

Conclusion:
Intrathecal baclofen pump is effective in management of severe adult spasticity, with good patient satisfaction. Long term complications need to be monitored in this group of patient population. The complications were higher with a less mature pump and catheter systems. The catheter related complications may be higher in a subgroup like ours, possibly because many of them do not have normal sensations, and due to the fact that these patients had very high level of disability.

P145
Cortical reorganization of dorsal columns and spinothalamic tract input after spinal cord injury
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Switzerland

Background:
Cortical reorganization of motor and sensory areas depends on dynamic interactions between afferent inputs and the capacity of motor control following spinal cord injury (SCI). Therefore we investigated task related cortical activation during thermal and proprioceptive stimulation and active-passive movements.

Methods:
Seven subjects with cervical SCI and seven healthy controls were recruited. The initial examination included a systematic motor and sensory examination of neurologic function (i.e., ISNCSI, Von Frey Filament testing, Pinprick, light touch). Using functional MRI we assessed cortical activation in response to uni-lateral (i) active and (ii) passive wrist extension, (iii) heat stimulation, and (iv) brushing. A general linear model was set up to assess the main effect of group and interaction between sensory and motor activation (SPM8). Parametric regression was used to identify relationships between the clinical parameters and cortical reorganization.

Results:
The fMRI paradigm revealed reliable activation in the contralateral primary motor cortex during active and passive wrist movements in the healthy controls. Peripheral heat stimulation resulted in brain activation in the anterior cingulate cortex, insula, and secondary somatosensory cortex, while brushing explicitly showed brain activation in the hand area of primary sensory cortex.

Discussion:
The preliminary data demonstrated a significant, task-specific activation of distinct brain areas in healthy controls. Thus, the current study design appears to be feasible to investigate the afferent and efferent pathways in healthy subjects. Additionally, the effect of impaired dorsal column and spinothalamic tract inputs onto cortical plasticity can be distinguished and the relevance on functional outcomes estimated.
PNF techniques to improve pelvic stability and gait in incomplete paraplegic patients

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Physiotherapy, India

Purpose:
To assess the improvement in pelvic stability and overall gait in incomplete paraplegic patients by using PNF techniques and diagonal patterns.

Methods:
The study involved 60 subjects, age group between 20 to 25 years. Study duration: 4 months. The patients in consideration were incomplete paraplegic patients with ASIA C (6 months post injury, level of Injury: D10 - D12). Study was conducted at Indian spinal injury center, India.

Patients were divided into two groups. Group 1 undergoes conventional program for muscle strengthening, improving pelvic control and stability, reducing spasticity, improving coordination and balance and overall gait training.

Group 2 undergoes PNF training in which PNF variables (i.e. dynamic reversal, stabilizing reversal, combination of isotonics, contract and hold relax, etc) were used in different pelvic and lower limb diagonal patterns during gait training. Additionally, patients also underwent the conventional program as mentioned in group 1.

Results:
During the first four weeks, no marked improvement was seen in the pelvic stability of both groups. In the next eight weeks, there is a significant improvement in the pelvic stability, coordination and balance of group 2nd patients in comparison to group 1st patients. During the last four weeks, group 2nd patients improved considerably in terms of their gait pattern, muscle strength and pelvic stability. Finally, group 2nd patients managed to walk confidently with less external support and good balance.

Conclusion:
PNF training offers overall improvement in pelvic stability, coordination, balance and gait of paraplegic patients with enhanced lower limb endurance.

Review of knowledge translation and implementation strategies in spinal cord injury

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Canada

Background:
Challenges in translating research evidence into the clinical setting are well known. To facilitate translation of evidence into spinal cord injury (SCI) clinical practice there is a need to determine which factors are critical to ensure successful implementation and evaluate if knowledge translation (KT) initiatives have impacted outcomes. The objective of this study was to conduct a systematic review of the literature to evaluate the KT strategies used throughout the SCI continuum of care (pre-hospital through to community) and determine the effect on patient and clinical outcomes.

Methods:
Four electronic databases MEDLINE/Pubmed, CINAHL, EMBASE and PsycINFO were searched for English studies published from January 1980 to July 2011. Studies were included if there was a SCI KT initiative that described the process of implementation. Two reviewers independently screened the abstracts, the full articles and rated the study quality. Data abstracted included: 1) details of the KT initiative, 2) the implementation strategy (methods and evaluation), 3) impact of the KT initiative on patient or clinical outcomes (methods and evaluation), and 4) barriers and facilitators encountered with implementation.

Results:
A total of 2902 publications were identified in the initial search. 94 full articles were reviewed and 18 studies met the inclusion criteria. Strategies used for implementing research evidence included disseminating clinical practice guidelines, incorporating standardized assessments into routine clinical practice and educating clinical staff. Frequently cited barriers included lack of knowledge, time, and cost, while facilitators included management support, engagement of staff and providing regular feedback. Impact of the implementation on patient or clinical outcomes was only reported in 12 of the 18 studies.

Conclusions:
Results from this systematic review provide an overview of the state of KT research in SCI. The barriers and facilitators identified in this review may also inform ongoing KT initiatives in SCI, and other health conditions.
Cognitive adjustment and coping after SCI in relation to work status
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Objectives.
To investigate the differences in cognitive adjustment and coping between patients with and without paid work after Spinal Cord Injury (SCI). It is expected that cognitive adjustment and active coping are related with work status.

Subjects.
All 397 eligible patients submitted for spinal cord injury rehabilitation in the Sint Maartenskliniek at Nijmegen, the Netherlands, between 1999 and 2009 where asked to participate in a cross-sectional correlational study. Patients with SCI due to cancer were excluded.

Methods.
Patients completed a set of questionnaires assessing demographics, SCI characteristics, psychological mood, work-status, cognitions, and coping styles. Patients within the working age of 18-65 were selected for this study and dichotomized (paid job vs. no paid job). Differences between groups were calculated using Chi-square for categorical variables, and T-test for continuous variables. Within the group of SCI patients with a paid job, correlations were computed between measures of active coping and hours of working.

Results.
A total of 130 (33%) patients participated, with 88 patients in the age of 18-65, of whom 34 (39%) had a paid job. Patients with a paid job were younger and higher educated, reporting higher levels of independence, and lower levels of tiredness. Depressed mood was lower in patients with a paid job. Cognitive adjustment differed between both groups with patients with a paid job reporting higher levels of acceptance, and lower levels of helplessness. Both groups did not differ in any of the coping styles measured. Within the group of patients with a paid job, correlations were computed between measures of active coping and hours of working.

Conclusion.
Patients with a paid job report higher levels of cognitive adjustment to their condition. However, coping was unrelated to current work status. Within the group of patients with a paid job, a small but significant relation was found between Tenacious Goal Pursuit and hours of working.

Evaluation of Social Participations of Spinal Cord Injured Individuals in a Turkish Sample
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PMR, Turkey

Background:
Environmental factors are important for participations of spinal cord injured (SCI) victims. The aim of this study is to evaluate enviromental factors and anxiety/depression of SCI.

Methods:
One hundred-twenty patients with SCI were included in the study. All patients were evaluated with CHIEF SF. It was repeated twice in 15 days. American Spinal Injury Association Impairment Scale (AIS) and Spinal Cord Independence Measurement III (SCIM) were used for the evaluation of the neurological loss severity and functional status. Emotional status was assessed by Hospital Anxiety and Depression Scale (HADS). Internal consistency reliability, test-retest reliability and construct validity were evaluated.

Results:
CHIEF SF correlated with HADS (p<0.05). It is a reliable and valid test.
Modifiable risk factors for depression after spinal cord injury: opportunities for treatment

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Background:
Major depressive disorder (MDD) is common and impairs functioning after spinal cord injury (SCI), but there are limited data on modifiable risk factors for depression that may inform approach to treatment. We sought to identify promising depression treatment approaches for people with SCI by examining the association between depression severity and theoretical depression risk factors: physical activity, environmental reward, and self-efficacy.

Methods:
Multi-site, observational study which was part of a randomized controlled antidepressant trial (Project to Improve Symptoms and Mood after SCI, PRISMS). We completed cross-sectional surveys with persons 18-64 years old in outpatient and community settings in Washington, Alabama, Michigan, Texas, and Illinois (United States). Measures included: Patient Health Questionnaire-9 depression scale (PHQ-9), International Physical Activity Questionnaire (IPAQ), Environment Rewards Observation Scale (EROS), and Modified Lorig Chronic Disease Self-Management Scale (CDSMS)

Results:
The 244 participants were 77% male and 61% White, 58% were >40 years old, and 53% were <10 years post-injury. After controlling for education, years since injury and injury severity (adjusted R-squared=.13), lower environmental reward (change in R-squared=.34) and lower self-efficacy (change in R-squared=.19) were independent predictors of higher PHQ-9 scores. Using both environmental reward and self-efficacy scores to predict depression severity produced the best model (adjusted R-squared=.49).

Conclusion:
The level of environmental reward had the strongest independent association with depression severity in persons with SCI. Our findings suggest that interventions, such as behavioral activation, designed to increase the level of rewarding activities and positive reinforcement may be a promising approach to treating depression in this population.

[Note: This paper would benefit from being presented jointly with other papers from Fann et al and D. Tate et al from the same multi-site trial]
P152
The role of alpha dornase in re-inflating chronically collapsed lung in high cervical SCI patients
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Introduction
Patients with high cervical SCI have a poor cough reflex, resulting in sputum retention. This leads to a number of problems including pneumonia, ventilatory failure and collapsed lower lobes of lung. These patients have a more protracted stay in hospital with recurrent pneumonias and may end up needing long term ventilation.

Aim
The aim of this analysis was to identify and target SCI patients who had chronically collapsed basal segments and who had not improved despite standard physiotherapy and cough assist techniques. These patients had alpha dornase instilled bronchoscopically into the affected areas to see if this improved their radiological outcome.

Method
Over a 12 month period, 6 inpatients on one ward with cervical SCI were identified as having recurrent infections and chronically collapsed lower lobes on their CXR. These patients underwent targeted bronchoscopy. They had therapeutic suctioning followed by instillation of 5000 units of alpha dornase into the affected segments. Following this, patients continued to have physiotherapy, cough assist and volume controlled ventilation via their tracheostomy. The effectiveness of the alpha dornase was assessed by repeating the CXR several days later.

Results
All 6 patients had SCI of C4 ASIA A and above. Their lower lobes had been collapsed between 6 and 50 months as evidenced by their CXR. Following instillation of alpha dornase, 3 patients had complete resolution of their basal collapse, 2 patients had significant but not complete resolution and one patient had no benefit based on their CXR. Of the 5 patients who had improvement there seemed to be an associated reduction of sputum production, less need for antibiotics and better weaning from their ventilators.

Conclusions
Alpha dornase may be useful in helping with inflating chronically collapsed lung by breaking down secretions and should be done in conjunction with standard therapy. Potentially this may reduce long term morbidity and mortality. However this was not a randomised trial and further studies are required so see if in fact alpha dornase does have a role in this group of patients.

P153
Cardiovascular risk factors in patients with traumatic spinal cord injury in Brazil
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Brazil

Objectives:
Evaluate cardiovascular risk factors in patients with traumatic spinal cord injury (TSCI) at the SARAH Network of Rehabilitation Hospitals.

Study Design:
Multicenter (5 hospitals), descriptive, transversal.

Methodology:
Analysis of significative sample of 992 patient charts from a database of 4,170 TSCI between 2007-2011. Analysis used univariate and multiple linear regression models. Data analyzed as independent variables: time, level and extension of injury, gender, age; and as dependent variables: total cholesterol (TC) and fractions, triglycerides, fasting glucose (FG), systolic blood pressure (SBP), body mass index (BMI). Antihypertensive medication use, smoking and cardiovascular disease family history were considered.

Results:
Database (4,170) had predominance of paraplegics (66.9%), AIS-A (59.5%), males (82.4%). Average age: 34.1 y.o. (18-86). Time of lesion was < 2 years in 73.6%. Average FG was 90.4 mg/dl (±17.4), TC 179.1 mg/dl (±42.7), HDL 38.8 mg/dl (±12.5), LDL 114 mg/dl (±34.2), triglycerides 130.5 mg/dl (±78.2).

Analysing the sample (992): 11,4% (95% CI 9,4 - 13,7) were hypertense, 3,2% (2,2 - 4,6) diabetics, 9% (7,7 - 11.1) smokers and 2,3% (1.5 - 3.6) had positive family history. BMI mean: 22,9 Kg/m2 (±4,5). Differences between paraplegics and tetraplegics were HDL and LDL cholesterol, IMC and BP, higher in the former (p<0.001). HDL<40 mg/dl prevailed among tetraplegics (67.2% p<0,001).

Time of lesion did not explain any of dependent variables. Complete motor injuries were associated with lower values of HDL and BP. The only dependent variable that showed significant interaction between level and extension of injury was BP (p=0.035).

Conclusion:
Prevalence of cardiovascular risk factors was lower than that found in previous studies, explained by studied population being younger. Level and extension of lesion participated in models, pointing to the need for specific risk predictor for this population, which takes into account clinical and laboratorial parameters, as well as specific characteristics of TSCI.
Outcomes of youth with spinal cord injury of short and long duration
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USA

Background:
Determine differences between outcomes of youth with spinal cord injury (SCI) of short (less than five years) and long (at least ten years) duration, and determine how mental health relates to participation and quality of life (QOL) in each group.

Methods:
Youth ages 5-18 years who had been injured at least one year and were receiving care within one specialty hospital system completed standardized assessments of participation, QOL, anxiety, and depression. Date of injury was gathered from medical records. Youth were part of a larger study examining psychosocial outcomes, and were selected for the current study if they had been injured for less than 5 years, or 10 years or more. Independent samples t-tests, correlations, and regression analyses were used to analyze data.

Results:
271 youth participated: mean age was 13.85 years (SD=3.78); 58% were male; 65% Caucasian; 9% were C1-C4 AIS ABC, 20% C5-C8 AIS ABC, 56% T1-S5 AIS ABC, 15% AIS D. 217 youth had been injured for less than 5 years (80%) and 54 youth for 10 years or longer (20%). Youth with older injuries had higher social (p=0.012) and psychosocial (p=0.023) QOL, and lower anxiety (p=0.040); relationships persisted after controlling for child age. In both groups, anxiety and depression were related to lower QOL (p<0.001). Among youth with more recent injuries, anxiety and depression were related to participating with a narrower group (p=0.004, p=0.024) and anxiety to participating closer to home (p=0.029). Among youth with older injuries, depression was related to decreased enjoyment of participation (p=0.025).

Conclusion:
There are differences in outcomes between youth with injuries of shorter and longer duration. Results suggest interventions are needed for youth with more recent injuries to address anxiety and QOL. Differences should be examined with larger samples to determine how to best support positive outcomes throughout post-injury development.

INDEPENDENT variables that influence cardiovascular risk estimates (Framingham Risk Score) in adults with traumatic spinal cord injury
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Brazil

Background:
Evaluate the independent variables that influence cardiovascular mortality estimates (Framingham Risk Score - FRS) in patients with traumatic spinal cord injury (TSCI).

Study Design:
Multicenter, descriptive, transversal.

Population:
Total of 992 patients with TSCI admitted to the rehabilitation program at the SARAH Network of Rehabilitation Hospitals between 2007-2011.

Methods:
Analysis of a sample of 992 patient charts obtained from a database of 4,170 individuals with TSCI. Data analyzed: time, level and extension of injury, gender, age, total cholesterol and fractions, triglycerides, fasting glucose, blood pressure (BP), BMI, antihypertensive medication use, previous history of hypertension and diabetes, cardiovascular family history. FRS was calculated. Analysis used multiple linear regression models (forward stepwise), considering possible interaction between injury level and extension. FRS was the continuous dependent variable. In patients with Diabetes Mellitus (3.2%, 29 patients), the FRS was considered 20%.

Results:
A detailed description of the sample is provided in another study. The prevalence of high cardiovascular risk (FRS ≥10%) was 11.7% (IC 95% 9.7-14), greater among tetraplegics (14.9%; p=0.018). When the interaction between injury level and extension was considered, the tetraplegic FRS risk was lower than paraplegic. The best model obtained an adjusted R2 of 13.2% (p<0.001) and included that interaction, as detailed below:

FRS = -2.039 + 2.491 TETRA -1.346 COMPLETE MOTOR LESION - 2.902 (TETRA vs COMPLETE MOTOR LESION) + 0.22 TIME OF LESION + 0.217 BMI.

Conclusion:
The risk estimated by the FRS is associated with the level, extension and time of the lesion, and also BMI. However, it is not possible to conclude that these variables change the FRS estimation, since cardiovascular outcomes were not obtained. Future studies should address this issue.
Why have doors you can’t open? Environmental control technology, home automation and smart homes: Are we achieving optimal outcomes in SCI?

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Background:
Home automation and environmental control is a fast growing and exciting area for individuals with tetraplegia. Despite advancements, individuals continue to report issues with these devices. Environmental controls cannot be prescribed as stand alone devices and need to be considered as a part of the home modifications planning process.

Aim:
To identify challenges and develop strategies to minimise the disparity between actual and possible outcomes with environmental control technology use in tetraplegia.

Study Design:
Case review of ten clients with tetraplegia, discharged from the Queensland Spinal Cord Injuries Service since 2009, who had environmental control technology installed. Data collated include utilisation feedback and audiovisual material from clients, service providers and suppliers. These data were analysed with respect to perceived success or failure of the environmental controls and perceived reasons for these outcomes.

Results:
In the majority of cases, clients did not have an optimal environmental control system set up. The following top ten challenges were identified:
- Accessing and mounting the devices and switches;
- Aesthetics;
- Power supply and phone lines;
- Infra red line of sight;
- Wiring in devices;
- Converting device communication methods;
- Reliability;
- Supporting consumer choices at the right time;
- Communication between all parties; and
- Disparity between disability market and non disability market products.

Positive outcomes for home automation were facilitated by:
- Therapist skill;
- Access to trial devices;
- Technology template for education;
- Consumer engagement;
- Collaboration between prescribers of technology and home modifications;
- Supplier and product innovation; and
- Research

Conclusion:
Despite advancements in environmental control, ongoing challenges were identified. Study results have led to the development of key strategies to improve practice and maximise outcomes with the use of environmental control technology and home automation in SCI.
Penile fracture in a patient with spinal cord injury. A case report

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Turkish Armed Forces Rehabilitation Center, Turkey

Background:
Penile fracture (PF) is relatively a rare condition characterized by traumatic rupture of the tunica albuginea. The urethra may also be involved. It usually develops after blunt trauma of the erected penis. PF manifests with an audible crack accompanied by immediate detumesance that were followed by a rapid swelling, ecchymosis and severe pain. Usually the penis deviates to the opposite side. Penile ultrasonography, cavernosography and magnetic resonance imaging can be helpful in the diagnosis of PF. To our knowledge, PF has never been reported in patients with spinal cord injury (SCI). We represent a case of PF in a patient with paraplegia.

Case report:
A 36-year-old male patient with T12 paraplegia ASIA-B admitted to our department. On physical examination, his sensory level was T12 and motor level was L2 on the right and T12 on the left; voluntary anal contraction was absent. Urination was being done with clean intermittent catheterization (CIC). He reported that during transfer to the bed at night, he dropped between the wheelchair and the bed and then he hardly accomplished the transfer. He had no complaint during the night. In the morning, while CIC he observed a swelling and ecchymosis on the penis and scrotum. Penile ultrasound revealed hematoma in the corpus cavernosum and diagnosed as PF. Since the patient did not accept the surgery, conservative treatment was performed with indwelling catheter and coban bandage for 10 days. After 10 days CIC was started. 1 month later, the appearance of the penis was normal.

Conclusion:
PF is an important clinical condition since urethral injury may associate and it may further deteriorate the sexual or voiding problems that SCI patients already have. This case showed us that the patients should be informed and members of the rehabilitation team should be aware of this condition.

Dentist outreach model for supply of an oral appliance in patients with quadriplegia and obstructive sleep apnoea

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Australia

Background:
The incidence of Obstructive Sleep Apnoea (OSA) in people with quadriplegia is significantly higher than in the able-bodied. Unfortunately, Continuous Positive Airway Pressure (CPAP) is poorly tolerated in quadriplegia and whilst oral appliances are an accepted treatment modality for OSA in the able-bodied there is only anecdotal evidence describing their use in quadriplegia. We are currently examining the feasibility of a mandibular advancement device (MAd) for treating OSA in quadriplegia. Travel to hospital or a dentist’s rooms is typically logistically difficult and time consuming for people with quadriplegia. We are therefore trialling an outreach model to minimise these issues.

Methods:
Our dentist has assembled a home-visit kit that allows him to examine the patient, create dental impressions, check the fit of the device and to alter the device as necessary. Care, maintenance and titration information is provided via a laminated A4 sheet and an e-mailed link to a YouTube video.

Each participant has four home visits by our dentist and a dental assistant. At the first visit a dental history and examination is carried out and dental impressions are made. The custom-made device is delivered and fitted at the second visit and any adjustments are made at this time. The device is set-up at 60-72% of the total range of protrusion and participants wear the device for one week without further advancement to ensure comfort. At the third visit participants and their carers are taught how to advance the device. Participants are contacted weekly for adverse event and adherence monitoring. The fourth visit occurs at the conclusion of titration to ensure that maximal comfortable mandibular advancement has been attained.

Results:
We have provided mandibular advancement devices to six participants. Geographical range is limited to Melbourne and its suburbs with travel time ranging from 20 minutes to 70 minutes. The first visit has taken 50-60 minutes whereas the three subsequent visits have taken 15 to 30 minutes. Two participants have completed titration; one within eight weeks of device delivery and the other within 10 weeks. The four remaining participants are in the titration phase. There have been no discontinuations and all participants have been very positive regarding the outreach model.

Conclusion:
Our preliminary experience suggest that MAd implementation may be both feasible and effective in a community setting.
Recurrent subluxation of the hip in an adult tetraplegia patient causing autonomic dysreflexia treated with phenol neurolysis. A case report

YILMAZ, BILGE; Guzelkucuk, Umut; Duman, Iltekin; Tan, Kenan
Turkish Armed Forces Rehabilitation Center, Turkey

Case Report:
We present a case of tetraplegia having autonomic dysreflexia attacks due to hip subluxation caused by severe adductor spasticity. 22-year-old male patient with C6 tetraplegia admitted to our clinic. He had severe adductor spasticity. He was complaining from his left hip during activities and reported associating flushing, sweating and hypertension. Investigations for etiology of AD were made. No urinary retention or infection, catheter problem, fecal impaction, pressure ulcer, nail problems, intestinal problems or urinary stone were obtained. Plain graph revealed slightly shallow acetabulum, subluxation in the left hip and heterotopic ossification. He did not respond to increased dose of baclofen. Phenol block was performed to obturator nerve under the guidance of a neurostimulator. In the following 2 weeks; adductor spasticity, subluxation recurrence and autonomic dysreflexia attacks decreased gradually. On follow-up visit after 3 months, he reported that he had no autonomic dysreflexia attacks in the last 3 months.

Conclusion:
Severe adductor spasticity needs to be closely followed in adult patients as well. Subluxation of the hip should be kept in mind in the etiology of autonomic dysreflexia and heterotopic ossification. If autonomic dysreflexia develops, spasticity should be treated effectively. Phenol blockage seems to be effective in this regard.

Coordination of spinal cord injury care in under-resourced areas
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Many people with spinal cord injuries and disorders live in rural areas or countries where specialty health care is lacking and even basic health care needs go untreated. However, the existing medical infrastructure even in these locations can be used to provide better SCI care by coordinating management between local clinics and specialty centers using principles and techniques of networked health care which are being shown to produce good outcomes in other situations.

The National System of Care for Spinal Cord Injuries and Disorders of the US Department of Veterans Affairs has a network of 24 Spinal Cord Injury Centers and 133 Spinal Cord Injury Clinics which provide primary and specialty care for life to about 25,000 people with SCI including those in sparsely populated geographic areas such as Alaska and the Pacific Islands. Each Center, or “hub”, is linked to a set of Clinics, or “spokes”, in which local primary care providers are also trained to provide basic spinal cord injury specialty care and to refer more complex specialty care to the Center. This hub-and-spoke model allows much care to be delivered on an outpatient basis close to patients’ homes, or even in their homes using home care teams and family caregivers, while serving multi-specialty teams in Centers for initial rehabilitation, annual review, complex evaluations and treatment of complications. This model is being enhanced by increasing use of teleconsultation and telehealth such as transmission of digital photographs of pressure ulcers, digital video for physical and psychological evaluation, secure text messaging, and remote monitoring of vital signs and measurements. These techniques can reduce the need for travel and inpatient admission and reduce costs. Many of these processes can be replicated at low cost in many countries using existing medical infrastructure and widely available technology such as smartphones.
Recurrent pressure sores due to scoliosis in a patient with spinal cord injury

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Turkish Armed Forces Rehabilitation Center, Turkey

Background:
Patients with spinal cord injury have a lifelong risk to develop pressure sores. Pressure sores lengthen the duration of hospitalization, slow down the rehabilitation procedures and decrease quality of life. Prevention from pressure ulcer is easier and cheaper from its treatment.

Case report:
A 37-year old female paraplegic patient who had experienced a traffic accident 11 years ago admitted to our hospital with the complaint of recurrent pressure sores around his left buttock. Her level was T7-paraplegia ASIA-A. In physical examination, a pressure sore of grade-3 was observed on the left ischial region. Since her posture was leaned to the left while she was sitting on the wheelchair, plain radiographs of the spinal column and gluteal pressure mapping was performed. On gluteal pressure mapping, significantly higher pressures were obtained on the left side. Plain radiographs revealed a severe fracture of the vertebral corpus at the lower border of the surgical fixators causing scoliosis. An immediate surgical revision was planned to the patient.

Conclusion:
Spinal deformities might facilitate the occurrence or recurrence of pressure sores by shifting the loads on sitting surface. Patients with spinal cord injury should be comprehensively assessed during their long term follow-ups.

Cortical activity during imagined wrist actions mirrors plastic changes due to motor rehabilitation after spinal cord injury

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Background:
Motor Imagery (MI) is the mental representation of an action without any overt movement, and a relevant technique to stimulate motor programs for impaired limbs movements after SCI. Recent studies showed that SCI patients might benefit from MI to improve motor functions. Using magnetoencephalography (MEG), we addressed whether cortical activations during MI mirrored plastic changes due to motor rehabilitation.

Methods:
Three C6/C7 SCI patients (6 months post injury) took part in rehabilitation sessions combining both physical practice and MI during 5 weeks, with the aim to improve grasp function. Movement times and MEG recordings were collected before (pretest) and after (post-test) mental rehearsal and classical physiotherapy. Participants performed 3 blocks of 10 imagined wrist extensions, and remained motionless during a rest condition. Three age-matched healthy participants underwent a similar procedure.

Results:
Similar pre- and posttest movement times were recorded in healthy participants. MEG beta signals (15-35 Hz) further revealed similar primary sensorimotor cortical activations during MI before and after motor rehabilitation. In contrast, movement times were shorter and MEG recordings evidenced a significant reduction in primary sensorimotor activity during the post-test in SCI patients.

Discussion:
Shortened movement times support motor program automation following training. While wrist extension alone does not serve specific functions in healthy participants, this movement has an important function after SCI as a key component of the tenodesis grasp. After automation, wrist extension may be controlled at a subcortical level, hence explaining reduced cortical activity during the post-test. While previous studies evidenced that motor learning elicited parallel changes during MI practice and actual execution, the present data support the hypothesis of plastic changes due to motor rehabilitation including mental training.
Comprehensive Nursing Intervention after Surgery for Pressure Ulcers in a Spinal Cord Injury: A Case Report

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Object:
Pressure ulcers are a major component of rehabilitation nursing. Pressure ulcer prevalence rates in acute care patients range from 14% to 17%. Nurses play an important role in the multidisciplinary approach for the rehabilitation of SCI patients who had surgery for pressure ulcers.

Design: Case Report

Participants: The single subject is a 48-year old woman patient with incomplete tetraplegia. She got a spinal cord injury from a traffic accident and then received operation on June 30, 2011. She got pressure ulcers during post operation care at another hospital and received related treatment. On October 14, she was first admitted to the Severance Rehabilitation Hospital. At that time, she had a 7*9*3.3cm Stage³ pressure ulcer in the sacrum and the underlying part of the wound wasn’t clean. For the wound cleansing and granulation before the surgery, bedside debridement and aseptic dressing were each performed twice. On November 9, she received a local flap operation. She was discharged from the hospital on December 12, 2011 because her surgical wound recovered and her general condition was better.

Results:
After the surgery, rehabilitation nursing focused on the following: help the patient recover from the surgical wound, prevent other complications developing from the spinal cord injury, provide rehabilitation treatments.

The major challenges were to perform surgical wound management without causing complications; control pain; increase pulmonary functions; reduce risks for malnutrition and the recurrence of the pressure ulcer; deal with sleep disorder; prevent orthostatic hypotension and DVT; manage neurogenic bowel and bladder, and depression. To solve such problems, nursing interventions were provided.

Conclusions:
A comprehensive nursing intervention was introduced for the surgical wound recovery after the pressure ulcer operation and prevention of other complications in a spinal cord injury. The surgical wound management and complication prevention were also conducted effectively through a multidisciplinary approach including rehabilitation doctors, plastic surgeons, physical therapists, occupational therapists, nutritionists, and interns. This nursing intervention played a significant role not only in making an early recovery possible but also speeding up the rehabilitation program. As a result, the patient’s level of satisfaction increased during the treatment.

Effect of Combined PTH and Locomotor Training on Bone Density in Chronic Spinal Cord Injury

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Background/Objective:
Individuals with SCI who are not weight-bearing have profound bone loss and increased fracture risk involving their lower extremities. Animal models suggest that combining weight-bearing with parathyroid hormone (PTH) can have a synergistic anabolic effect on bone. The purpose of this study was to investigate the effects of 6 months of weight-bearing exercise combined with daily PTH injection on bone mass and architecture in spinal cord injured individuals.

Methods:
12 participants with chronic SCI (all non-ambulatory, mean age 34 ± 8.1 yrs, 10 male, 5 AIS-A, 3 AIS-B, 4 AIS-C, 10.5 ± 6.7 yrs since injury) and osteoporosis (mean L total hip BMD = 0.638 ± 0.090 gm/cm²; mean R total hip BMD = 0.626 ± 0.088 gm/cm²) were treated with daily teriparatide, 20 ug/day, and robotic assisted gait training, 3 x week, for 6 months. BMD was determined by DXA at spine, hip, forearm and bone microarchitecture evaluated by MRI at distal tibia at baseline, 3 months and 6 months. Serum bone markers were also obtained.

Results:
At the 6 month study endpoint, P1NP, BAP and CTX increased by 61.3 ± 35%, 53.8 ± 22.2% and 137.6 ± 68.8% (mean ± SE) respectively when compared to baseline levels. BMD at the spine, L total hip and R total hip also showed increases at the 6 month time period of 2.2 ± 1.1%, 0.63 ± 0.88% and 0.74 ± 0.89% (mean ± SE) respectively when compared to baseline levels. MRI data suggest improvements in surface to curve ratios and trabecular thickness.

Conclusion:
The overall increases in BMD and changes bone architecture observed in this study are consistent with improvements observed in previous PTH interventions targeting other osteoporotic populations. Longer studies are needed to evaluate clinical utility. These findings provide motivation for conducting future controlled clinical trials to assess the independent effects of weight bearing and PTH administered both alone and in combination on lower limb BMD and bone architecture in people with chronic SCI.
A stitch in time... Identifying and monitoring psychosocial predictors of outcome following spinal cord injury
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Background:
A wide range of studies has been undertaken which examine the relationship between individual psychosocial factors and outcomes following a spinal cord injury (SCI). The potential benefit of these studies is to facilitate identification and intervention with those people who are at risk of poor outcomes, but little is known about how to use this information in practice. This study aimed to examine how this may be effectively done.

Method:
A systematic literature review was undertaken to identify psychosocial variables that are reliably associated with outcomes following SCI, and measures to assess these variables were selected. A cohort of 40 individuals with newly acquired SCI admitted to two acute spinal cord injury rehabilitation services in Sydney, Australia were recruited to the study from August 2009 to December 2011. Individuals underwent a systematic psychosocial assessment at three time points: shortly after SCI, pre-discharge and after 6 months in the community.

Results:
Variables and their associated measures were identified, including: cognitive function (NUCOG), personality (NEO-FFI), alcohol use (CAGE and AUDIT), drug use (MINI Screen), acute stress (Post-traumatic Adjustment Scale), personality disorder (Iowa Personality Disorder Screen), anxiety and depressive symptoms (HADS). The MINI was used to establish a likely diagnosis for a range of psychiatric disorders at each time point, such as major depressive episode. Preliminary data from shortly after injury and pre-discharge respectively identified: 3 (10%) and 3 (12%) with major depressive episode; 1 (3%) and 5 (16%) with PTSD; as well as 1 (3%) and 2 (3%) with alcohol dependence and 3 (12%) and 1 (4%) with alcohol abuse.

Conclusions:
Practical aspects of implementing the systematic assessment protocol will be reviewed. The implications of preliminary findings for choice of variables to monitor and measures used to do so will be discussed.

Developing a community of practice and research in dual diagnosis (SCI with traumatic brain injury)
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Background:
Traumatic spinal cord injury (SCI) is often accompanied by traumatic brain injury (TBI), and this ‘dual-diagnosis’ (SCI+TBI) presents challenges for both initial treatment and longer-term rehabilitation. Collaborators at the Brain and Spinal Injury Center at UCSF and the San Francisco General Hospital and Trauma Center, The Palo Alto Veterans Affairs Health Services, and the Santa Clara Valley Medical Center have formed a consortium of research and clinical scientists and practitioners to attempt to better define SCI+TBI as a clinical entity, to produce a dataset on current and recommended practice, and to drive a ‘bedside-to-bench’ effort to produce useful animal models that can help to resolve practical clinical questions derived from practitioner inputs and concerns.

Methods:
A cohort of practitioners at the 3 centers has been identified, and focus groups to engage these individuals and to begin data collection have been held over the past year. To date, the group has agreed on the need for an evidence based consortium statement on the management of dual diagnosis, has identified available databases (SCI and TBI Model Systems, VA, and Center admissions), and begun the development of a rodent model of SCI+TBI (see Bresnahan et al, this meeting).

Results and conclusions:
A significant portion of SCI admissions to the 3 centers also have at least mild, moderate, or severe TBI, but database structures are not optimized to identify these cases. The group has identified drug interactions with rehabilitation as an area of concern that might be amenable to animal modeling. A survey of community-based practitioners revealed skepticism about the usefulness of animal models in changing clinical practice, and these discussions will be continued. We will present an update on the emerging dataset, as well as our experience in setting up a consortium of diverse researchers and practitioners with the long-term goal of improving translation of evidence into practice.

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P167
Effects of combined unilateral cervical spinal cord injury (SCI) and traumatic brain injury (TBI) in the rat
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Cases of concurrent SCI and TBI are relatively common, and treatment strategies are not well established. The effects of combined SCI and TBI in rats has not been reported. In combination with efforts to better define the clinical entity of SCI+TBI, we are developing an animal model. Unilateral C5 SCI was administered under isofluorane anesthesia after laminectomy using a 75 kdyne force delivered by the Infinite Horizons device. Controlled contusion injuries to the brain were produced using a 5 mm impactor tip centered within a 6 mm craniectomy defect centered at 0 mm AP and at 4 mm lateral to bregma. The probe was set to penetrate 2 mm into the brain. TBI was given either contralateral or ipsilateral to the SCI in order to evaluate combined effects on forelimb function.

Forelimb functions (grooming, paw-placement, cereal-eating) were measured over 6 weeks after injury, and showed highly significant and dramatic interactions between SCI and TBI. Further, these interactions varied across the different measures. Unilateral right-sided cervical SCI produced initial deficits with partial recoveries of the right forelimb in all of the measures. TBI alone (left side) produced a significant and lasting deficit in right-sided paw placement, a transient deficit in the cereal-eating task, but no deficit on the grooming task.

Adding a left-sided TBI to the SCI exacerbated both the grooming and paw-placement deficits, suggesting cortical involvement in recovery of these functions. Remarkably, ipsilateral (right-sided) cortical TBI resulted in a profound recovery of paw-placement in rats with right-sided SCI, suggesting that the crossed, right-sided deficit in placement produced by the cortical lesion forced, or released, use of the right forelimb even in the face of a large SCI. These findings will be discussed in relation to strategies for rehabilitation after combined SCI and TBI.

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P168
Conservatively Treated Ossification of Posterior Longitudinal Ligament Increases Risk of Spinal Cord Injury: A Nationwide Cohort Study
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Background:
The optimal treatment strategy for OPLL patients depends on symptoms and remains uncertain. To date, whether the risk of SCI is increased in patients with cervical spinal stenosis or clinically spondylotic myelopathy caused by cervical OPLL remains unclear. This retrospective cohort study aimed to evaluate the risk of spinal cord injury (SCI) in patients with ossification of the posterior longitudinal ligament (OPLL) of the cervical spine when managed with conservative treatment.

Methods:
Study subjects were identified from a nationwide cohort of 26,544,883 people from 1998 to 2005 and were divided into the OPLL group (n=265), who were hospitalized for OPLL but had conservative treatment (no surgery), and the comparison group (n=5,339), composed of age- and sex-matched people. Until the end of 2008, 5,604 subjects were followed-up for 34,723.5 person-years. The propensity score method was used to adjust for covariates, including age, sex, osteoarthrosis, osteoporosis, rheumatoid arthritis, diabetes, and hypertension. Kaplan-Meier and Cox regression analyses were performed.

Results:
The incidence rate of cervical SCI in the OPLL group was significantly higher than in the comparison group (4.81 vs. 0.18 per 1,000 person-year, p<0.001). Cervical SCI was more likely to happen in the OPLL group than in the comparison group (crude hazard ratio 25.64, p<0.001). After adjustments for co-morbidities, the OPLL group had a 32.16-fold (p<0.001) higher risk for cervical SCI. Disability caused by SCI had an even higher risk (HR=110.72, adjusted HR=104.78, p<0.001) for the OPLL group.

Conclusions:
Cervical SCI and related disabilities are more likely to happen in OPLL patients, who should be cautioned for subsequent SCI if treated conservatively.
Intravenous administration of granulocyte colony-stimulating factor for treating neuropathic pain associated with compression myelopathy

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Introduction:
We previously conducted a clinical trial of neuroprotective therapy using G-CSF for patients with worsening symptoms of compression myelopathy, and obtained data that G-CSF administration suppressed progression of myelopathy. During this trial, several patients unexpectedly experienced a dramatic reduction of neuropathic pain associated with compression myelopathy after the G-CSF administration. Thus, we have started clinical trials using G-CSF for spinal neuropathic pain.

Methods:
Between January 2009 and February 2010, this clinical trial included 17 patients who were divided into two groups. One group included 7 patients who complained of pain associated with worsening symptoms of myelopathy (progressing myelopathy-related pain group). The other group included 10 patients who complained of pain that persisted after surgery for compression myelopathy (post-operative persistent pain group). All patients underwent intravenous administration of G-CSF (10 μg/kg/day) for 5 consecutive days. Pain severity was evaluated using a visual analog scale (VAS) before and after G-CSF administration.

Results:
In 14 of the 17 patients, pain was relieved within several days after G-CSF administration. Pain disappeared completely in 3 patients. In the progressing myelopathy-related pain group, the mean VAS was 71.4/100 mm before G-CSF administration, and decreased to 35.9/100 mm at 1 week after G-CSF administration (p<0.05). In the post-operative persistent pain group, the mean VAS was 72.0/100 mm before G-CSF administration, and decreased to 51.7/100 mm at 1 week after G-CSF administration (p<0.05). No severe adverse events occurred during and after G-CSF administration.

Conclusions:
The present results provide us with the possibility that G-CSF has a pain-relieving effect for neuropathic pain in patients with compression myelopathy.

Intramedullary myxopapillary ependymoma of the conus medullaris: surgical technique and outcomes

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Objective:
The purpose of this study is to introduce our surgical technique for intramedullary myxopapillary ependymomas (MPE) accompanied by syringomyelia at the conus medullaris.

Methods:
Four male patients with histologically verified subpial MPE of the conus medullaris were identified. Neurological outcomes (Japanese Orthopaedic Association score: JOA score), clinical features, operative findings, pre- and post-operative imaging results were reviewed.

Results:
Operations were performed on all four patients (mean age: 29.5 y/o). The average of postoperative follow-up was 50 months. Preoperative magnetic resonance imaging (MRI) revealed that all the tumors accompanied by syringomyelia were intramedullary at the conus medullaris. After identifying a plane between the tumor and syringomyelia using transdural sonography, pia matter was cut transversely at the plane and en block tumor resection without damaging the tumor capsule was accomplished in all cases. Since two patients had already developed spontaneous perforation of tumor capsule at the caudal side, they received radiation therapy along with surgery. Postoperative MRI showed no residual tumor and disappearance of syringomyelia in all cases. Clinical follow-up showed a consistent pattern of improvement over time (mean recovery rate of the JOA score: 86.7%) and none of patients developed recurrence.

Conclusion:
The goal of surgical treatment of MPE is en block complete resection without damage of tumor capsule. Our surgical technique is critical to accomplish this complete resection on intramedullary MPE at the conus medullaris. As removal of tumor also resulted in the disappearance of syringomyelia, the obstruction of cerebrospinal fluid flow by an intramedullary tumor may be a significant factor for development of syringomyelia.
The reliability of interface pressure mapping parameters
Swaine, Jillian; Romeo, M; Nguyen, V; Stacey, M.C.

Background:
Interface pressure mapping (IPM) is a clinical tool used by seating clinicians. Specific IPM parameters have been recommended in the International Standards Organization clinical protocol for IPM but their inter-rater reliability is unknown.

Aim:
The aim of this study was to assess the inter-rater reliability of a novel post processing protocol for IPM.

Methods:
Twelve individuals with a spinal cord injury (SCI) and 13 able bodied individuals (AB) were mapped using a standardized protocol and the Force Sensing Array (FSA) IPM system. In Part A, a post processing protocol was developed to determine 29 parameters such as peak pressure index and pressure gradient. In Part B, post processing protocol was piloted by three blinded raters using 12 IPM recordings randomly selected from the total number of maps. The protocol was refined based on the results. In Part C, post processing was completed on all IPM maps by three raters and inter-rater reliability was determined. The parameters were reviewed for sources of error by an independent researcher.

Results:
In Part C, 74 IPM maps were evaluated and three raters calculated the values for up to 29 post processing parameters for each map. 19/29 (66%) of the parameters were reliable with the ICC (2,1) = 0.79-0.98 and 10/29 (34%) were unreliable with the ICC (2,1) = 0.07-0.71. Post processing parameter values were reviewed and 101/3567 (3%) errors were found. Of these, 54/101 (53%) involved using multiple functions of the software, 27/101 (27%) were transcription errors, 20/101 (20%) file due to file management.

Conclusion:
Nineteen post processing parameters demonstrated inter-rater reliability for IPM and ten parameters remain unreliable. Using multiple steps in software calculations, transcription errors and file management errors contribute to the error in post processing. 16 post processing parameters which met the ICC 0.8 or above will be used in a multi-site, international study.
P173
The influence of Reflex locomotion according to Vojta on locomotion system in spinal cord injured patients
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Background:
Reflex locomotion according to Vojta is diagnostic and therapeutic concept based on activation of global locomotion patterns. These inborn, in CNS innate patterns, can be provoked in the case of impairment of movement system, their activation enriches by injury or illness reduced spontaneous mobility. The therapy influences postural and locomotion function as well as sensory and autonomic functions. The global patterns, reflex creeping, reflex turning and 1st position, are activated in defined initial position and provoked by specific stimulations applied on stimulations points of precise location on the body and defined pressure directions. Therapeutic positions are chosen according patients assessment and subjective problems. Duration and frequency of the therapy is always individual according to response on therapy. The goal of the therapy in spinal cord injured patients is to activate all compensatory capacities at patient’s disposal.

Methods:
Surface polyelectromyography and video recording were used in the study to evaluate the effect of the Reflex locomotion according to Vojta.

Interpretation:
The main goal of the poster is to present an positive effect of Vojta’s method on quality of active movement, its coordination and improvement in patients with different levels of spinal cord injury and different recovery time.

P174
Impact and effect of vertebral artery trauma in spinal cord injury
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Study Design:
Prospective cohort study.

Aim:
To estimate the incidence of vertebral artery injuries and the subsequent effect on posterior circulation stroke in chronic spinal injury patients.

Setting:
The National Spinal Injuries Centre, Stoke Mandeville Hospital, Aylesbury, UK.

Background:
The vertebral arteries supply the head and neck with oxygenated blood and are prone to injury from cervical spine trauma because these arteries run towards the head through openings inside the neck’s vertebrae. Hyperextension of the neck, as occurs in whiplash injuries, can cause stretching and tearing of the inner lining of these arteries and a blood clot may form at the site of insult. Vertebral arterial injuries (VAI) appear to be more common in patients who have had serious spinal injuries and there is a risk of blood clots travelling through the circulation to the brain causing strokes. The incidence and impact on neurological outcome of VAI in cervical spine trauma is largely unknown as it is often asymptomatic and easily overlooked.

Method:
Adult patients AIS A or B with a traumatic cervical spinal cord injury at least 6 months post-injury were included in this trial. Two extra MRI sequences were added to the routine protocol including MRI sequence of the carotids for the detection of VAI, and sequence of the brain for the detection of posterior circulation stroke.

Results:
76 patients have participated in this trial including 60 males and 16 females. The median age is 48 years (range 19 – 80). 59 participants were AIS A (78%) and 17 were AIS B (22%). 40 participants (53%) had a spinal fixation, 28 anterior and 12 posterior. The incidence of VAI in this spinal group was 13% (10 patients) and the incidence of posterior circulation infarction in the brain was 9% (7 patients).
Recurrent TIAs as premonitoring sign of spinal cord infarction: Case report

**Background:**
Acute spinal cord ischemia syndrome is a rare condition that may be seen after aortic surgery or dissection, in decompression sickness, myocardial infarction, with extradural tumors, i.v. disc herniations (surgery) etc. The reduction of blood flow for anterior two thirds of the cord cross section is usually the cause. Typical presentation is the anterior spinal artery syndrome. It is of utmost importance to urgently rule out spinal cord compression by mass lesion and to begin with restoration of the cord perfusion with antiplatelet therapy as soon as possible.

**Objective:**
To point that TIAs corresponding with spinal cord dysfunction can be premonitoring sign of impending infarction of same location.

**Method:**
A 74-year-old woman with previous history of hypertension and hyperlipidemia was referred for evaluation of a sudden onset of urinary incontinence and paraparesis. During preceding three months she felt in three occasions tingling and weakness of both legs each lasted approximately 10 minutes. Neurologic examination showed muscle weakness of lower extremities. Knee and ankle jerks were absent. Both plantar responses were extensor. Light touch and pain sense were decreased from L1/L2 dermatome. Neurologic examination showed muscle weakness of lower extremities. Knee and ankle jerks were absent. Both plantar responses were extensor. Light touch and pain sense were decreased from L1/L2 dermatome. Proprioception and vibration were intact. Spinal MRI revealed central hyperintensity of the cord cross section from Th8 to conus medullaris, corresponding to hypoperfusion. Spinal angiography was normal. CSF showed proteinorachy and oligoclonal IgG as in CSF as well in serum. EMNG indicated proximal spinal lesion with minor axonal damage, at the level of lower motor neuron.

**Result:**
After symptomatic treatment motor deficit is improving so that the patient can be verticalised with a help.

**Conclusion:**
Our case showed that TIAs corresponding to spinal cord dysfunction can be premonitoring sign of impending infarction of same location pointing to the need of early diagnostic workup, antplatelet therapy and treatment of predisposing conditions.

SEXUAL-urological dysfunction and psychological distress in patients with spinal cord injury (SCI)

**Background:**
To evaluate the relationship between psychological features and sexual-urological disorders in patients with SCI, the correlation between social variables (age, time after injury, level and completeness of SCI, marital status, and educational level) and sexual-urological disorders and psychological features. Finally, to evaluate the effect of psycho-sexual rehabilitation in patients with SCI.

**Materials and methods:**
200 patients with SCI (120 male and 80 female, mean age 46.83 ± 18.5) at their first rehabilitation cycle were evaluated by the American Spinal Injury Association standards to assess neurological status (Tetraplegia= 40%; Paraplegia= 60%); Barthel Index; CBA STAI X 2 sheet 3 for anxiety, CBA-QD sheet 8 for depression; self esteem and motivation tests, Psycho-Uro-Sexual Questionnaire. All tests were administered at the time of admission, after two months and at discharge.

**Statistical analysis:**
ANOVA for Repeated Measures.

**Results:**
Patients with low level of education and without psychosexual treatment showed higher level of anxiety (p = 0.005) and depression (p = 0.003). Subjects with a good relationship and/or children showed significantly (p<0.001) lower levels of anxiety and depression and higher level of motivation. Women, with a good sexual activity, sex-appeal and the presence of orgasm showed positive correlations with the self esteem and motivation, respect to the men, but not with the level of anxiety and depression.

**Conclusions:**
In this study we found that psychosexual rehabilitation in patients with SCI is fundamental to improve their psychological status, and to improve their sexual life. After the rehabilitation they showed lower level of depression and anxiety and they were more motivated and showed feelings of adequacy, good level of self esteem and more confidence with their sexual ability. The psychosexual rehabilitation was more effective in patients who received the treatment within the first year after the lesion.
**P177**

**Risk factors of shoulder pain and shoulder functionality in athletes and sedentary wheelchair users**

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**Purpose:**
The aim of this study was to analyze the influence of shoulder flexibility, shoulder strength, shoulder temperature, and the kinematics of wheelchair propulsion on shoulder pain between athletes and sedentary wheelchair users.

**Methods:**
Data from 37 males were registered (sedentary, n=15; athletes who are permanent wheelchair users, n=11; athletes who are users for sports practice only, n=11). The range of motion (ROM) and the maximal isokinetic strength (60°•s⁻¹ & 180°•s⁻¹) were recorded for the rotator cuff. Wheelchair propulsion was analyzed with a rotational position transducer connected to both forearms. This maximal test monitored number of strokes, maximal speed, mean speed, maximal power, and mean power during 30 seconds. Before, 1 minute after the propulsion test, and 10 minutes after the propulsion test, thermographic images were recorded from anterior and posterior upper body (16 and 20 zones were analyzed respectively for anterior and posterior images). Shoulder pain was estimated using the Wheelchair Users Shoulder Pain Index (WUSPI) and the Performance-corrected WUSPI (PC-WUSPI).

**Results:**
WUSPI was related with the ROM of the dominant arm internal rotators (r=-0.321; p<0.05). No correlation was found between WUSPI or PC-WUSPI and isokinetic strength variables for any arm or speed tested. Regarding the wheelchair propulsion test, PC-WUSPI was related with maximal speed (r=-0.393; p<0.05) and with mean speed (r=-0.308; p<0.05). After the propulsion test, a correlation between the maximum temperature of the posterior part of the arm and the WUSPI (r=0.678, p<0.05) and PC-WUSPI (r=0.678, p<0.05) was found for sedentary subjects. Likewise, 10 minutes after the end of the test a correlation of the maximum temperature of the upper arm and WUSPI (r=0.682, p<0.05) and PC-WUSPI (r=0.627, p<0.05) was found for sedentary subjects.

**Conclusion:**
ROM, and not muscle strength, is related to shoulder pain. This limitation on shoulder functionality affects movement speed.

**P178**

**ACTIVITY OF DAILY LIFE (ADL) INDEPENDENCE AND PSYCHOLOGICAL DISTRESS IN PATIENTS WITH SPINAL CORD INJURY (SCI)**

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**Background:**
To assess the correlation between clinical features of SCI patients, ADL independence and psychological features, at admission and discharge.

**Materials and methods:**
160 consecutive patients (110 males and 50 females; mean age 49.9 ± 18.34 years; lesion level: 57 C, 38 L, 65 T; ASIA impairment: 48 A, 15 B, 38 C, 59 D), at their first rehabilitation cycle were evaluated by the American Spinal Injury Association standards to assess neurological status; Barthel Index; CBA STAI X 2 sheet 3 for anxiety, CBA-QD sheet 8 for depression; self esteem and motivation tests.

**Statistic:**
Independent and Paired-Samples T-Test, Pearson correlation.

**Results:**
160 SCI patients were examined at admission and discharge to evaluate if psychological distress was associated with lesion feature and with ADL independence, taken into account age and sex. No significantly differences were found for age and sex on levels of depression, anxiety, motivation, and self –esteem. Depression (9.48±5.80, p<0.005), and anxiety levels (33.83±7.62, p<0.005), were significantly lower at discharge compared to admission (7.53±3.81; 32.3±8.37, p<0.005); while the motivation (10.99±; SD=1.93, p<0.005), and self-esteem (42.43±16.38, p<0.005), were significantly higher at discharge respect to the admission (11.83±1.83; 49±16.53, p<0.005), paralleled with the higher level of the ADL independence (61.82±29.35, p<0.005). However Pearson’s correlation did not show an association between psychological status and Barthel Index scores.

**Conclusions:**
Psychological distress in SCL patients does not seem to be related to ADL independence. The direct effects of the disease, as well as the effects of the treatment, may influence the emotional state in these patients. Psychological problems like depression and anxiety require monitoring alongside the physical assessments especially across longitudinal studies. Several other possible factors could influence the psychological status of these patients, both clinical (for example the presence of pain) and social (having a family, the possibility to return to work).
Correlation between orthostatic hypotension and nocturnal polyuria in spinal cord injured patients

Yanagiuchi, Akihiro; Nomi, Masashi; Sengoku, Atsushi; Fujisawa, Masato

Introduction and objective:
Spinal cord injury (SCI) patients often show nocturnal polyuria (NP), and that can causes various complications including urinary incontinence, urinary tract infection and urinary tract deterioration, which also could compel them to carry out clean intermittent catheterization (CIC) frequently at nighttime and lead degradation in the quality of life. Furthermore, cervical SCI patients shows orthostatic hypotension. In this study, we performed head-up tilt (HUT) to cervical SCI patients suffering from NP and verified interrelation between the extent of orthostatic hypotension and their NP.

Methods:
A total of 12 cervical SCI patients showing NP (10 males and 2 females, the mean age was 25.7 ± 8.5 years old) were examined blood pressure (BP) and heart rate (HR) during supine rest and during HUT. And we evaluated nocturnal polyuria index (NPI) according to the frequency volume charts (six days or more for each).

Results:
The mean value of NPI was 32.3 ± 9.6%. During HUT, both systolic and diastolic BP significantly decreased (p<0.001 / p<0.001) and HR was significantly increased (p<0.001). But it was no significant correlation between NPI and hemodynamic changes during HUT.

Conclusion:
Cervical SCI patients showed marked orthostatic hypotension and it was considered various factors are responsible for nocturnal polyuria with SCI patients.

Monitoring of respiratory dysfunctions after traumatic spinal cord injury

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Background:
Respiratory dysfunctions after traumatic spinal cord injury (SCI) are very common findings. Management of these dysfunctions in SCI patients represents very complex and problematic topic. Respiratory complications are leading causes of morbidity and mortality in people after SCI, especially among cervical and higher thoracic injuries. Respiratory system (RS) is a complex of integrated physiological systems that is still not fully understood. Objective and reproducible measures of pulmonary function testing (PFT) should document all abnormalities of lung function. We focused on serial PFT assessments in a small group of SCI patients with high lesions.

Patients and methods:
Five patients with high-level SCI have been recruited so far: 2 pts with C4-C8/AIS A,B; 1 pt with C4-C8/AIS C,D and 2 pts with T1-T6/AIS A,B classification. The following methods have been serially performed using MasterScope and MicroMedical spirometers (VIASYS, Yorba Linda, USA): spirometry including flow-volume loop; interruption technique (Rint); assessment of respiratory muscles drive (diaphragm function) using occlusion techniques; negative expiratory pressure (NEP) technique to test expiratory flow limitation, EFL. The following time scheduling have been used for PFT assessments: 2 weeks; 5-7 weeks; 3 months and 6 months (±7 days frame) after injury.

Results:
Obstructive peripheral/central airway pattern was found in 3 of 5 pts. Progressive regression of both lung hyperinflation and airway patency was detected in all pts. Only one patient revealed partial EFL (tested by NEP technique). Neither signs of dyspnea (assessed by modified Borg scale) nor pain (VAS pain score) was detected during PFT measurements.

Conclusion:
Objective and reproducible measures of PFT documented consecutive clinical events after SCI as well as trends in RS dysfunction. By following PFT parameters closely, even new deficits in RS function could be identified and subsequently treated. Therefore, serial PFT measurements improved both a hospital and ambulatory care of SCI patients.
**P181**

**Long-term follow-ups of urodynamic studies in spinal cord injury patients**

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Korea, Republic of

**Background:**
As bladder management and preservation of renal function is vital in SCI patients, follow-ups of urodynamic studies to detect changes for proper pharmaceutical management and adjustment of voiding methods are necessary.

**Methods:**
Medical records of 45 SCI patients over 15 years old who visited Severance Rehabilitation Hospital between 2005-2012 and underwent at least 3 yearly urodynamic studies consecutively were reviewed retrospectively.

**Results:**
Among 45 patients, 30 were male and 15 were female. Of the 22 tetraplegic and 23 paraplegic patients, 19 had complete injury, and 26 incomplete injury. Average age at onset was 35.9 year-old. The causes of injury was trauma for 36 patients and non-trauma for 9 patients. An average of 3.4 urodynamic studies were performed per patient. A total of 154 cases were examined.

At 1st urodynamic study, 20 patients were diagnosed with areflexic bladder and 25 patients were diagnosed with overactive bladder. On 2nd and 3rd follow-up studies, only 5 patients who were diagnosed with cauda equina injury showed areflexic bladder. 15 patients with areflexic bladder, who did not have cauda equina injury, developed to overactive bladder status on 2nd follow-up study. Among the 20 areflexic bladder cases, voiding methods were clean intermittent catheterization in 4 cases and indwelling catheter in 16 cases. 8 cases were either newly prescribed or dosed up with bladder medication. One case changed voiding method, while 11 cases changed medication and voiding method.

Among the 25 overactive bladder cases, voiding method was self voiding in one case, clean intermittent catheterization in 4 cases, and indwelling catheter in 20 cases. 11 cases were newly prescribed or dosed up with bladder medication. 14 cases changed medication and voiding method.

**Conclusions:**
Follow-ups of urodynamic studies are required for proper medication prescriptions and voiding method adjustments for preservation of bladder and renal function.

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**P182**

**Reeducation for SCI patients in the Spinal Cord Unit (SCU) through sport rehabilitation activities: inside or outside the hospital? Our model**

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**Background:**
Reeducation through Sporting Activities (RSA) has started in the SCU Montecatone in 2003 as one of the rehabilitation techniques. As a key way out for its neuromotor value, the RSA has been performed since the beginning outside the hospital in sporting areas for normal common people during the patients’ immediate rehabilitation in hospital after the injury. This aspect has been extremely significant and valid for the social reintegration of the patients. The patients’ inclusion in the RSA is chosen by the rehabilitation team and may involve one or more sports in relation to their clinical and functional remaining capacity.

**Objective:**
In this rehab practice the following study has been formulated. Its purpose has been to evaluate whether the activity of reeducation through athletic movements performed in sport areas for common people outside the hospital may have side-effects in psychological and physical recovery of SCI patients.

**Materials and methods:**
In 2005 a questionnaire concerning self-perception of the psycho-physical condition has been submitted to all participants in the RSA. 83 patients have filled a questionnaire containing 18 questions, 15 of which related to the perception of physical and psychological condition, 2 concerning the procedures for carrying out of the hospital and 1 on their wish to pursue the sporting activity at home.

**Discussion:**
The analysis of the collected data has brought significant and positive replies in relation to psycho-physical self-perception during and after this new manner of practicing sporting activity outside the clinical setting. 100% of patients have expressed their wish to continue the sporting activities at home.

**Conclusions:**
From the data obtained from the questionnaire and the lack of critical clinical events during this activity, we believe that organizing RSA in sporting areas for normal people during the first rehabilitation hospitalization after injury isn’t negative and unhelpful for patients, but rather encouraging and supporting social inclusion.
Basal sympathetic activity in the microcirculation in human tetraplegic man by wavelet transform of laser dopplery flowmetry
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Background:
The 1984/86 published neurogram results showing only rare sympathetic nerve activity (SNA) to the muscles and skin in tetraplegia are still accepted. This study my a different method attempted to confirm or deny those findings.

Methods:
The effect of basal (SNA) to the microcirculation of the feet and calf in 10 ASIA A tetraplegic and 10 able bodies age matched subjects were evaluated by wavelet transform of laser doppler flowmetry (LDF) recordings. Results: The results indicated there is significant basal SNA from the decentralized spinal cord in tetraplegia. Wavelet analysis allowed study of other influences on the microcirculation besides SNA. Collectively, in tetraplegia compared with controls, the powers of the low frequency oscillations in blood flow were reduced, in that the endothelium caused less vasodilatation while the SNA and intrinsic vascular smooth muscles induced smaller degrees of vasoconstriction. However, the high frequency and the cardiac powers were greater. The latter presenting an obvious important factor for the preservation of blood flow in the microcirculation.

Conclusions:
It is suggested that basal SNA to the cutaneous microcirculation occurs in complete tetraplegia, and the significant levels of circulating noradrenaline reported by others indicate this is also true in the other parts of the body. This may explain the usual absence of severe, incapacitating autonomie deficiency in complete tetraplegia.

A case study: the importance of a well-fitting tracheostomy tube in a patient on prolonged ventilation
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¹Spinal Unit, New Zealand; ²Speech and Language Therapy, New Zealand; ³ENT, New Zealand

Introduction:
There are many complications associated with tracheostomy, from failure to wean, to bleeding from a tracheoinnominate fistula. This case study reveals how a poorly fitting tube, apart from these complications, can have a wide impact on a patient’s clinical course and experience, and take time to trace to its proper source.

Case summary:
A 22y tetraplegic man with VC = 0, ventilated via size 9 Portex tracheostomy tube, with widespread pulmonary crackles and reduced basal air entry, persisting collapse/consolidation bilaterally on CXR, fed by NGT. To establish effective voice and progress to eating, we aimed to establish a regimen of cuff deflation. For 3 months, each period of cuff deflation was accompanied by escalating manifestations: desaturation to 85 – 88% needing high flow O2 to maintain SpO2 at 95%; chest pain; distress; weak inconsistent voice; increasing limb & trunk spasms; rapid fatigue; increased secretions during and after deflations, increase in HR by 20 – 30/min, depression and withdrawn affect. Also frequent tracheal infection (weekly) and persistent cuff leak. Attempts to rectify this with changes in TV and PEEP were unsuccessful. Serial flexible endoscopies showed the tip abutting the tracheal wall, with gradually widening adjoining mucosal devitalisation. Downsizing to Portex 8 and then 7 worsened rather than improved matters. On day 100 the tube was changed to Tracoe size 7. Endoscopy afterwards showed a tube tip sitting free, centrally in the airway. After this he improved out of all recognition: mood consistently positive and cheerful, making eye contact, no further chest pain, SpO2 consistently 98 – 100% on air, a strong controlled voice, reduced frequency and amount of suctioning, only rare tracheal infection, disappearance of lung crackles, good AE to bases, and clear lungs on CXR, able to tolerate his cuff down for 24 hours continuously, improved energy (able to remain awake easily till midnight whereas he used to be exhausted by 6pm), improvement of spasms, HR consistently under 100/min. No more cuff leak.

Result:
Comprehensive clinical improvement because of a better-fitting tracheostomy tube.
P185

Technology-assisted task-oriented skill training in tetraplegia: a feasibility study

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Background/Aim:

For patients with cervical spinal cord injury (C-SCI) a task-oriented client-centered upper skilled training (ToCUEST) was developed and proven beneficial, but little experience with task-oriented technology-assisted training is available in C-SCI. For stroke patients, a Technology-assisted Task-Oriented-Arm-training concept (T-TOAT) was developed to improve upper extremity functioning, which may be used in combination with the Haptic Master robot (HM). This study aims to assess the feasibility of the T-TOAT training with the HM in C-SCI persons.

Methods:

A pilot-study in which C-SCI patients, who have finished rehabilitation more than one year ago, were trained with the HM for 6 weeks. The training system consisted of 1)a computer-screen and PC, 2) video-instructions of a tailor-made arm-hand training, 3) Haptic TOAT software and 4)a HM robot that may assist the patient’s arm movement. Measurements were taken before training, after 4 weeks of training and after the training stopped.

Results:

5 C-SCI patients participated (mean age: 47 year; 3 ASIA Impairment Scale(AIS) AB, 2 AIS CD; lesion level between C5 and C7). No significant progress was demonstrated at the ICF function level (measured by the Microfet) and ICF activity level (measured by the Van Lieshout Test and the Spinal Cord Independence Measure). Patients scored the credibility better than the expectancy (mean item-score on Credibility and Expectancy Questionnaire 6.6 and 4.3 out of 9 respectively. All items of the Intrinsic Motivational Inventory scored more than the neutral score of 3.5, with the exception of the pressure/tension item (mean of 1.5 out of 7). System usability was rated to be moderate (mean of 4.7 out of 7 on USE).

Conclusion:

It is feasible to train C-SCI persons with the HM. Further research is needed to assess in which group of C-SCI and in which stage of the rehabilitation HM training is most beneficial.

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Long-term results of radiation and medication decompression vs. surgical of the spinal cord in patients with extradural metastatic spine tumors

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Purpose:

Improved results of treatment of patients with extradural metastatic spine tumors with spinal cord compression.

Material and methods of studies:

The 673 patients (age was 32 – 83 years) with extradural metastatic spine tumors (breast cancer - 347 patients, prostate – 120, lung – 117, kidney – 89) with spinal cord compression were followed up in 1-5y. Neurological status was level B in 31,7% of patients, C – in 29,3%, and D in 39% out of them, according to ASIA/IMSOP (1996) score. All patients were divided in two groups. The first group (467 patients) consisted of patients with high sensitive to radiotherapy and medication (chemotherapy, hormonotherapy, etc.) tumors. The second group (206 patients) - was resistant to the mentioned above therapy. The surgery was used approximately in 50% of patients in the first and 78% of them in the second group. Indications for surgery were spinal cord compression by the soft tissue component of tumor isolated or with fragments of broken vertebrae.

Results and discussion:

In Group I the neurological status improvement was noted in 92% of patients. We did not get evidence that surgery improves final patient outcomes in spinal cord compression of soft tissue component of the tumor. Surgical decompression significantly improved treatment outcome when spinal cord compression of the tumor was complicated by pathological fracture of the vertebra. High sensitivity of tumors to radiotherapy and medication explains high effectiveness of minimally invasive operations, even with partial resection of metastatic tumors.

In Group II the neurological status improvement was noted in 78% of patients. Compared with the first group only timely surgical treatment allowed to restore function in spinal cord as an isolated compression of soft tissue component of the tumor, and complicated by pathological fracture of the spine. Moreover, only a radical resection of metastatic tumor strongly reduced the risk of recurrence with progression of neurological disorders.

The time of diagnostic and the treatment of pathology significantly improved final outcome in both groups. However, in the first group, the effectiveness of treatment was higher than in the second. Even with prolonged history of spinal cord compression was possible to reach a good clinical outcome in most cases.
Validation of Bone Marrow Cell harvesting and enriching procedure for transplantation in persons with Acute Spinal Cord Injury

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Background:
There have been extensive pre-clinical studies which have demonstrated the potential role of Bone marrow cell (BMC) transplantation for Spinal Cord Injuries (SCI). Four human trials undertaking transplantation of autologous BMCs in SCI have been published so far. However, knowledge regarding composition of the cell population being transplanted is limited and the bone marrow harvesting and enriching procedure has not been validated yet.

Objective:
To validate the quantity of Bone Marrow Aspirate (BMA) required for enriching the desired number of BMCs and the sterility as well as viability of the enriched cells.

Participants/Methods:
The BMA of initial 8 subjects participating in a pilot study on Autologous BMC transplantation in acute complete SCI (10-14 days post-injury) was harvested by a standard technique from the iliac crest. For enriching BMC we used a point-of-care device with a closed bag system.

Results:
60 ml of BMA was sufficient to obtain the required number of (2 x 10^8/2ml) cells. All cell concentrates were reported to be sterile as well as mycoplasma and endotoxin free. The total nucleated cells (TNC) obtained varied from 7.2 x 10^8 to 10.1 x 10^8 and the total number of mononuclear cells varied from 3.5 x 10^8 to 5.4 x 10^8. The CD 34+ population varied from 0.94% to 1.12% of the TNC, equivalent to around 7.0 x 10^6 to 10.9 x 10^6 CD 34+ cells.

Conclusion:
The quantity, quality, composition and sterility of the enriched BMCs through the procedure were validated. The procedure is less time consuming, requires less volumes of BMA than the traditional method and does not require a clean room facility. However, a larger study is required to arrive at a conclusion in this regard.

Multidisciplinary “Inreach” model of care for patients with spinal cord injury-a pilot study

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Background:
Rehabilitation planning and acute management of the spinal cord injury (SCI) patient should go hand in hand. While the acute trauma care model is restructuring in the UK, we have piloted multidisciplinary “Inreach” as a proactive approach even before the referral is initiated to our spinal injuries rehabilitation unit.

Methods:
In December 2010, the Welsh regional spinal injuries centre based at Rookwood hospital commenced a weekly inreach ward round at University Hospital of Wales (major spinal surgical centre for South Wales, UK) which is the main referral centre. The team consists of a spinal injuries consultant, physiotherapist, and occupational therapist, senior nurse and discharge liaison Sister. Most traumatic and suitable non traumatic SCI patients are fast tracked to intensive rehabilitation program at our spinal centre. We also support slow stream rehabilitation and care of neurogenic bowel and bladder for non traumatic SCI patients fast tracked to medical rehabilitation wards.

Results:
The program piloted in 2010-11, has made a significant difference in several areas of care. So far, we have received a total of 152 referrals of which 88 patients were seen on the inreach ward round. Of the total, 46 patients were fast tracked to intensive and 106 patients to slow stream. All slow stream rehabilitation progress is monitored by outpatient follow up in 6 weeks to ensure safe bowel and bladder function are established in addition to other functional goals.

Conclusion:
The inreach team provides immediate environmental controls, wheelchair measurements, early home access visits and regular meetings with patients and families while waiting to be transferred to a Spinal Injuries unit. The inreach effort has impacted on the length of stay in the acute ward, engagement with rehabilitation team prior to transfer and improved collaborative care between referring hospital and spinal injuries centre.
Asymptomatic intraabdominal pathologies in patients with traumatic spinal cord injury

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Turkey

Background:
Patients with traumatic spinal cord injury, intraabdominal pathologies may not have distinct symptoms. The aim of this study was to determine abdominal pathologies in patients with traumatic spinal cord injury.

Method:
We reviewed medical records of 362 (269 male; 74.3 %) patients (mean age: 35.8±14.5 years) with traumatic spinal cord injury who were referred to our hospital for rehabilitation. Demographic data, duration of injury, level of injury, ASIA scale, functional status, drugs, laboratory results and abdominal ultrasonography of patients were recorded retrospectively. Control group consisted of 200 asymptomatic individuals.

Results:
Ultrasound examination of abdomen revealed liver steatosis in 60(16.6%), nonspecific liver paranchimal alterations in 46(12.7%), liver cysts in 3(0.8%), cholecystectomy in 2(0.5%), cholelithiasis in 16(4.4%), nephrolithiasis in 31(8.6%), bladder stone in 16 (4.4%), increased trabeculation of bladder wall in 10 (2.8%), renal pelvis dilatation in 23 (6.3%), splenomegaly in 10(3.3%) patient. Prevalence of liver steatosis and cholelithiasis was significantly higher in chronic patients than acute and subacute patients (p<0.0001, p=0.04 respectively).

In control group incidence of liver steatosis (17 %), liver paranchimal alterations (11%), liver cysts (1.5%), cholelithiasis (6%), cholestektomni (0.5%), splenomegaly (1%) were similar to the study group (p>0.05) but incidence of nephrolitiasis (0.5%), bladder stone (0.5%) were significantly higher in SCI patients (p=0.0002 and p=0.01 respectively).

Conclusion:
The patients complaints and physical examination may not aid in identifying intraabdominal pathologies in patients with spinal cord injury. These patients are at high risk for nephrolitiasis and bladder stone. Ultrasound which is readily available, non invasive method which is useful in detecting abdominal pathologies in patients with traumatic spinal cord injury.

The relation of physical fitness between ambulation and depression in spinal cord injury patients

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Turkey

Objective:
As known physical fitness has many positive physiological and psychological effects for healthy individuals. This current study aimed to examine the impact of physical fitness over the ambulation level and depression status among the individuals with spinal cord injury.

Materials and Methods:
Subjects with SCI (n=21, 15 of them with thoracic and 6 of them lumber lesion level) evaluated with symptom limited cardiopulmonary exercise test to determine physical fitness by peak oxygen uptake (peak VO2; L/min) and peak power output (peak PO; W). Ambulation was assessed with walking index for spinal cord injury (WISCI). Also depression existence and quality of life (QoL) were evaluated with Beck depression inventory (BDI) and Short Form Health Survey (SF-36). Activity was measured using the motor subscale of the Functional Independence Measure (mFIM).

Results:
There was a correlation between peak oxygen uptake and WISCI but it was not statistically significant (r = 0.431). Peak oxygen uptake and WISCI both were correlated with mFIM (respectively r=0.491, r=0.663). There was no correlation confirmed between peak oxygen uptake and WISCI both with BDI (respectively r=0.166 r=0.01). Furthermore peak oxygen uptake and WISCI were not related with SF36 results (p>0.05). Also there was a significant difference for physical function between the groups of wisci upper and lower than 5 (p<0.01). No significant difference was found between two groups for BDI and peak VO2. (p>0.05)

Conclusion:
In SCI patients physical fitness defined as aerobic capacity and ambulation status both affect on activity of subject by altering mFIM scales. We could not determine a relation between physical fitness and ambulation with depression as projected; this may be due to personal expectations and self-hood characteristics. In further studies in it would be interesting to assess the effects of ambulation quality over psychological characteristic in larger groups.
Situation on admission and discharge of a group of newly injured spinal cord injury (SCI) patients admitted to a spinal cord injury centre (SCIC).

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**Background:** There is little UK based evidence to identify outcomes associated with early or late transfer to an SCIC, how patients progress once admitted to the SCIC or the impact of discharge delays on the individual and the service. This presents difficulties both for the clinician arguing the benefits of their service and protocols and for service commissioners planning services.

This presentation aims to:
- Map processes, timescales and key indicators in the SCI injury and rehabilitation pathway.
- Establish the impact of complications acquired prior to admission and delayed discharge.

**Methods:**
Prospective collection of data regarding 74 traumatic and non-traumatically injured patients during their first episode of SCI rehabilitation at the London SCIC.

**Main outcome measures:**
- Time to admission and discharge including delays at each time point.
- Complications on admission.
- Achievement of rehabilitation aims
- Discharge disposition and destination.

**Results:**
- Time from referral to admission was longer in those cases where referral was delayed.
- Length of rehabilitation stay did not increase with increased time to admission and in some cases was reduced.
- Time to admission was not significantly different for those who did or did not sustain complications prior to admission.
- Those admitted with skin issues not only had a longer than usual pre-mobilisation period but also a longer than expected rehabilitation stay.
- Length of rehabilitation stay increased if an additional condition was diagnosed during the hospital stay.
- Injury grouping was significantly related to the number of discharge delay days and reason for delayed discharge.
- Discharge delay days led to a total of 1.5 beds (11%) being ‘blocked’ for the entire period of the study.

**Conclusion:** Many issues can affect the progress that a patient will make in their rehabilitation some of which appear to have a more profound effect at particular points of the injury and rehabilitation pathway. Further UK research is required to increase our knowledge of potential issues for SCIC services, acute hospital services and the patient.

**Sponsorship:** This research was part funded via a grant from the Research and Development Department of RNOH.

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**Post Traumatic Syringomyelia (PTS) after spinal cord injury (SCI) - 47 Years Oswestry Experience**

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United Kingdom

**Introduction:**
The reported incidence of symptomatic PTS is 5 – 8%.

**Objectives:**
To compare current incidence with the incidence of PTS published in 1996 and document change over time.

**Methods:**
Retrospective analysis of medical records of patients with established diagnosis of PTS (n=62, in a population of 2200 SCI patients who are regularly followed up). Demographic details, injury details, date and mode of presentation and intervention performed and outcome were collected.

**Results:**
There were 28 patients with PTS out of 815 patients at the end of 1992 with an incidence of 3.43%. There were 34 newly diagnosed patients between 1993 and 2012. The incidence of PTS in this group was 2.45 % (34/1385). The mean age at injury was 34.8Yrs (range 17.6yrs – 58.0Yrs). The interval between injury and diagnosis ranged from six days to 34 yrs (Mean 7.5Yrs) with a complete to incomplete SCI ratio of 2:1. The incidence in the population of SCI patients admitted between 1965 and 2012 was 2.8%. 23 patients from the initial population of 815 between 1965 and 1992 were diagnosed after 1992 bringing the total number in this population to 51/815. The incidence over an average period of paralysis of 35.2 years in this consecutive group of patients was 6.25%. The most common presentation was sensory changes (27.86%). There were 8 (13.11%) patients presenting with sphincter changes, 2 with loss of deep tendon reflexes in the upper limbs. 3 patients presented with quantitative reduction of grip strength only.

**Conclusion:**
With longer survival of SCI patients a small increase in incidence of PTS is expected. The incidence of PTS in patients treated at MCSI is 2.8%. The incidence in the original population of 815 patients injured between 1965 and 1992 has increased from 3.43% to 6.25% in 2012. Attention to grip power has previously not been documented.
P193
Preventing spinal cord injuries from falls: different approaches in different regions
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ISCOS Prevention Committee, USA

Background:
The Prevention Committee of ISCoS is dedicated to prevention of traumatic spinal cord injuries (SCI) worldwide.

Methods:
A worldwide traumatic SCI mapping project has been undertaken by the Prevention Committee of ISCoS in order to provide data for regional or national SCI prevention programs and for education for coordination of prevention strategies.

Results:
Falls are identified as the second most common cause of SCI worldwide. At first glance, “falls” would seem to be a homogeneous group that could be addressed with one overall plan. However, we show that there are vast regional differences based on such issues as population age, regional customs and occupations, as well as variations in safety standards.

Conclusion:
Examples and photos of these regional variations will demonstrate how a prevention program for one region may not be appropriate for another region.

P194
FES-rowing improves bone micro architecture and strength in the paralyzed lower extremity
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Background:
Spinal cord injury (SCI) causes rapid, severe osteoporosis in the lower extremities. As a result, up to 50% of all individuals with a complete SCI will sustain a fracture at some point following their injury. Because mechanical loading is a powerful bone building stimulus, we conducted a pilot study assessing the impact of functional electrical stimulation (FES) rowing on bone micro architecture and bone strength in subjects with motor complete SCI.

Methods:
Cortical thickness, cortical density and trabecular parameters at the proximal tibia and fibula were determined by flat panel volumetric computed tomography (fp-VCT, Siemens Medical Solutions, Forchheim, Germany). As no improvements were expected at the fibula, this site was analyzed for comparison. Finite element analysis was the performed for 1 subject using Mimics software (Materialise, Belgium) to determine changes in bone volume and bone stiffness in response to rowing.

Results:
2 male subjects with thoracic AIS A SCI were studied at baseline and then 3 months (subject A) or 6 and 9 months (subject B) after initiation of row-training. No change in thickness was seen at the fibula in either subject. Cortical thickness increased at the tibia in both subjects post-training. We found a 10% increase in cortical thickness in subject A at 3 months and a 15% increase in cortical thickness in subject B at 6 months of training. At 9 months of training (subject B), we saw a 15% increase in trabecular number at the tibial plateau. These changes corresponded to a 17% increase in bone volume and a 28% increase in bone stiffness.

Conclusion:
These findings demonstrate bone regeneration in response to FES-rowing with improvements in bone volume and stiffness. FES-row training has therapeutic potential to improve bone quality, and perhaps reduce fracture risk, at the most common fracture site following SCI.
The acute inflammatory response is attenuated after administration of Docosahexae-noic Acid in a clip compression model of spinal cord injury

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Background:
Essential fatty acids are lipids that cannot be synthesized within the body and must be ingested through the diet or from supplements. Two families of essential fatty acids, omega-3 and omega-6, are required for normal physiological function. The long chain omega-3 PUFAs, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) have significant biological effects. DHA, in particular, is the critical component of cell membranes in the brain and it is involved in neural function as well as neurotransmitter metabolism. The aim of this study was designed to gain better insight into the mechanism of action of omega-3 PUFAs, such as DHA, in an animal model of spinal cord injury (SCI).

Methods:
SCI is a highly devastating pathology that can lead to dramatic dysfunction, with significantly reduction of the quality of life. In this mouse model, SCI was induced by the application of an aneurysm clip to the dura via a four-level T5-T8 laminectomy, for replicating the persistence of cord compression that is commonly observed in human SCI. Thirty minutes after compression, animals received a tail vein injection of DHA at a dose of 500 nmol/kg and were sacrificed at 24 h after SCI. SCI in mice resulted in severe trauma characterized by oedema, neutrophil infiltration, and production of inflammatory mediators, tissue damage, and apoptosis.

Results:
Our results in this in vivo study, clearly demonstrate that DHA treatment reduces: the degree of spinal cord inflammation and tissue injury (histological score); pro-inflammatory cytokine expression (TNF-α); nitrotyrosine formation and the activation of apoptosis pathways (e.g. FasL, Bax and Bcl-2 expression).

Conclusion:
This study clearly demonstrates that DHA reduces the early development of inflammation and tissue injury associated with spinal cord trauma.
**Effect of Fasudil, a selective inhibitor of Rho Kinase activity, in the secondary injury associated with the experimental model of spinal cord trauma**

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**Background:**
Rho kinase (ROK) may play an important role in regulating biological events of cells, including proliferation, differentiation and survival/death. Blockade of ROK promotes axonal regeneration and neuron survival in vivo and in vitro, thereby exhibiting potential clinical applications in spinal cord damage and stroke. The aim of this experimental study was to determine the role of ROK signaling pathways in the inflammatory response, in particular in the secondary injury associated with the experimental model of spinal cord trauma.

**Methods:**
The injury was induced by application of vascular clips to the dura via a four-level T5-T8 laminectomy in mice. Fasudil was administered in mice (10 mg/kg i.p.) 1 h and 6 h after the trauma.

**Results:**
The treatment with fasudil significantly decreased (1) histological damage, (2) motor recovery, (3) nuclear factor (NF)-êB expression, (4) pro-inflammatory cytokines production such as Tumor Necrosis Factor (TNF-alpha) and Interleuchin-1â (IL-1â), (5) neutrophil infiltration, (6) nitrotyrosine and poly-ADP-ribose (PAR) formation, (7) Glial fibrillary acidic protein (GFAP) expression, (8) apoptosis (TUNEL staining, FAS ligand expression, Bax and Bcl-2 expression), (9) MAP Kinase activation (P-ERK and P-JNK expression).

**Conclusion:**
Our results indicate that inhibition of ROK by fasudil may represent a useful therapeutic perspective in the treatment of inflammation associated with spinal cord trauma.

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**Acute Psychological Responses in Outdoor and Indoor Virtual Reality Arm and FES-leg Cycling in individuals with Spinal Cord Injury**

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**Background:**
Functional electrical stimulation (FES) leg cycling has the potential to improve cardiorespiratory fitness after spinal cord injury (SCI). Combined arm and FES-leg exercise develops greater cardiovascular demand compared to FES-leg cycling alone. Previous studies reported greater enjoyment and satisfaction with outdoor exercise activities in natural environment compared to indoors. However, recent technologies have enabled Virtual-reality (VR)-enhanced exercise which facilitates interaction within a virtual environment providing enjoyment, sense of participation and exercise motivation.

**Objective:**
This study compared acute psychological responses during outdoor versus indoor VR-enhanced combined arm and FES-leg cycling.

**Participants/methods:**
Eight individuals with chronic thoracic-lesion SCI performed voluntary arm and FES-assisted leg cycling on a commercial recumbent tricycle. Electrical stimulation was applied to the quadriceps, hamstrings and glutei muscle groups and individuals modulated stimulation intensity according to preference and comfort. The experiments were conducted outdoors and indoors incorporating VR technology whereby the same outdoor environment was simulated on a large flat screen monitor. Four separate trials (2 outdoor, 2 VR) were conducted at least two days apart. Subjects were instructed to cycle at self-selected workloads for 30-min in the outdoor and VR-simulated indoor test courses. Heart rate was recorded throughout the exercise. Exercise effort was measured using a 1-10 Rating of Perceived Exertion (RPE) scale. Immediately after exercise, subjects were asked to complete the Exercise-induced Feeling Inventory (EIFI) which comprised of four components; positive enjoyment, revitalization, tranquility and physical exhaustion.

**Results:**
During outdoor cycling, mean RPE was 5.93 ± 1.5 at 15 minutes and 8.06 ± 1.9 at 30 minutes compared to 6.25 ± 1.9 and 8.01 ± 1.8 during indoor cycling. The outdoor cycling heart rate was 128.3 ± 12.4 b•min-1 compared to 126.3 ± 10.7 b•min-1 indoors. T-tests revealed that there is no significant difference (p>0.05) in acute psychological responses between indoor and outdoor tests.

**Conclusion:**
This study suggests that exercise environment and exercise intensity do not impact the acute psychological responses during combined arm and FES-leg cycling in people with SCI.
Traumatic versus non-traumatic spinal cord injuries: a comparative study of neurological and functional outcomes
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Objectives:
To compare neurological and functional outcomes of patients with traumatic and non-traumatic spinal cord injuries admitted in a Spinal Cord Unit of a general hospital.

Material and methods:
Retrospective study which includes the patients admitted between January 2007 and December 2010. Medical records and a data base of the Unit were used as a source of information. The variables analyzed were mean age, lesion level, ASIA, discharge destination and functional outcomes. Gait ability was assessed using the walking Index for spinal cord injury (WISCI). Functional ability, based on Spinal Cord Injury Measure, was assessed as dichotomous: dependence (SCIM < 70) and independence (SCIM >70). A multinomial logistic regression model was used in order to analyze the effects of age, lesion level and ASIA grade in the achieved independence.

Results:
The study was carried out with 227 patients, of whom 165 had traumatic spinal cord injuries (TSCI) and 62 had non-traumatic (NTSCI). The mean age was similar in both groups. The percentage of thoracic and incomplete injuries was significantly higher in NTSCI group (p = 0.000). TSCI had a higher percentage of pressure ulcers and urinary infections. No differences at discharge destination between the two groups were found. The percentage of walking patients was similar (21.8% TSCI versus 16.1% NTSCI, p=0.224). No statistically significant difference existed between TSCI and NTSCI for SCIM (44.8% TSCI were independent versus 54.8% in NTSCI, p = 0.116). Multivariate analysis revealed the existence of statistical association between the three studied variables and regarded functionality.

Conclusions:
Despite the methodological difficulties brought out from the elaboration of comparisons, functional outcomes at discharge in patients with TSCI and NTSCI are similar. The etiology of the spinal cord injury doesn’t appear as a determinant factor in the functionality reached.

Effect of formal ISNCSCI training on classification accuracy
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Background:
The International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) are widely used in clinical SCI research as inclusion/exclusion or sub-grouping criterion and outcome measure. The aim of this study is to quantify the effect of formal ISNCSCI training on the classification accuracy.

Methods:
Participants of the EMSCI network rated five challenging, but real cases with full sensory, motor and anorectal examination data before (pretest) and after (posttest) a two-day ISNCSCI instructional course. Classification variables included sensory and motor levels (ML), completeness, ASIA Impairment Scale (AIS) and the zones of partial preservation.

Results:
106 attendees have been trained in 10 ISNCSCI workshops since 2006. In the pretest 49.6% (2628/5300) of all questions were answered correctly. This number increased significantly (p<0.00001) to 91.5% (4849/5300) in post testing. While every attendee improved, 12 (11.3%) participants finished the post test without any mistake. After training the classification performances are independent from the self-rated experience in ISNCSCI and the profession. In post testing, sensory levels (96.8%) and completeness (96.2%) are easiest to rate, while ML (81.8%) and AIS (88.1%) are more difficult. Most of the errors in ML determination arise, when sensory levels are located in the high cervical region (C2-C4), where by convention the ML follows the sensory level. It seems to be counterintuitive to look first at the sensory scores of C2-C4 to determine a motor level. The most error-prone step in the AIS classification process is the motor incompleteness decision.

Conclusion:
ISNCSCI workshops allow to acquire excellent classification skills. However, ML and motor incompleteness remains difficult to determine even after training. These findings need to be considered in clinical trials for calculating sample sizes and for estimating the statistical power.

Sponsorship:
This work was supported by the International Foundation for Research in Paraplegia (IFP), Zurich, Switzerland.
Absence of endogenous Toll-like receptors (TLRs) worsened secondary inflammatory process after spinal cord compression injury in mice

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Background:
Toll-like receptors (TLRs) are transmembranal proteins, which form the major pattern-recognition receptors that trans-duce signals in response to diverse pathogen-associated molecular patterns (PAMPS). As such, TRLs have a central role in the initiation of innate immunity against invading microbial pathogens. Toll-like receptors are ubiquitous and present both in immune and non immune cells, and their expression is rapidly altered in response to pathogens, cytokines, and environmental stressor. A large body of evidence suggests that TRLs play a central role during the activation of the inflammatory process, they posses a dual function: they are able to modulate the inflammatory process through NF-kB activation or cytokines production and in the same time they posses anti-inflammatory effects. The aim of this study was to investigate the role of TLR-4 in C57BL/10ScN (TLR-4 KO) on the modulation of the secondary events in mice subjected to spinal cord injury (SCI).

Methods:
Spinal cord injury was induced by application of vascular clips (force of 24 g) to the dura via a four-level T5-T8 laminectomy in mice. The mice were sacrificed at 24 hours after SCI.

Results:
TRL-4 Wild-type mice developed severe spinal cord damage characterized by oedema, tissue damage and apoptosis (measured by Bax, Bcl-2, and Fas-L expression). While western blot analysis shown an increased NF-kB activation or cytokines production and in the same time they posses anti-inflammatory effects. The aim of this study was to investigate the role of TLR-4 in C57BL/10ScN (TLR-4 KO) on the modulation of the secondary events in mice subjected to spinal cord injury (SCI).

Conclusion:
Taken together, our results clearly demonstrate that the presence of TRL-4 reduces the development of inflammation and tissue injury events associated with spinal cord trauma.

Cause of death of patients with Spinal Cord Injury (SCI) treated in the Midland Centre for Spinal Injuries (MCSI): 65 Yrs Mortality Analysis

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Study Design:
Retrospective analysis

Objectives:
Examine trends in causes of death in SCI population managed by the MCSI over a period of 65 years.

Setting:
The MCSI provides an “injury to grave” service (inpatients and outpatients) to a current population of 3500 patients. On average we admit 100 acute and 350 readmissions with 1500 outpatient follow-up assessments annually.

Material & Methods
One medical officer collected all the information from the medical records. The International Classification of Disease - 10th Edition Clinical Modification was used. Information was collected from post mortem report, general practitioners and office for census and national survey. We looked at the cause of death by decade of injury between 1941 and 2006.

Results
There were 462 confirmed deaths. We were able to confirm the cause of death of 406 patients. Prior to 1980 the number of 28/84 (33.33%) patients died from cardiovascular disease and 29/84 (34.52%) from respiratory disease. After 1980 106/322 (32.91%) died from cardiovascular disease and 88/322 (27.32%) from respiratory disease. Although the SMR for deaths due to respiratory causes showed a reduction (from 7.06 to 5.59) in post 1980 injury years. Interestingly the SMR for Self harm (from 6.48 to 9.81) and infectious causes (12.55 to 15.56) have both increased significantly in the period post 1980. Malignancy related deaths (from 9/84 to 44/322) ranked third for entire study period. The majority of the deaths have occurred in the community and in general hospital wards.

Conclusion:
Our findings suggest that most causes of death in SCI are preventable and that some deaths might have been prevented if patients were admitted to the SCI Centre when patients develop complications related to SCI including pressure sores, cellulitis, respiratory and/or urinary tract infections, bowel problems.
Estimating glomerular filtration rate and detecting patients with impaired renal function in patients with spinal cord injury

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**Background:**
Guidelines emphasize the importance of determining renal function based on glomerular filtration rate using estimating equations (eGFR) rather than serum creatinine concentration (Scr) alone. The purpose of the study was to determine incidence of impaired renal function in patients with spinal cord injury (SCI) and to compare the performance of various models for estimating GFR with measured 24-hour urinary creatinine clearance (mCcr). Method: This study included 58 (48 male; 82.8%) otherwise healthy patients with SCI with normal serum creatinine (Scr≤1.2 mg/dL). eGFRs were calculated with Mayo Quadratic Formula, Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI), the Modification of Diet in Renal Disease (MDRD) and Cockcroft-Gault (CG) formulas and with mCcr.

**Results:**
The number of patients in acute, sub-acute and chronic phases of the disease were 26 (44.8%), 11 (18.9%) and 21 (36.2%), respectively. Incidence of impaired renal function (mCcr < 90 ml/min) was 12% in patients with SCI and normal Scr. The CKD-EPI formula provided the best estimate of GFR with a mean bias of 4.5 mL/min/1.73m², a 95% confidence interval of -5.02 to 14.03 mL/min/1.73m² when assessed with Bland-Altman Plotting. CKD-EPI had a 58% accuracy at ±20% deviation from mCcr. On the contrary, MDRD and CG provided best performance over various values of mCcr (Slope of bias: -0.01 and -0.06 respectively; p>0.05). All eGFR equations underestimated (0-4%) incidence of impaired renal function compared to mCcr. Addition of a correction factor of 0.85 for both MDRD and CG equations resulted in clinically acceptable detection error.

**Conclusions:**
Significant number of SCI patients with normal Scr may have impaired renal function. Although CKD-EPI provides best estimate of GFR in these patients none of the methods tested had the sufficient power to detect the patients with renal impairment. MDRD and CG has potential to detect such patients with correction factor of 0.85. Further studies are needed to develop methods to assess renal function in SCI patients.

Upper limb function after incomplete Spinal Cord Injury

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**Background:**
Upper limb function in the Tetraplegic population is underrepresented in the Spinal Cord Injury (SCI) literature. The purpose of this research was to correlate clinical and functional measures of upper limb function with kinematic measures of a discrete and continuous task.

**Methods:**
The study involved seven incomplete Tetraplegic patients (C5/C6) (M=58 years) from a regional SCI unit. Clinical (American Spinal Injuries Association (ASIA) classification) and functional (AuSpinal, Capabilities of upper extremity questionnaire (CUE), Spinal Cord independence measure III (SCIM III)) measures were correlated with kinematic measures (Path length, Path length time and track error) from two tasks (‘Lines’; a discrete task and ‘Figure eight’; a continuous task) completed using the newly developed Kinematic software ‘KiniLab’ based on a portable laptop tablet. All of these measures fit the International classification of functioning, disability and health (ICF) framework in terms of body structures/functions and activity limitation.

**Results:**
Clinical measure ASIA classification resulted in the strongest correlations with AuSpinal (r=.921, p=0.003), CUE (r=.799, p=0.031), path length (r=-.801, p=0.030) and track error (r=.799, p=0.031), with better classification associated with greater functional ability and movement accuracy. AuSpinal and CUE correlated well (r=.758, p=0.048), however kinematic measures showed no strong correlations with functional measures.

**Conclusions:**
ASIA classification correlated well with functional and kinematic measures of upper limb function, indicating that sensory and motor scores influence upper limb function. Ongoing data collection aims to determine how time and severity of SCI influence clinical, functional and kinematic measures. More research using the KiniLab software in the SCI population is needed as it is a new, easy to use tool to measure kinematics, which are an important addition to clinical and functional measures in identifying underlying motor control strategies.
Ventilator weaning supported by abdominal muscle stimulation in acute tetraplegia

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Following a spinal cord injury at the cervical level affecting primary and secondary respiratory muscles, a period of mechanical ventilation is often required. When patients have retained partial diaphragm function, weaning from mechanical ventilation can usually be achieved, but may be time consuming, costly and delay rehabilitation. Electrical stimulation of the abdominal wall muscles, applied via transcutaneous electrodes, can augment respiration during the expiratory breathing phase. In this study we aim to evaluate how this technique can assist ventilator free breathing and support weaning in these patients.

We present a three subject case series (S1: 24 year old male, C4 motor complete; S2: 30 year old male, C4 complete tetraplegia; S3 (preliminary results): 43 year old female, C3/4 functionally complete tetraplegia). Abdominal stimulation was applied over a total period of four weeks to support ventilator weaning. Prior to stimulation all subjects were unable to breathe independently for more than 3min before desaturating, and were otherwise fully ventilator dependent.

During initial application of abdominal muscle stimulation, all subjects showed improvements in vital capacity (S1: 135ml to 380ml, S2: 300ml to 500ml, S3: 185ml to 480ml), leading to ventilator free breathing times with abdominal muscle stimulation of 9min (S1) and 5min (S2, S3), respectively. At the end of the 4 week intervention, total ventilator free breathing times reached 90min (S1) and 40min (S2) while assisted breathing was tolerated for more than 20min (Results for S3 not available).

Diaphragm fluoroscopy (conducted in S1 and S2) showed increased diaphragm movement when stimulation was applied (S1: from 1cm to 2cm, S2: from 1.5cm to 2cm).

These results demonstrate that abdominal stimulation can assist ventilator breathing in acute tetraplegia. The increases in respiratory capacity, diaphragm movement and time off ventilator with abdominal stimulation suggest that this technique can support ventilator weaning in tetraplegic patients with partial diaphragm function.

Long term outcome after repeated intradetrusor botulinum neurotoxin A injections in patients with neurogenic bladder dysfunction

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Background:
Botulinum neurotoxin A (BoNT-A) is effective and minima-invasive treatment of neurogenic bladder dysfunction in patients with side-effects or intolerance of anticholinergic treatment. We evaluate the influence of repeated BoNT-A injections on the bladder function in patients with neurogenic bladder dysfunction due to suprasacral spinal cord injury.

Methods:
We analyzed retrospectively 50 patients with neurogenic bladder dysfunction due to suprasacral spinal cord injury. BoNT-A intradetrusor injection was indicated only if the anticholinergic treatment was ineffective or intolerable due to contraindications or side-effects. The data assessment included comprehensive neuro-urologic history, incontinence evaluation, urodynamic parameters before the first and the last BoNT-A intradetrusor injection.

Results:
The cohort of patients included 24 women (48%) and 26 (52%) men. Each patient undergone 3 BoNT-A injections (range: 2-14) with the mean interval between the injections of 12 months. The mean follow up was 36 months (range: 16-46 months). Before the first BoNT-A injection 27 (54%) patients were incontinent and 23 (46%) continent. While the mean maximal bladder capacity increased only slightly from 355 ml to 376 ml, the mean detrusor pressure reduced significantly from 58 cmH2O to 40 cmH2O (p=0.001) and the mean bladder compliance improved from 19 ml/cmH2O to 52 ml/cmH2O (p=0.003). After the last BoNT-A injection 8 (30%) of 27 (100%) incontinent patients achieved continence.

Conclusion:
Repeated BoNT-A treatment improves the bladder function in the long term and protect the upper urinary tract from the damage due to high intravesical pressure. However, only each third patient has a benefit from the repeated BoNT-A intradetrusor injections in achieving continence.
Motor level determination in different revisions of the ISNCSCI assessment sheet

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Background:
Recent revisions of the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) include not only changes of the assessment and classification rules but also updated assessment sheets. This study compares the influence of the assessment sheet on the ISNCSCI motor level (ML) accuracy in the 2001 versus the 2011 revision. We hypothesized that the revision 2011 impairs ML classification performance, because corresponding myotomes and dermatomes – previously listed no next to each other – have been separated by a comment box. This new layout causes some confusion in particular if the ML is located in ‘not testable’ myotomes (C2-C4, T2-L1 and S2-S5), where the ML by definition follows the sensory level.

Methods:
Post-test results of the ISNCSCI instructional courses within the European Multicenter Study on Human Spinal Cord Injury (EMSCI) served as data source for this study. We introduced the 2011 ISNCSCI revision in late 2011 using the same five challenging cases with a complete set of sensory, motor and anorectal examination data. Attendees rated all ISNCSCI variables including the left and right ML resulting in 10 motor level decisions per person. Two of them are in the high cervical region (C2-C4).

Results:
106 attendees used the 2001 revision for post testing in 10 ISNCSCI workshops since 2006 to 2010. The 2011 revision was used in one workshop by 15 attendees. ML classification performance reached 81.8% (± 13.1%) with the 2001 revision compared to 76.7% (± 11.1%) with the 2011 revision. This difference is not yet significant (p=0.12), but shows a clear trend towards impaired classification accuracy.

Conclusion:
The results of this study suggest that the ML classification accuracy deteriorates on the recent ISNCSCI assessment sheet. Therefore, it should be considered to return to the layout of the 2001 revision with corresponding myotomes and dermatomes aligned to each other.

ASIA Impairment Scale: AIS D is not AIS D

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Background:
Functional outcome in AIS D subjects is assumed to be high. However not all AIS D subjects become “dependent” or “independent” walkers. The goal of this study was to analyze the variability of functional outcomes in subjects classified as AIS D one year after traumatic spinal cord injury (SCI).

Design:
Retrospective, longitudinal study

Participants/methods:
To describe functional outcomes 1 year after injury data from 340 tetraplegic and 232 paraplegic AIS D SCI subjects from the EM-SCI Study Group were analysed. Subjects were grouped according to their initial AIS grade within the first 4 weeks after injury, ASIA motor scores, Walking Index for Spinal Cord Injury II (WISCI II) and Spinal Cord Independence Measure (SCIM) 1 year post-injury were used to describe the functional outcome in the chronic stage of SCI (12 months). Subjects were scored as “independent” walkers (able to walk without assistance; WISCI=20) or “dependent” walkers (required canes/crutches or braces; WISCI>15).

Results:
1 year after injury tetraplegic SCI subjects, who were initially classified as AIS D, showed consistently better functional outcomes than subjects with an initial classification of AIS A, B or C that eventually converted to AIS D. In addition, they were more likely to become independent walkers than subjects that converted to AIS D. In paraplegic subjects the same pattern was observed, i.e., subjects initially classified as AIS D showed consistently better functional outcome than those that later converted to AIS D. However, variability in functional outcome was smaller in paraplegic than in tetraplegic AIS D subjects.

Conclusion:
The variability in functional outcome in AIS D subjects 1 year after injury is high. Functional outcome in tetra- as well as paraplegic SCI subjects 1 year after injury depends on the AIS grade that was initially scored in the acute phase, specifically, subjects that convert to AIS D have a significantly lower functional outcome than subjects already initially classified as AIS D. Therefore, the functional level of AIS D outcomes, like in terms of walking ability, depends on the initial condition.

Support:
EM-SCI is supported by IRP, Switzerland.
Neurological recovery after traumatic paraplegia

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Background:
The course and extent of neurological recovery in persons with traumatic paraplegia has been reported recently using the Sygen and European Multicenter Study about Spinal Cord Injury (EM-SCI) databases. This report updates neurological outcomes using the United States SCI Model Systems (SCIMS) database.

Methods:
Records of 518 subjects with thoracic paraplegia, injured from 1996-2010, and admitted within 1 day of injury were analyzed for change in ASIA Impairment Scale (AIS) and lower extremity motor scores (LEMS). Subjects were grouped as high (T2-5), middle (T6-9) and low (T10-12) thoracic levels. Changes in sensory levels (SL) and LEMS by thoracic level group were examined in subjects with complete injuries (AIS A).

Results:
The sample was 81% male. Main etiologies were vehicular accidents (37%), falls (25%), and violence (31%). At baseline 402 (78%) were AIS grade A, 63 (12%) grade B, 36 (7%) grade C and 17 (3%) grade D. Most AIS A subjects (86%) remained complete while 8% converted to motor incomplete by one year. Conversion to motor incomplete was not influenced by penetrating/non-penetrating etiology, but more subjects with low thoracic levels converted to motor incomplete than subjects with higher levels (12.6% vs. 5.3%, p<.05). For AIS B subjects, 30% became AIS C and 29% AIS-D/E. Most AIS C subjects (81%) improved. For subjects with thoracic level AIS A injuries, average SL change was 0.4 levels, 86% remained within 2 levels of baseline SL. AIS A subjects with low level paraplegia gained more LEMS points than subjects with higher levels, 3.9 ± 8.0 vs. 1.3 ± 6.8 points (p<.01).

Conclusion:
Results from the SCIMS database generally agree with findings from the Sygen and EM-SCI databases, and confirm the relative stability of SL after traumatic paraplegia, particularly for levels above T10.

Heart rate variability (HRV) analysis and autonomic reflexes in a patient with C1-lesion

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Case-report

Background:
There is incomplete knowledge about the acute effects on autonomic nervous system after traumatic spinal cord injury (SCI). HRV analysis, including spectral analysis, can serve as a measure for the autonomic regulation after SCI. In conjunction with stimulation tests, it can give an overall view of the patients’ ability to regulate the autonomic nervous system. The patient in this case-report had a high cervical lesion at C1 (AIS-A) and suffered from several episodes of bradycardia. During the first 5 weeks he had a single cardiac arrest.

Methods:
The patient had 24-hour Holter monitoring performed at week 1, 2, 3 and 4 and at six months after SCI. Twenty-four hour RR-intervals were analysed in the time domain (SDANN) and in the frequency domain. In week 2 the function of the cardiovascular and the sudomotor response was recorded. ECG, beat-to-beat blood pressure, galvanic skin response (GSR) and Infrared-plethysmography were recorded, and the effect of electrical forehead stimulation was evaluated.

Results:
During the 6 periods of Holter monitoring a decrease in SDANN was observed at week 2, 3 and 4, for then again to rise at week 5 and at the six-months control. The frequency domain analysis showed no comprehensible pattern. After forehead stimulation, repeated tests elicited a nodal rhythm, which was reflected in a self limited decrease in blood pressure, pulse, and in the amplitude of the IR-plethysmogram.

Conclusions:
A noxious stimulus usually elicits an increase in blood pressure and heart rate, together with a vasoconstriction. In this patient with a high SCI, the effect was inverted. The SDANN show a tendency to decrease in the weeks after the SCI for then to rise later in the course.
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The Conditional Neuromodulator with electrodes on the intrathecal roots: an engineer’s view
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Background:
Brindley’s sacral root stimulator is a simple device: functional, reliable and inexpensive, yet the number of people with SCI who have the implant remains small. At least in some centres, the deterrent is thought to be the associated deafferentation that prevents bladder overactivity. As an alternative, Craggs proposed a Conditional Neuromodulator that stimulates the posterior roots to suppress the voiding reflex when a contraction is detected. We have been working on the design of such an implant in which intrathecal roots are trapped, for voiding (anterior root stimulation), detection of bladder contractions (posterior root recording) and neuromodulation (posterior root stimulation).

Methods:
At first sight, this is a neat idea but it has several disadvantages: it is as invasive as the Brindley procedure (laminectomy); the device must be continuously active (battery); the recorded neural signals are very small; and the root contain non-bladder afferent that interfere with the bladder signal. A design study completed in 2008 concluded that the idea was not technically feasible due to the difficulties of recording. Recently we have been testing microchannels for recording from dorsal roots in animals. Not only do these give much greater amplitude, but the activity of particular axons can be discriminated from their action potential spikes, so that rises in bladder pressure may be detected (though there may be false positives).

Discussion:
However, to justify the cost of developing an implant for humans, the commercial development must be plausible. It is difficult to see a device that is as complex as a modern pacemaker, but improves quality rather than saves life, can be commercially viable given the size of the market. Perhaps the next step should be a survey of urologists to discover whether this would be seen as avoiding the shortcomings of Brindley’s method and be their preferred treatment for many SCI patients.

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The relation of physical fitness over ambulation and depression in spinal cord injury patients
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Objective:
As known physical fitness has many positive physiological and psychological effects for healthy individuals. This current study aimed to examine the impact of physical fitness over the ambulation level and depression status among the individuals with spinal cord injury.

Materials and Methods:
Subjects with SCI (n=21, 15 of them with toracal and 6 of them lomber lesion level) evaluated with symptom limited cardiopulmonary exercise test to determine physical fitness by peak oxygen uptake (peak VO2; L/min) and peak power output (peak PO; W). Ambulation was assessed with walking index for spinal cord injury (WISCI). Also depression existence and quality of life (QoL) were evaluated with Beck depression inventory (BDI) and Short Form Health Survey (SF-36). Activity was measured using the motor subscale of the Functional Independence Measure (mFIM).

Results:
There was a correlation between peak oxygen uptake and WISCI but it was not statistically significant (r = 0.431). Peak oxygen uptake and WISCI both were correlated with mFIM (respectively r=0.491, r=0.663). There was no correlation confirmed between peak oxygen uptake and WISCI both with BDI (respectively r=0.166 r=0.01). Furthermore peak oxygen uptake and WISCI were not related with SF36 results (p>0.05). Also there was a significant difference for physical function between the groups of WISCI upper and lower than 5 (p<0.01). No significant difference was found between two groups for BDI and peak VO2. (p>0.05)

Conclusion:
In SCI patients physical fitness defined as aerobic capacity and ambulation status both affect on activity of subject by altering mFIM scales. We could not determine a relation between physical fitness and ambulation with depression as projected; this may be due to personal expectations and self-hood characteristics. In further studies in it would be interesting to assess the effects of ambulation quality over psychological characteristic in larger groups.
A descriptive study of patients with chronic spinal cord injuries
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Objective:
To describe epidemiological characteristics, complications, and long term functional outcomes of spinal cord injuries (SCI) in Spain.

Material and patients:
325 SCI patients attending their annual check-up in Hospital Nacional de Parapléjicos (Toledo, Spain) during 2010 were selected. Main outcome measures were demographic and injury characteristics, medical complications, functional status and social adaptation

Results:
Mean age was 46 and mean following period since SCI was 11 years. Male/female ratio was 4:1, 80% traumatic aetiology. 10% reported respiratory complications (mostly tetraplegic people). 13% reported irregular defecation frequency, 11% had gastrointestinal complications, 64% among them had haemorrhoids. Pressure ulcers were suffered by 20%, most of them in sacral and ischial regions. Sacral ulcers increased with time post injury (p<0.03). Intermittent catheterization was used by 40% and 27% used indwelling catheters. Urinary tract infection was the most frequent urologic complication followed by vesicoureteral reflux. 63% suffered spasticity, and 23% were unable to perform daily life activities. 60% reported pain with an intensity 3.3 according with visual analogic scale, and among them 50% felt neuropathic pain. 86% (68/79) endorsed having a primary care physician. 85% (68/80) of the sample are English-speaking. The most common problem reported was urinary tract infections (75%), and anemia (29%). 76% received a Pap Test; 42% a mammogram; and 56% a flu shot. A high number of women reported that preventative measures were not being taken to maintain their health: 44% were exercising (33/75); 11% were smokers (8/76); 29% (21/73) used illegal drugs; and 48% (35/73) performed breast self-exams.

Conclusions:
Longer time from injury is associated with a higher frequency of medical complications (digestive) and worst functional status.

Health Care Needs and Services for Women Aging with a Spinal Cord Injury
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Objectives:
To determine what healthcare concerns women with a SCI encounter most frequently. To describe women seeking services in the outpatient Women with Disabilities Healthcare Clinic at Santa Clara Valley Medical Center (SCVMC).

Problem Statement:
Women with SCI are believed to face multiple obstacles in receiving healthcare following an injury due to a lack of accessible facilities. Facing embarrassment at non-accessible facilities may deter women from attempting to seek vital follow up treatment.

Methods:
80 with a SCI completed a 2-page general health questionnaire while attending the clinic. The clinic provides staff specializing in SCI, educational materials and most importantly, accessibility to women needing follow up healthcare. The questionnaire was self-report and reviewed retrospectively.

Data analysis:
Of 113 women who have attended the clinic since its inception, 80 have sustained SCI. Summary statistics show that 33% (26/80) are married while 43% are single (34/80). The average age is 42 and 86% (68/79) endorsed having a primary care physician. 85% (68/80) of the sample are English-speaking. The most common problem reported was urinary tract infections (75%), and anemia (29%). 76% received a Pap Test; 42% a mammogram; and 56% a flu shot. A high number of women reported that preventative measures were not being taken to maintain their health: 44% were exercising (33/75); 11% were smokers (8/76); 29% (21/73) used illegal drugs; and 48% (35/73) performed breast self-exams.

Significance:
Results show that women with SCI need to receive ongoing and accessible healthcare as well as improved education on preventative health measures.

Conclusion:
Women with SCI are not receiving consistent and crucial healthcare to maintain their physical and emotional health.
A kinetic evaluation of a novel forearm crutch with a shock absorption system
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Rehabilitation Sciences, Canada; Medicine, Canada; Orthopaedics, Canada

Background:
The forearm crutch enhances control during gait for individuals with mobility impairments. Compared to advancements in other forms of assistive devices, such as wheelchairs, the forearm crutch has evolved minimally. An innovative forearm crutch has recently been developed. The device includes ergonomic handles and footpads, as well as a shock absorption system that aims to reduce peak forces and impulse.

Methods:
Thirteen able-bodied individuals participated in this study. Three different crutches were compared: the SideStix™ Discovery (no shock with a Fetterman™ footpad), the SideStix™ Boundless (shock with a rotating footpad) and a Traditional model. Force plates were used to measure ground reaction forces at the crutch footpad during swing-through gait. Velocities were calculated for each trial. Statistics were performed on the averaged data from all participants. A repeated measures ANOVA was used to determine differences between crutch types. Bonferroni pairwise comparisons were used to determine which conditions were different when crutch type was significant.

Results:
Peak Force: There was a significant difference in peak values for braking and propulsive forces between crutch types. The Boundless crutch demonstrated a significantly smaller peak braking force compared to the Discovery model (p=0.009) and the Traditional model (p=0.001) according to a Bonferroni pairwise comparison. The Boundless crutch demonstrated significantly greater propulsive force than the Discovery model (p=0.008) and the Traditional model (p<0.001) according to a Bonferroni pairwise comparison.

Impulse: There was a significant difference in vertical impulse between crutch types (p=0.006). The Boundless crutch had a significantly smaller impulse compared to the Traditional model according to a Bonferroni pairwise comparison (p=0.013). Implementing a shock absorption system may provide benefit to crutch users with physical disabilities including spinal cord injury. These benefits may help to reduce overuse injuries and fatigue. Future research should focus on amputees and those with a spinal cord injury.

Memokath trans sphincteric stent insertion for detrusor sphincter dyssynergia - short term gain but long term pain?
Hardaker, Henry; Fulford, S
Urology, United Kingdom

Introduction:
Memokath trans sphincteric stent (TSS) insertion has been advocated as an alternative to trans-urethral sphincterotomy (TUS) in the management of detrusor sphincter dyssynergia (DSD). Good short term results have been published but few long term reports exist. We report on the outcome in ten sequential cases with a mean follow up of 7 years 11 months.

Patients and methods:
Ten patients with urodynamically proven detrusor hyper reflexia and DSD underwent TSS insertion between 2001 and 2009. One has cerebral palsy and the rest have thoracic or cervical spinal cord injuries. They ranged in age from 17 to 61 years with a mean of 31 years. All were having problems with autonomic dysreflexia (AD), urinary tract infections (UTIs) and / or upper tract dilitation.

Results:
Following TSS all had significant symptomatic improvement, reduced post micturition residuals (PMR), fewer UTIs and resolution of any upper tract dilitation. However only one patient still has TSS in place without problems 28 months after insertion. All the others have been removed. One patient was unable to use a penile sheath and his TSS was removed after a month. 8 patients developed recurrent problems with retention of urine, AD, UTIs and / or upper tract dilitation. At removal of the TSS 1-94 months after insertion (mean 39 months) one had migrated in to the bladder, 5 were heavily encrusted and significant urethral strictures had developed in two patients. One patient died of septicaemic shock three days after removal of his TSS. Two patients have been successfully managed since TSS removal with supra pubic catheter drainage and one patient has managed successfully with intermittent self catheterisation and regular botulinum toxin injections. Five patients had TUS following removal of their TSS. Four of these five have required repeated TUS 25 to 91 months (mean 63 months) after initial TUS because of recurrent AD, UTIs, Rising PMR and / or upper tract dilitation. In each case the peri sphincteric tissues were excessively fibrosed at the second TUS. One of these four patients is currently managed with a urethral catheter after three TUS since TSS removal 33 months ago. The others remain under close follow up.

Conclusions: Whilst the short term results of TSS are good the longer term outcome is poor. Of particular concern is the tendency for recurrent stenosis and complications after TUS following TSS.
We no longer advocate Memokath TSS.
Patient and staff satisfaction following implementation of Spinal Cord Essentials, an education initiative for patients with spinal cord injury

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Spinal Cord Rehabilitation Program, Canada

Introduction:
Spinal Cord Essentials (SCE) is a patient education initiative consisting of a series of informational handouts for patients which can be incorporated into a binder to meet the specific needs of individual patients undergoing spinal cord injury (SCI) rehabilitation. SCE was developed with widespread involvement of the clinic staff from the Toronto Rehab Spinal Cord Rehabilitation Program. Handouts can be downloaded in pdf format free of charge at www.spinalcordconnections.ca, and are currently available in four languages (English, French, Chinese, Farsi).

Methods:
Following the development and implementation of SCE, an evaluation was performed of patient and staff satisfaction with patient education, the content and organization of SCE, and the utility of SCE. Questionnaires were administered by telephone to cohorts of patients pre- and post-implementation of SCE. Participants were a minimum of one month post-discharge from inpatient rehabilitation. Evaluative questionnaires consisted of an in-house questionnaire addressing preparedness for discharge, a patient satisfaction questionnaire called Patient Perspective on Care and Rehabilitation, and an adapted Website Evaluation Questionnaire used to evaluate the content, organization, and delivery of SCE. Staff questionnaires consisted of an in-house questionnaire based on the Acceptability Planner framework for evaluating adult learning. The majority of the items on the questionnaires are scored on a five-point Likert scale.

Results:
Results from pre- and post-implementation patient evaluations and results from the staff questionnaires will be presented.

Post-laminectomy rotokyphoscoliosis causing paraplegia in long-term. A case report

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Background:
Childhood laminectomy can lead to spinal deformity.

Methods:
55-years-old woman with paraplegia admitted to our clinic. She had experienced a spinal surgery for spinal tumor when she was 13. Total laminectomy through C6-T4 and intramedullary tumor excision had been performed without fusion. Pathological diagnosis of the tumor was intramedullary astrocytoma. She reported that she had no weakness or sensorial problem and incontinence after the surgery. Kyphosis had begun to develop 2 years after the surgery and gradually progressed over the years. She had no complaints for a long time. She had begun to feel weakness at her lower limbs 25 years after the surgery. She became unable to walk without bilateral canes 4 years ago. Although surgery was recommended, she did not accept because of the risks explained to her. She reported that for the last 4 months she could not walk even with bilateral canes and she has been using wheelchair for mobilization. In physical examination, she had severe kyphoscoliosis. She was diagnosed as T3 paraplegia AIS-C. Plain graphs showed marked kyphosis and scoliosis. Magnetic resonance imaging revealed that the calibration of spinal cord significantly decreased beginning from C7 vertebra level. No recurrence of tumor was seen. Reconstruction computed tomography revealed a severe kyphoscoliosis. Rotation of vertebral bodies, cervicotoracholumbar S shaped scoliosis and severe kyphosis with the apex at T4 vertebra were obtained. There were defects of laminectomies between C6 and T4 vertebrae.

Results:
This case is highlighting a possible complication of laminectomy without stabilization that might occur in very-long-term. Children should be followed closely after laminectomy since development of spinal deformity is very common. Unless it is treated, the kyphosis might progress and in long-term, serious complications including paraplegia can occur.
Cortical activation of the tenodesis grasp after C6 quadriplegia: a MEG control case study.

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Background:

Human prehensile movement is dramatically disturbed after cervical spinal cord injury. Indeed, persons sustaining C6-quadriplegia lose the ability of active grasp. However, a compensatory passive prehension remains possible using the tenodesis grasp: wrist extension elicits passive fingers closure. So far, little is known about the pattern of cortical activity mediating the tenodesis grasp. Using magnetoencephalography (MEG), motor tasks can be studied within the 13-35 Hz beta band using the beta rebound occurring right after movement end.

Objective:

This study investigated cortical activations in a C6-quadriplegic participant and a control participant performing repetitive wrist extension movements.

Participants:

A 24-aged chronic stable stage C6-quadriplegic participant and a healthy age-matched control participant were included in this study after the local ethics committee has given its approval (CPP 2009-051 B). Both participants were right-handed. The C6-quadriplegic participant had a 26/100 motor ASIA, a 68/112 sensitive ASIA and a Frankel B scores. Muscular strength of the extensor carpi radialis longis and brevis was normal (5/5 MRC score).

Methods:

Both participants were requested to perform a set of 30 wrist extensions while MEG data were recorded. Inverse modelisation of the cortical activation sources within the 13-35 Hz beta band were used to determine the location and amplitude of maximal activation when comparing time-windows during and after movement.

Results:

Preliminary results showed a significant increase of the beta rebound within the left contralateral motor cortex in the C6-quadriplegic participant as compared to the control participant, suggesting an enlarged cortical activation of motor areas involved in wrist extension movements.

Conclusion:

This activation pattern does not correspond to an increasing of the wrist extensors muscular strength which was similar for both participants. It could reflect the motor cerebral plasticity induced by the repetitive wrist extension movements performed during the tenodesis grasp learning.

Exploring the feasibility and scalability of central recruitment for patients with subacute SCI in tertiary academic rehabilitation centres

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Objective:

Insufficient or delayed recruitment is a common barrier to clinical study implementation. Screening to recruitment ratios, for subacute SCI patients are low. This initiative aims to streamline recruitment and consent processes for subacute SCI patients, thereby reducing patient burden and maximizing research participation.

Design:

Quality Improvement Initiative

Participants/methods:

The patient’s RN ensures the patient is suitable for research screening, based on fluency, health status, and research interest thereby initiating the CR process. The central recruiter (CR) then serves as a single contact for information about ongoing research. The CR meets with the patient to determine their willingness to participate in research, conducts a chart audit to determine eligibility, and discusses eligibility for one or multiple studies with the patient. The CR then completes the informed consent process(es).

Results:

During a 7-month period, 108/130 patients were deemed ‘suitable’ for research. Seventy nine percent (83/108) of suitable patients consented to chart review to determine eligibility. Nineteen percent (16/83) patients were ineligible for all studies. Of the 67 eligible patients - 16/19 patients eligible for three studies consented, 25/33 eligible for two studies consented and 13/15 eligible for one study consented. Overall, there was a 65% participation rate with 16% of suitable patients declining enrolment.

Conclusions:

Approximately 3/4 of subacute SCI patients were interested in learning about research opportunities. Based on eligibility, >60% were willing to participate in at least one study during inpatient rehabilitation. CR appears to reduce the burden of consent for subacute SCI patients as: 1) study eligibility is rigorously pre-addressed prior to meeting with patients; 2) the number of study coordinators approaching the patient is reduced; and, 3) screening to recruitment ratios are higher than anticipated. Meaningful engagement of rehab team members (RN) can facilitate research engagement for patients and staff. Evaluation of CR process scalability is planned.
Predicting Health Preference in Spinal Cord Injury
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Background:
In order to justify appropriate resources to support the health needs of individuals aging with spinal cord injury (SCI), government agencies in Canada advocate for data from cost-utility analyses to facilitate decision-making. This type of economic analysis requires disease-specific health preference estimates that reflect the quality of the health state, and summarizes morbidity status in one measure to thereby allow for cross disease or health condition comparisons.

Objectives:
To use elements of the International Classification of Functioning, Disability and Health (ICF) framework to predict health preference in a community-dwelling group of persons with chronic SCI.

Methods:
Telephone survey methods were used to collect participant data including (1) demographics, (2) impairment, (3) secondary health conditions using the SCI-Secondary Conditions Scale – Modified (SCS-M), (4) functional abilities using the Spinal Cord Independence Measure (SCIM-III), and (5) health preference using the Health Utilities Index-Mark III (HUI-Mark III) in 380 adults with chronic SCI. Variables were categorized according to ICF headings and hierarchical regression analysis was used to predict HUI-Mark III scores.

Results:
The sample’s mean health preference score was 0.27 (+ 0.27). In predicting health preference, our model accounted for 55.1% of the variance with ‘body functions and structure’, ‘activity and participation’, and ‘environmental factors’ significantly contributing to the model (p < .0001). In particular, older age, employment, and high SCIM scores were positively associated with health preference. Conversely, reporting a higher secondary health condition impact score was associated with poorer health preference.

Conclusion:
Variables representative of ‘activity and participation’ largely influence health preference post-SCI, which may be amenable to intervention. These findings may be used to advocate for health promotion and employment support programs in order to minimize health-care system costs while maximizing well-being among persons aging with SCI.

Isokinetic assessment of diurnal variation of spasticity: Pilot study
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Aim:
It is the aim of this study to investigate diurnal variation of the spasticity of the lower extremity.

Method:
Patients were included who were known to have spasticity in the lower limbs at least for six months, who did not suffer from any joint problems, who had good sitting balance, voluntary, and who had cognitively intact (Mini Mental State Examination >25). The patient group consisted of four spinal cord injury patients, three male, and one female, all of whom had varying degrees of hypertonus on Ashworth scale. Age range of the patients was 35-40 years, time range post injury was 6 months-2 years. The level of injury ranged from T6 - T10. We tested a flexion/extension movement of the knee in the sitting position. For all patients, the same physician recorded Ashworth grades for knee flexion and extension. A commercially available computerized isokinetic dynamometer (IsoMed 2000, Germany) was used to quantify passive resistance. Passive knee motion was performed at five pre-selected velocities (6, 30, 120, and 3000/s) in the morning and also in the afternoon. Correction for gravity was undertaken to account for the weight of the limb. The maximum peak torque (Nm) values of three repetitions for knee joint motion at each velocity were recorded.

RESULT:
There were no significant difference of maximum peak torque values recorded in the morning and in the afternoon.

Conclusion:
Even though we could not find any diurnal variation of spasticity at different velocities, it would be worth investigating the usefulness of isokinetic measures for detecting changes in hypertonus with large sample.
Measuring skin thickness on bony prominences by ultrasound in spinal cord injury patients: A possible predictive tool for pressure sore

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Objectives:
The skin and soft tissues over bony prominences have been a great deal of concern in the management of spinal cord injury (SCI). Previously, they have been evaluated in a small group of SCI patients by MRI scans while MRI has a lower reliability for skin measurements than the other soft tissues. This study is the first comparing the differences in skin thickness between SCI patients and controls by ultrasonographic measurements.

Design:
Cross-sectional.

Setting:
Physical medicine and rehabilitation clinic.

Participants:
Thirty two patients with SCI and 34 healthy individuals were evaluated.

Main Outcome Measures:
By ultrasound the thickness of the skin (epidermis and dermis) was measured overlying the sacrum, trochanter major, ischium and waist both for the patient and control groups.

Results:
Mean skin thickness of patient and control groups were 1.8±0.4 mm and 1.9±0.5 mm at the trochanter, 2.1±0.9 mm and 3.2±0.5 mm at the sacrum, 2.2±0.6 mm and 2.6±0.5 mm at the ischium and 2.3±0.5 mm and 2.5±0.6 at waist, respectively. There were significant differences between two groups for thickness of the skin over the ischium and sacral regions (p<0.01) but not for trochanter and waist. (p>0.05). Additionally, a positive correlation was found between the thickness of skin over the trochanter and sacrum in the control group (r=0.422) but not in patient group.

Conclusions:
The significant differences in skin thickness among the sacrum and ischium provide the basis in establishing the early signs of pressure damage. One of the issues that could emerge from findings is that thinning of the skin could increase the risk of soft tissue damage leading to pressure ulcers. Further work needs to be done to establish whether ultrasonographic skin measurements as a non-invasive and available technique could be a follow up criteria for selecting the patients with a tendency for pressure ulcers.

Spinal Cord Essentials: A customized patient education initiative for spinal cord injury

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Spinal Cord Rehabilitation Program, Canada

Background:
An important part of spinal cord injury (SCI) rehabilitation is the delivery and acquisition of information needed to live and thrive following such an injury. Patient education is therefore essential to health maintenance and well-being after SCI. Barriers to effective patient education include (1) lack of individualization, and (2) the timing and relevancy of the information. To address this need, clinical staff at Toronto Rehab's Spinal Cord Rehabilitation Program developed Spinal Cord Essentials (SCE), an educational resource for individuals with SCI.

Methods:
SCE consists of a series (~70) of brief 1-4 page informational handouts on various aspects of living with SCI. Topics include activities of daily living (dressing, bathing) management of health conditions (bladder, bowel, autonomic dysreflexia), mobility (transfers, equipment), community living (transportation, recreation), home living (modifications, attendant services), and financial implications. Diagrams and photos increase visual appeal and add instructional value. A system of delivery by multidisciplinary team members was organized with the aim to provide information as it becomes relevant.

Results:
At admission, patients are provided a tabbed binder with a stylized, graphically designed cover. The binder initially includes a limited number of introductory handouts. During rehabilitation, clinical staff provide each patient with additional handouts tailored to his or her individualized needs. Staff are encouraged to combine the delivery of handouts with 1:1 teaching, as a tool to augment and reinforce patient education. The handouts are also incorporated into biweekly group patient education sessions, and are freely available to patients and family members in multiple cabinets located throughout the program. Handouts can be downloaded in pdf format free of charge at www.spinalcordconnections.ca, and are currently available in four languages (English, French, Chinese, Farsi). Patients leave the rehabilitation centre with a customized educational resource for future reference and to share with their care givers and families.
The upper extremity neuropathies in Turkish wheelchair users and the additive/alternative value of ultrasonography to the evaluation of entrapments

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Objective:
Previous studies have confirmed the diagnosis of peripheral neuropathies in manual wheelchair users by electrodiagnostic studies alone. The aim of this study was to evaluate upper entrapment neuropathies in wheelchair users, both with the electrophysiological and ultrasonographical technique.

Design:
Cross-sectional.

Setting:
Physical medicine and rehabilitation clinic.

Participants:
Eighty four arms of 42 spinal cord injury patients were evaluated.

Main Outcome Measures:
Bilateral nerve conduction studies and sonographic imaging of the ulnar and median nerves were performed in all participants.

Results:
The electrophysiological prevalence of nerve entrapment among the manual wheelchair users was 27.3% while the ultrasonographic prevalence was 39.2%. The most common electrodiagnostic dysfunction was median neuropathy at the wrist (17.8%), followed by ulnar neuropathy at the elbow (9.5%) The ultrasonographic prevalence of median neuropathy at the wrist was %22.6 and ulnar neuropathy at the elbow was 16.6%. The sonographic findings conform with the electromyographic data more for the diagnosis of median neuropathy at the wrist than the ulnar neuropathy at elbow. Also the ultrasonographic diagnosis was more consistent with the clinical symptoms for ulnar nerve than the median nerve.

Conclusions:
In contrast to the general wheelchair user population, the frequency of neuropathies in our patient group was lower, both with electrophysiologic and ultrasonographic studies. This may be due to the increased attention in primary prevention and patient education for preserving upper-limb functions but probably one of the most important factors contributing to the low prevalence is the very low average outside propulsion time of wheelchair users in our society related to the environmental and architectural barriers limiting integration of wheelchair users into the community. Also this study confirmed, ultrasound is a very powerful complementary tool, particularly when the electrodiagnostic studies are insufficient in defining the diagnosis and localization of entrapment neuropathies, particularly in mild cases of ulnar neuropathy.
Development of a sham condition for a future whole body vibration intervention trial

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Background:
Whole body vibration (WBV) is a novel intervention which has received attention in SCI research for the treatment of sublesional osteoporosis, sarcopenia, obesity, metabolic syndrome and cardiovascular disease. Our objective was to create a sham passive-standing and WBV for use as a control in future phase III and IV intervention trials.

Methods:
Three vibration setups were tested during the development stage and attached to a customized WAVE Pro vibration plate fitted with an EasyStand 5000 standing frame: 1) Utilization of gaming joystick motors 2) Two small DC motors 3) Five small 3V/1A DC motors with offset weights. A circuit was created to allow for independent control of the motors. Based on participant and scientist feedback it was determined that the third method most closely approximated the vestibular and proprioceptive feedback of the real device. Five small 3V/1A DC motors with offset weights were attached in three different configurations to the customized plate. Sound recordings were made from below the vibrating platform using various recorders and speakers. The best audio replication was achieved through the high definition recording of the plate in a sound dampening chamber.

Results:
The optimized sham device is identical in appearance but includes three 3V/1A DC motors with 10g weights on the standing frame and two below the platform with 15g offset weights and high definition sound recordings played from speakers under the platform.

Discussion:
Development of an optimal sham device is necessary to facilitate determination of WBV therapy efficacy in phase III trials. Evaluation of this “sham” WBV device in a double blind design to determine whether SCI subjects and staff therapists can differentiate between real and sham WBV is planned; with efficacy similar to placebo tablets (50-70%) desired.

Studying sensorimotor control in locomotion after human spinal cord injury using robotics and electrophysiology

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Background:
The human lumbosacral spinal cord contains neural circuitry for stepping but following spinal cord injury, activating this circuitry with normal sensorimotor control is difficult, even with locomotor training. It is not clear the degree to which changing different sensory cues associated with stepping impacts spinal cord motor output. It is also not clear how much those sensorimotor input/output relationships can be improved with additional spinal neural circuit activation like with spinal cord stimulation.

Methods:
Patients with spinal cord injuries were studied during stepping in a robotic gait orthosis, the Lokomat. Sensorimotor control of locomotion was assessed using electromyography (EMG) of leg muscle activation patterns and by measuring reflex modulation across the gait cycle. Classic soleus H reflexes were studied as were posterior root motor reflexes (PRMRs) elicited by transcutaneous spinal cord stimulation (tSCS). Tonic tSCS was also applied at different strengths and frequencies to influence the magnitude and quality of EMG patterns during stepping. Mechanical measures of stepping were recorded by the Lokomat.

Results:
We have characterized how H reflexes are modulated across the gait cycle in patients with varying degree of spinal cord injury and how they change over the course of locomotor training in those with motor incomplete injuries. We found that the extent to which H reflexes become more or less hypereflexic is related to the extent of locomotor recovery measured by gait speed. We have also found that soleus PRMRs can demonstrate similar modulation to soleus H reflexes across the gait cycle. We have found that increased loading and treadmill speed during stepping increases EMG activity and normalizes EMG patterns in leg muscles and that tSCS can augment that improved sensorimotor control. Specifically, tSCS at lower frequencies (~10 Hz) tends to augment extensor activity and at higher frequencies (20-30 Hz) tends to augment alternating flexion and extension activity with the greatest impact being on flexion during the swing phase of gait. Lastly, we have found that the frequency of tSCS can differentially affect spasticity during gait, specifically clonus, and that higher frequencies (~50 Hz) can decrease spasticity measured at rest.

Conclusion:
Robotics and electrophysiology can be used to study and augment sensorimotor control in locomotion following human spinal cord injury.
The effects of repetitive transcranial magnetic stimulation on refractory neuropathic pain in patients with spinal cord injury

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Background:
Neuropathic pain is one of the most challenging complications after spinal cord injury (SCI). It is mostly resistant to pharmacologic and interventional therapies. Currently repetitive transcranial magnetic stimulation (rTMS) seems to be an alternative therapy for refractory neuropathic pain in patients with spinal cord injury. The aim of this study is to assess the long term efficacy of rTMS in these patients.

Method:
Inclusion criteria for the study were (i) chronic neuropathic pain for more than 12 months and (ii) pain that is resistant to pharmacologic and interventional treatments. Patients having epileptic attacks, metal implants in the head, cardiac pacemaker and psychiatric illness were excluded. Sixteen patients were randomized to either the treatment group or placebo group. In the rTMS group, patients received 20 trains of 10Hz stimuli for 10 days. A figure of 8 coil was used and rTMS was applied at 110% of the resting motor threshold with a 25sec intertrain interval. In the placebo group, the same protocol was used but the coil was angled away from the head. Pain was assessed with visual analog scale (VAS) at 3rd, 5th and 10th day, 6 weeks after the treatment and 6 months after the treatment. Patients’ satisfactions obtained at 6 months after the treatment.

Results:
Pain score changes obtained in the treatment group were p=0.026; p=0.007; p=0.02; p=0.02 and p=0.34 respectively. In the placebo group, changes in the scores were p=0.26; p=0.26; p=0.04; p=0.78 and p=0.41 respectively.

Conclusion:
Our results revealed that in SCI patients with refractory pain, rTMS seems to have some therapeutic effects.

Association between arterial stiffness, cardiovascular risk factors, and injury related risk factors in people with chronic spinal cord injury

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Background:
People living with spinal cord injury (SCI) are a vulnerable population prone to coronary artery disease (CAD) related morbidity and mortality. Arterial stiffness assessed by pulse wave velocity measured via ultrasound between the common carotid and femoral arteries (cfPWV) is an established independent predictor of CAD morbidity and mortality in the able-bodied population. To date, the associations between cfPWV, CAD risk factors and SCI-related risk factors are unknown.

Objective:
To explore the associations between cfPWV, CAD risk factors and SCI-related risk factors.

Methods:
Twenty-two consenting men with chronic SCI (C2-T12; AIS A-D; time post injury: 14.3±11.7 yrs; Age: 50.6±11.8 yrs; Height: 175.9 ± 9.4cm; and Weight: 85.7 ± 19.1 kg) participated. cfPWV, CAD risk factors, and SCI-related risk factors were assessed. CAD risk factors included: age, smoking history, fasting blood sugar, total cholesterol/HDL ratio, triglyceride level, systolic and diastolic blood pressure, C-reactive protein (CRP) concentration, percent body fat (%body fat) and cardiopulmonary fitness (Vo2peak). SCI-related risk factors included: level of injury, duration of injury, AIS and Spinal Cord Independence Measure (SCIM) total scores and subscores. Correlation coefficients between cfPWV and each risk factor were calculated.

Results:
There was a high correlation between cfPWV and age, SCIM self-care score, Vo2peak, and SCIM total score (r = 0.717, -0.686, -0.631, and -0.599 respectively, p<0.01). Moderate correlations were found between cfPWV and SCIM respiration and sphincter management subscore, SCIM mobility subscore, level of injury, CRP and %body fat (r = -0.560, -0.558, -0.505, 0.498, and 0.470 respectively, p<0.05). There were no significant correlations between cfPWV and other risk factors.

Conclusion:
The correlation results imply that age, SCIM scores and cardiopulmonary fitness are primary predictors of cfPWV. Further multivariate modeling with a larger sample is planned; routine assessment of SCIM and VO2peak is suggested.
Professional reintegration after spinal cord injury

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Background:
In our experience patients with spinal cord injury (SCI) often show great resistance to professional reintegration. Study of literature shows low employment rates after spinal cord injury (SCI). In a systematic review of Lidal IB et al. in 2007 only 21-67% of individuals with SCI, working at the time of injury, returned to work after injury. Nevertheless, maximizing professional reintegration is an important rehabilitation goal. The purpose of this study was to examine which factors are associated with professional reintegration after SCI in Belgium. There also has been investigated whether the return to employment is influenced by the main benefit provider: a division was made between compensation by the social security, private liability insurance or occupational accident insurance.

Methods:
A retrospective study of patient files has been performed, using the database of the Rehabilitation Centre campus Pellenberg (University Hospitals Leuven, Belgium). The files of 553 SCI patients between 18 and 55 years of age, who were employed at the time of injury, have been investigated. Possible variables concerning return to work were examined with statistical analyses.

Results:
Lower intensity of work pre-injury (P < 0.001), higher Barthel Index (P < 0.001), sportaccidents (P = 0.03) and wheelchair independence (P < 0.001) were related with a higher rate of professional reintegration after SCI. A significant relation has been found between as well impairment type as etiology of SCI and return to work (both P = 0.03). There also was a significant relation between time of return to work and re-employment in the previous occupation (P = 0.04). In contrast, lower age, male sex and main benefit provider (social security, private liability or occupational accident insurance) were not significantly related with higher re-employment rates.

Conclusion:
After SCI, only a minority (26%) of the patients that stayed at our rehabilitation centre are professionally reintegrated. Return to the previous job gives higher re-employment rates (86%) and also the time to return to work is shorter. Therefore stimulating the return to the previous job, whenever possible, seems to be recommendable.

Development of specific spinal cord injury community rehabilitation models for Mid- and South Wales (UK)

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The Wales neuroscience review, started in 2007 on request from the minister of health and social care. In 2011 the review included a specific workstream responsible for rehabilitation.

Main aim for this workstream was
- Establish a rehabilitation network integrating spinal and neuro rehabilitation that supports patients at acute sites and in the community, reaching out from the specialist centers, to ensure that patients are rehabilitated closer to home, by the development of pragmatic models for community based rehabilitation to patients with acquired brain injury (ABI) and spinal cord injury (SCI), to facilitate timely discharge to the community, with on-going input and support from the specialist centers.

The work was split into separate ABI and SCI workgroups.

Development of the models started with a scoping of current services and obtaining a wide agreement on the needs of the patients using the community services. Through a series of workshops with a wide group of clinicians, managers and patient representatives. Getting this agreement and insight would ensure the models to be patient (need) focussed.

The developed models are based on 3 common patient pathways which focus on delivering seamless care:
1) Community Integration pathway
This describes the patient pathway from immediately post-acute injury through an inpatient rehabilitation period (if appropriate) into the community.

2) Community Support pathway
This describes the on-going monitoring of Acquired Brain Injury (ABI) and Spinal Cord Injury (SCI) patients

3) Escalation pathway
This describes the process of rapid (re-)provision of a service to the patient whose needs have changed, deteriorated or otherwise been identified as needing further support. It aims to provide this at the lowest appropriate level of service and as close to home as possible.

In addition these pathways recognise 3 main levels of patient need or community service Recommendation: development of a specialised SCI Community and Outreach Service (SCICOS) for Mid and South Wales. This service is to operate from the Welsh regional SCI centre and to cover the catchment area of the service to ensure a seamless transition from inpatient to community service.

The detailed proposed models have been subject to a wide consultation which took place over the summer involving clinicians managers and patient representatives. The models have been submitted to Executive Directors in the Health Boards on November 2011 and have been accepted.
Aging and menopause in women with Spinal Cord Injury: Comparison to men with SCI and able-body women

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Background:
Aging after a SCI results in secondary complications that are gender specific. OBJECTIVE: Determine frequency and degree of osteoporosis, spine changes, pain and function, hormone levels, metabolic parameters, and quality of life in post-menopausal women with SCI (WSCI), without SCI (ABW), and men with SCI (MSCI).

Participants/methods:
Study participants included women with motor complete SCI who had undergone menopause at least 2 years prior. Control participants included post-menopausal, able-body women matched by age and DEXA scans results; and men with SCI matched by time post-injury. All participants received: DEXA scans of spine, femur, and hip, metabolic labs, spine X-rays, mobility and functional questionnaires and Life Satisfaction Tools. WSCI and MSCI were also given the Wheelchair User’s Shoulder Pain Index (WUSPI) test.

STATISTICAL ANALYSIS:
Cross-sectional study: student t test, chi square and ANOVA. RESULTS: 43 participants completed testing and were grouped as: 14 WSCI-MSCI pairs; 14 WSCI-ABW pairs; 10 WSCI+ABW+MSCI triads. Mean ages were 51.25 years for WSCI, 54.2 for ABW, 52.1 for MSCI. Menopause ages were 43.36 for WSCI and 45.38 for ABW. Mean years post injury were 21 years for WSCI and 19 for MSCI. Statistically increased osteoporosis only at the hips and scoliosis were found in the WSCI followed by MSCI compared to ABW. WSCI had significantly higher (p<.05) pain and functional limitations on the WUSPI compared to MSCI and significantly more (p<.05) difficulties with Activities of Daily Living compared to ABW. Significant (p<.05) metabolic differences were: WSCI had higher fasting glucose, Total/LDL Cholesterol, and estradiol levels. WSCI and MSCI had the lowest Vitamin D levels. There were no statistical differences in Total Life Satisfaction Scales between any group.

Conclusion:
The impact of menopause and aging in women after SCI is significant and unique compared to their Able body post-menopausal women and aging post-SCI male counterparts.

A questionnaire development study exploring the views on the use of Functional Electrical Stimulation in Spinal Cord Injury

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Background:
Functional Electrical Stimulation (FES) is a specialist technique that can be applied in several areas of spinal rehabilitation. Recently, it has been highlighted that it is essential to include the users’ perspective at the earliest stage of the design process of FES devices. Recent qualitative and consumer research highlighted important benefits, barriers and issues related to the future use of FES in Spinal Cord Injury (SCI). However, it is now essential to use the qualitative data to develop a series of questionnaires that will help determine the extent to which these beliefs are held by the wider SCI population. The aim of this study was to use a cognitive interviewing approach to develop three questionnaires exploring the views and experiences of people with SCI, Health Care Professionals (HCP) and researchers about the current and future use of FES.

Methods:
Three draft questionnaires with six sections were developed using the themes and sub-themes on the views of current and future use of FES in SCI, established from the previous qualitative study. The questionnaires were reviewed and discussed by the team before being tested by cognitive interviewing (CI). This process is a means of pre-testing a questionnaire to help determine whether the questions asked are generating information that the authors intended. A mixed methodology of CI was utilised involving ‘thinking aloud’ and ‘verbal prompting’.

Results:
12 participants (4 people with SCI, 4 HCP and 4 researchers) from across the UK were interviewed. Interviews were recorded and transcribed and a panel of researchers reviewed the modifications. The next versions of questionnaires containing the revised six sections including the support for use of FES, views on the benefits and barriers and future use of FES in SCI, were then sent back to the participants for their comments and the process of modification was repeated.

Discussion and Conclusions:
CI was carried out in order to ensure that the questionnaires are readable, clear and relevant and not ambiguous. Moreover, the approach ensured that the questionnaires use language that is suitable for all of the groups and related to current clinical practice and research. The next stage of the project will be to administer the questionnaires within the UK and modify them so that they can be administered at an international level among English speaking participants (i.e. within the US, Canada, Australia and Europe).
P235

The frequency and severity of adverse events during whole body vibration (WBV) and passive standing among individuals with chronic spinal cord injury

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Background:
Whole body vibration (WBV) therapy is intended to emulate mechanical strains on bone and muscle during instrumental activities of daily living. We describe the frequency and severity of adverse events among male subjects with paraplegia enrolled in a nine-month WBV study.

Methods:
Male subjects (n=15), age 20-60 years, with chronic paraplegia (T2-T10 AIS A-D) and low lower extremity bone mass were enrolled. Subjects were screened for stones, hydronephrosis, renal anomalies, loose/broken spine hardware, non-union fracture, prior venous thromboembolism, and lower extremity flexion contractures prior to enrolment. Results from tolerability testing and vibration transmission informed the choice of WBV parameters. Passive standing and intermittent WBV at 45Hz, 0.7mm amplitude, 160° knee angle was implemented using the WAVE device for 45 minutes 10 times per month. The frequency and severity of side effects, AEs and SAEs reported to date were systematically assessed and collated.

Results:
Fifteen subjects participated in 810 WBV sessions at time of reporting. Six subjects completed the intervention, five withdrew due to unrelated AEs or prolonged absence, and four are ongoing. Seventy-nine AEs and twelve SAEs were reported with the most common being falls, pressure sores, and urinary tract infections. Most frequent AEs determined to have possible (n=9) or probable (n=11) relationship to the WBV intervention included: dizziness, headache, autonomic dysreflexia, low back pain, and orthostatic hypotension. The most common acute WBV side effects (incidents >4) included shortness of breath, low blood pressure, back pain, spasms exacerbation, increased muscle tone, increased sensation, sensation of pins and needles, and dizziness.

Discussion:
The AEs and SAE's observed in this WBV study were similar to those observed in our prior passive standing intervention trial http://clinicaltrials.gov/ct2/show/NCT00150683. Although, WBV is relatively safe and well tolerated, participants require screening and a meaningful discussion of the potential risks prior to WBV implementation.

P236

Reliability of the Portuguese Version of the International Bowel Function Basic Spinal Cord Injury (SCI) Dataset

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Background:
Survival after SCI with improved quality of life (QOL) increased significantly recently. Clinical trials on recovery and related QOL outcomes are conducted in various countries. This global research effort resulted in the need for data standardization and measures pertaining to SCI, so that reliable data can be compared across countries. Here we explore the validation of an instrument measuring bowel function and related complications after SCI. Bowel dysfunction can lead to serious medical complications and decreased QOL after SCI.

Methods:
The current English version of the International Bowel Function Basic SCI dataset was independently translated into Portuguese by a group of bilingual Brazilian investigators. The approved English version was first translated by two investigators and then back translated to English by another team of two independent other investigators. These versions were then compared for consistency and accuracy. A final version was assembled including all final revisions. To assess its intra and inter rater reliability, two physicians independently administered the same translated form to 57 SCI inpatients. The form was administered twice to the same patient within one week to determine consistency across time. Data was analyzed using a Chi-square model and Kappa coefficient statistics.

Results:
Subjects were on average 44 years old classified 51% as tetraplegia and 49% as paraplegia. Intra-reliability was excellent for both raters across time with an average agreement rate of 97.8%. One rater had 100% agreement for 7 of 12 items while the other reached this same agreement for 5 items. The two items with least intra-reliability were items 5 and 6 that measure time required for defecation and frequency. Inter-rater reliability exceeded 90% for 8 of 12 items. The lowest intra-rater agreement was for the item related to supplementary defecation methods (68.4%).

Conclusions:
Overall both intra and inter-rater reliability ranged from excellent to very good. Consistency of ratings tended to be lower for items with numerous possible combinations of responses, highlighting the possibility for improvement if clinicians are given thorough and consistent training for the best use of these forms. Along this lines, training would probably eliminate the use of multiple responses for questions for which only one response should be given, such as those about frequency of defecation and incontinence, or awareness of need to defecate.
**Immediate skin response and late T-cell functions in spinal cord injury patients with autonomic dysfunction: a preliminary report**

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**Background:**
Autonomic dysfunction causes various changes on the immune system in patients with spinal cord injury (SCI). Some studies reported that, the level of the injury is critical for the dysfunction of the cellular immune system and impaired natural killer cell activities were seen in those patients with autonomic dysfunction. The aim of this study is to determine the changes at immediate skin response and late T-cell functions in SCI patients with autonomic dysfunction.

**Method:**
Patients allocated into two groups according to their level of injury; group 1 (patients with a level of injury with T6 or above) and group 2 (patients with a level of injury below T7). We performed skin prick tests with histamin, tetanus toxoid, candida allergens in both group of patients. Patients were also performed PPD and autolog serum skin tests. The prick and autolog serum skin tests were recorded 15 minutes later, whereas PPD results were recorded 48 hours later.

**Results:**
There were 49 (28 in group 1 and 21 in group 2) patients in the study groups. Demographic characteristics in both groups were similar. There were no statistically significant differences between two groups in terms of study parameters.

**Conclusion:**
Preliminary results of our study revealed no difference at immediate skin response and late T-cell functions in spinal cord injury patients with autonomic dysfunction.

**A qualitative study exploring views about the use of Functional Electrical Stimulation (FES) in Spinal Cord Injury (SCI)**

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**Introduction:**
For nearly half a century FES has been used in the treatment and management of physical problems encountered by people with SCI, such as bladder and bowel control, pain relief, and improvement of movement. Despite intensive research and development, only a small percentage of people who potentially benefit use FES illustrating with the translation from research to clinical practice. Although there has been growing recognition and some research exploring the user’s perspective, little research has been carried out within the UK which can be used to guide the future use of FES in SCI. The aim of this study was to explore views of people with SCI, healthcare professions and researchers about the current and future use of FES.

**Methods:**
The design of the study was qualitative employing a focus group approach. A total of eight focus groups lasting between 90 to 120 minutes were carried out with people recruited from a FES researcher’s network and spinal centres throughout the UK. Participants were selected using a purposive sampling technique to ensure that the sample was diverse in terms of age, level and severity of injury and whether they had previous experience of using FES.

**Results:**
Thematic analysis identified five categories of themes relating to the different 1) decision to use FES, 2) physical improvements, 3) doing something active, 4) lack of resources, and 5) future use of FES. Key issues effecting the uptake and use of FES seemed to relate to resource issues, carrying out screening and checking the suitability of patients, and the lack of agreed protocols and procedures regarding the application of FES.

**Discussion and Conclusions:**
These findings can be seen as a starting point to try and understand issues regarding the current and future use of FES in the UK. We have started to provide an outline of key issues related to the translation and application of FES research into clinical practice and illustrated some of the critical issues that require further investigation. These findings can be used to develop a series of questionnaires to explore the extent to which these beliefs are held by the wider SCI community.
P239

Intravesical gentamicin instillations for the treatment of refractory urinary tract infections

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Introduction:
Recurrent urinary tract infection is a common problem in the management of patients with reconstructed bladders who require ISC for emptying the bladder. In our institution we have used intravesical instillation of gentamicin for treatment in the patients who failed conservative management with oral antibiotics and required repeated hospital admissions for intravenous antibiotics. The purpose of our study was to check the safety and efficacy of intravesical gentamicin.

Materials and Methods:
A prospective audit was started in 2007 and intravesical gentamicin instillations were done as per the protocol and serum gentamicin and creatinine levels were monitored in the follow up.

Results:
A total of 8 patients 5 female and 3 male have been recruited in the audit so far. Median age of patient is 49 years (17-66 years) and median duration of the treatment was 874 days (92-1095) days. None of the patient had any detectable levels of serum gentamicin. One patient did not respond to the treatment, two patients had decrease in the number of infections to 4-6 in a year from 4 infections a month, two patients had 2 infections in last year and three patients did not have any infection since starting the treatment. No adverse reactions were recorded.

Conclusion: Intravesical instillation of gentamicin appears to be a safe and effective treatment for prevention of recurrent urinary tract infections in patients with reconstructed bladder requiring ISC who failed treatment with oral antibiotics.

P240

Validity of the anorectal examination as the sole indicator of spinal cord injury severity: preliminary results

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Purpose:
To validate the use of functional magnetic resonance imagining (fMRI) for purpose of evaluating and classifying the neurological consequence of spinal cord injury (SCI) in children.

Methods:
Four male and two female patients, average age 13.5 years underwent one complete ISNCSCI examination (motor, sensory, and anorectal exam) by one of two trained therapist. Subjects then underwent the anorectal portion of this exam while fMRI data was collected using a 3.0 Tesla Siemens Verio Scanner. Cortical areas of activation was analyzed to study possible differences of cortical involvement between complete (AIS A) and incomplete (AIS B, C, D) SCI subjects. Anxiety/anticipation of the stimulus was also assessed.

Results:
Preliminary results found no significant differences in cortical activation between subjects classified as complete and incomplete SCI. There was bilateral cortical activation (p=0.001) of Brodmann areas 6 (premotor) and 19 (visual association) during the anticipation of deep anal pressure (DAP) being applied to the rectal wall. These areas, in addition to Brodmann area 40 (part of Wernicke’s area) were activated during DAP. In contrast, areas 8 (frontal eye field), 32 (rational thought), and 47 (syntactical processing) were found to be activated during external anal sphincter contraction.

Conclusion:
fMRI is a useful tool in determining the validity of the anorectal examination to determine spinal cord injury severity.
Bases for a combined cellular therapy to improve chronic spinal cord injury outcome

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1CIITT, Argentina; 2Physiology, Argentina

Introduction:
Different authors agree that, in acute condition, Th1 cells which infiltrate the damaged tissue, favors spinal cord recovery after injury. Two and a half weeks after injury Th1 cells are replaced by Th2 cells. In turn Th2 cells inhibit SCI recovery. During the first and second week post injury there is a blood concentration peak of MSC. Looking for if these facts may that Th1 cells influence the MSC differentiation into Neuroblasts (NSC) we have tested this hypothesis in vitro.

Methods:
Human Th1 cells against CNS proteins and fat MSC were co-cultivated in a serum free medium without addition of any neurotropin. Cultures were in vivo studied at 0, 24, 48 and 96 hours. Cells populations were ex-vivo characterized through immune-staining (Neurofilament 66, beta tubulin 3, GFAP and Myelin Basic Protein), FACS analysis (Nestin, beta tubulin 3, MAP 2B and GFAP) and electric conductivity measured by whole cell patch clamp technique.

Results:
early signs of MSC differentiation into NSC for the three different precursor lines (neurons, astrocytes and oligodendrocytes) were observed at 24 hours. These changes increase during the following observation points.

Conclusion:
This experiment supports the basis for the combined use of MSC, specific anti-myelin Th1 cells and autologous adult NSC to treat SCI patients.

Cellular Therapy for Chronic Spinal Cord Injured Patients

Moviglia, Gustavo A; Moviglia Brandolino, MT; Albanesse, GA; Piccone, S; Blasetti, N; Etchegaray, G; Gaeta, CA
CIITT, Argentina

Chronic Lesions of Spinal Cord injury are characterized by 1- Poor Blood Supply of the damaged area and the spinal cord distal segment; 2- Presence of chronic ant-reparatory immune reaction, 3- lack of Neural stem cells (NSC) or subsidiary ones in the area. 4.-. Spatial and brain and spinal chord engrama organization Disrupted Therefore, to treat cSCI patients we combined the following treatments: 1- To procure restore capillary network of affected area, autologous MSC from bone marrow or fat were implanted through an intra vertebral artery Infusion, 2- 21 days later, to procure restore the pro-reparative inflammatory reaction autologous auto-aggressive effector cells against CNS (EC) were administrated by Intra Venous infusion. 3- 24 to 72 hours later autologous in vitro differentiated NSC were implanted through an intra vertebral artery Infusion. 4- To procure restore the lost neural engrams and recover the atrophied muscles a customized and intensive Neure-habilitacion program was instituted.


All treated patients were in the chronic phase of their pathology. 6/8 Frankel A, 5/5 Frankel B and C, and 1/1 tetraparetic 20 years evolution Transverse Myelitis patient were treated and post treatment evaluated.

4/6 Frankel A patients changed to Frankel D 2/6 to Frankel B, 5/5 Frankel B-C changed to Frankel D, Transverse Myelitis patient of 20 years evolution who was wheelchair dependent at the beginning of her treatment was able to climb more than 20 escalators steps with only one support after one year of treatment. Time to Recover Motor Function 4 Levels Down from the Original Lesion Level was of 12 to 18 months for Frankel A patients, 5 to 6 months for Frankel B-C patients and of 3 months for the Transverse Myelitis patient.
P243

The effect of everyday outdoor tasks on wheelchair propulsion patterns: results linking EMG analysis and a new lightweight force sensing wheel

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1United Kingdom; 2Department of Mechanical Engineering, Japan

Background:
Shoulder injury is a common problem experienced by wheelchair users. Modifying their wheelchair propulsion style is an important part of the rehabilitation process; with smoother strokes being the goal. However, a drawback to this rehabilitation programme is that it often takes place on smooth, flat ground within a hospital setting. The need for developing an advanced programme, which incorporates common everyday terrains encountered by patients is essential if the number of injuries is to be reduced.

Methods:
This paper presents results from a study conducted at the Pedestrian Accessibility Movement Environment Laboratory (PAMELA) at University College London with the newly developed PowerWheel. PAMELA is an ideal setting for testing outdoor terrains as exact streetscapes can be reconstructed. This study investigated the effect of footway construction parameters such as kerb height, crossfall (lateral slope for water drainage from the surface of footways) and surface type on muscle recruitment patterns and upper limb accelerations (using the TRIGNO Delsys system) and wheelchair kinetics. The PowerWheel weighs approximately the same as a standard spoke wheelchair wheel and therefore does not alter the propelling style of people as they push. <IMAGE02> <IMAGE03>

Results:
The study has shown that different muscles are recruited during asymmetrical tasks such as pushing along a crossfall. The results from different terrains have been compared with the same patients who followed a standard ergometer protocol where they were asked to push to fatigue. The comparison shows that different terrains produce what can be termed ‘fatigued muscle recruitment’ of the. There is therefore a need to develop rehabilitation techniques to help overcome everyday obstacles which may increase the possibility of upper limb injury for wheelchair users.

P244

Feasibility, safety, and clinical parameters within a 6 week pilot study of the Ekso wearable exoskeleton after SCI

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The sudden inability to walk is one of the most glaring impairments following SCI. Regardless of the time since injury, recovery of walking has been found to be a top priority for those with SCI as well as their rehabilitation professionals. It has been found that only 67% of patients, in the acute phase after SCI, with the presence of anal sensation, were able to walk independently at 6 or 12 months post injury. Thus, there is a tremendous consumer demand to improve ambulation outcomes following SCI. Multiple rehabilitation strategies to improve ambulation have been implemented throughout the past few decades including traditional over ground (TOG) therapy and body weight supported training (BWST). A promising new rehabilitative tool for achieving ambulation after SCI is the wearable robotic exoskeleton. While there has been little published on the clinical implementation of these devices, they do offer a few potential advantages. They are relatively lightweight, small, and may function essentially as an orthosis. These devices can allow for over ground ambulation, potentially with sole control by the user. To date, there have been no published trials describing the clinical use of wearable exoskeletons in a SCI population. Therefore the purpose of this study was to evaluate and describe the feasibility and safety of clinical use of the Ekso exoskeleton, in a group of individuals with SCI who completed their initial inpatient rehabilitation. Secondly, we will provide descriptive pilot case series data on clinical parameters over the course of the 6 week trial.
P245

**Using iPad technology for continued education and mentoring after SCI to social improve integration and quality of life**  
Kolakowsky-Hayner, S; Wright, J; Bellon, K  
Rehabilitation Research Center, USA

After initial hospitalization, there is often a lengthy period of readjustment in which individuals with SCI must learn a new way of life. Individuals with the most support have the best outcomes. The problem is, with decreasing lengths of stay in the hospital, how can we best support individuals with SCI in their adjustment and return to productive living in the community? The solution, we propose, lies in a technology-based mentoring program.

Research has shown that while the top-ranked preferred source of information was from a physician, SCI expert or rehabilitation specialist; the most frequently preferred method of obtaining such information was the internet. Additionally, previous research has revealed access to cell phone and computer/internet use is associated with higher social integration and quality of life.

This presentation will share information on providing education and mentoring through an internet/iPad-based setting during the transition from an acute rehabilitation facility back to productive living within the community. Suggestions will be made regarding specialized equipment for users who have impaired hand function. Additionally, no cost or low cost iPad applications relevant to improved activities of daily living, social integration and potential therapeutic interventions will be presented.

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P246

**Advances in the care of the spine in chronic spinal cord injury**  
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USA

The purpose of this presentation is to discuss some new concepts for both nonsurgical and surgical care of the spine in individuals with chronic spinal cord injury (SCI).

Spine deformity develops after SCI in over 90% of children and adolescents, and the risk of progressing to surgery when the injury occurs before skeletal maturity is approximately 67%. Prophylactic bracing beginning at the time of injury may prevent surgery in approximately 50% of patients. If it does not, it can delay it an average of six years, allowing the child to grow to a more adult height. Bracing plays a lesser role in curves 21 to 40° and probably no role in curves > 40°.

Indications for surgery include curves > 40° in the growing child, preferably > 10 years of age, and functional problems or pain in those who have already reached skeletal maturity. Outcomes after spinal fusion generally report 92% satisfaction with minimal decrease in function. However, activities probably require more effort and, therefore, most patients prefer their pre-fusion flexibility.

It is important to maintain the sagittal sitting position of the spine with special rod bending during surgery, especially for patients who are dependent on compensatory strategies for hand to mouth.

An investigational treatment of correction of spine deformity without fusion (wedge osteotomies) has been shown to be safe and moderately effective. Approximately 5% of adults with chronic SCI acquire scoliosis. Unique to patients with paralysis is the Charcot spine, which requires an aggressive early surgical approach. Delay or failure to treat can result in patients losing spasticity or function.

In summary, children and adults with chronic SCI can benefit from new operative and nonoperative strategies for treatment of their spinal deformity.

Onders, Raymond
Surgery, USA

Objective:
Tetraplegics with chronic respiratory insufficiency needing tracheostomies and mechanical ventilation have a much higher cost of care, increased pneumonia rates and higher mortality rates than non ventilated patients. Direct phrenic nerve pacing to replace ventilators for tetraplegics was initially developed in the 1960’s and intramuscular diaphragm pacing (DP) was first implanted in 2000 with full FDA approval in 2008.

Methods:
Review all ventilator dependent spinal cord injured (SCI) patients who were implanted with DP per country.

Results:
In the United States from 2010 to 2011 there was a 15% increase in DP for SCI (43 to 50 implants). Even with this increase and accounting for the phrenic nerve pacing patients implanted only a maximal 20% of all eligible SCI patients were implanted. For the rest of the world only 68 patients have been implanted over the last 4 years and include the following countries: France, Iceland, Germany, Spain, Switzerland, Israel, Netherlands, Australia, Belgium, Norway, Italy, Brazil, Jordan, Turkey, and Saudi Arabia. There was a significant difference in utilization rate between countries from 100% of eligible patients in Iceland to a small percentage in most countries.

Conclusion:
Published research of over 10 articles in the last 2 years continues to show the clinical benefit of removing patients from mechanical ventilation yet there is still an overwhelmingly low adoption of phrenic or diaphragm pacing. The low utilization of available technology may lead to less corporate research to help SCI patients in other areas. Fortunately this same technology is utilized for amyotrophic lateral sclerosis(ALS) or motor neuron disease (MND) with 90% of DP implants being done for ALS/MND which will help to maintain the DP technology for SCI patients.

The impact of interface pressure mapping on pressure ulcer prevention education

Swaine, Jillian; Romeo, M.; Nguyen, V; Swaine, M.C.
Australia

Background:
Traditional sitting-acquired pressure ulcer (SAPU) care education utilises a fear-based approach with photos of wounds as the motivator to adhere to a variety of prevention strategies. Pressure ulcer prevention strategies used by clinicians include: teaching clients to perform regular pressure relief techniques, daily inspection of the buttocks and appropriate wheelchair cushion selection (Garber et al. 1996). Interface pressure mapping (IPM) has not been reported as a component of pressure ulcer pressure prevention education.

Aim:
The aim of this study was to determine the impact of IPM on a participant’s feelings that included competency, self-esteem and adaptability.

Methods:
Twelve individuals with spinal cord injury (7 with paraplegia and 5 with tetraplegia; 8 complete and 4 incomplete SCI) consented to participate in an individualized sitting-acquired pressure ulcer education session which included IPM using a seat mat. These were conducted by two occupational therapists. Mixed methods were used. A pre and post test questionnaire was completed for their experience, knowledge and comfort with IPM. The Psychosocial Impact of Assistive Devices (PIADS) was used to assess the immediate impact of being pressure mapped. An open-ended questionnaire was used for the positive and negative aspects of IPM. An independent observer recorded their comments during the education session.

Results:
There was a significant increase in feelings of competency (Z=2.670, p=0.008, Wilcoxon signed rank test) and self-esteem (Z= 2.103, p=0.035) as a result of pressure mapping using a seat map system using the PIADS. Feelings of adaptability remained unchanged. Information about the technology and visual application IPM, pressure ulcer prevention strategies, and pressure ulcer prevention research were the major qualitative themes.

Conclusion:
Individualized IPM is a visual client-centred tool to increase feelings of competence and self-esteem for pressure ulcer prevention education administered by clinicians.
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Collection of user requirements in a population of spinal cord injury patients and medical staff for the assistive lower limb exoskeleton
Pisotta, Iolanda1; Scivoletto, G2; Federica, T3; Sylos Labini, F4; Motard, E5; Gancet, J6; Ilzkovitz, M7; Molinari, M8; Ivanenko, Y9
1Italy; 2Spinal Cord Injury Unit, Italy

Background
MINDWALKER project is funded by EC under an FP7 ICT research programme, that aims at improving inclusion in social life of individuals with reduced mobility. System requirements are part of the successful project development and are used to address technical aspects of a system to be designed, based on a need or expectation from a person that will be the end-user. The purpose of the study was elaboration and assessment of two questionnaires for collecting end-users requirements to develop a mind controlled orthosis system to empower walking: one for the Spinal Cord Injury Patients (SCI) and one for the physiotherapists (PhT).

Methods
4 SCI patients and 1 MD were interviewed to identify categories of system requirements. The obtained questionnaire was disseminated to the SCI community by two means: internet forums and direct interviews. 42 SCI patients and 15 PhT answered.

Results
All SCI patients want to be as autonomous as possible in wearing the system, PhT highlight the importance of using it in a daily life environment. Patients accept to wear a lower limb exoskeleton in external environments, but were less favourable to the use of the electroencephalographic cap, acceptable only in a rehabilitation gym. Regarding safety, the aspect all patients emphasise is a stability control and recovery from falling. PhT would prefer for a robot to be used as an aid with therapeutic aims as well (monitoring of physiological parameters). Patients consider worthwhile being trained to use the exoskeleton in the virtual reality training environment. Medical staff finds interesting the use of the virtual reality for training because it is adaptable to the patient needs, and it could be advantageous for finding new approaches in neurorehabilitation.

Conclusions
Results showed a good agreement between patients and medical staff in defining the characteristics of an ambulatory device, and both groups deem appropriate the introduction of this new tool in daily living.

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Flavectomy of Cervical Vertebrae in Treating Cervical Spinal Canal Stenosis
Song, Xiujun
Othorpeadics and Microsurgery, China
To investigate the operational method of cervical vertebral flavectomy and its clinical application in the management of cervical canal stenosis. The participants in this study were 25 patient. Spinous process and vertebral lamella were exposed, interspinal ligaments were cleared. Then, the flaval ligaments were disconnected from their insertion of the superior border of vertebral lamella. Lifting up the the flaval ligaments, the starting point of the flaval ligaments was cut down from the ventral and anterior side of the upper vertebral lamella. After the residual flaval ligaments also being scraped off, the dura mater inflated from the intervertebral lamella space and the compression was relieved. Results Symptoms in 20 cases were relieved and in 5 cases were partly relieved at a follow-up of 2 to 10 years. Conclusions 1. There is enough vacant space between cervical spinal process and lamella to enable resection of the yellow ligament. 2. Cervical spinal cord and nerves tolerate to a certain degree toward spinal canal “stenosis”. Symptoms occur only when stenosis is particularly severe. Compressive symptoms can be relieved effectively after flavectomy of the hypertrophic and apparent compressive flaval ligaments. Accordingly, those overdone enlarged open door operations are no longer needed. 3. This new operation resected the pathogenic yellow ligaments and reserved the relative integrality and stability of the bony spinal canal of cervical spine along with the cervical posterior muscles, ligaments, etc. The flavectomy corresponds with the highest aim of remove the pathological tissue, retain or reconstitute the normal anatomic structure and physiological function, thus, it avoids the shortage of axial symptoms often seen after open door operations.
Electromyographic analysis of replacement movement patterns used by persons with tetraplegia
Furmaniuk, Lech
Department of Kinesiotherapy, Poland

Objective:
The aim of this study was to analyse two patterns used by persons with tetraplegia: manual wheelchair propulsion and transfer out of the wheelchair. Study design: Case series.

Methods:
6 persons with tetraplegia (aged 21-29 years), assigned according to the neurological level of impairment to C5 C (2 subjects), C6 C (2 subjects), C7 C (2 subjects), were examined. The levels of neurological damage and impairment scale were determined according to the ASIA standard. Activity of the shoulder muscles was documented with surface electromyography. Electrodes were attached to the following muscles: deltoid, pectoralis major, serratus anterior, trapezius, latissimus dorsi biceps brachii, triceps brachii and extensor carpi radialis. The electrodes were placed according to SENIAM recommendations.

Results:
Among persons with C7 tetraplegia patterns of transfer out of the wheelchair were determined by triceps activity. The replacement patterns of elbow extension were noticed among persons with C6 tetraplegia. Those patterns were replaced by activity of extensor carpi radialis and posterior deltoids muscles. The replacement patterns in persons with C5 tetraplegia comprised of shifting of the trunk and muscle contraction of biceps brachii.

Conclusions:
The level of spinal cord injury affected the movement strategies for wheelchair propulsion and transfer out of the wheelchair. Differences in replacement patterns require specific considerations in the design of rehabilitation programs.
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1Clinical Psychology, United Kingdom; 2Midlands Centre for Spinal Injuries, United Kingdom

87. Intensive physical therapy and exercise for persons with spinal cord injury - a pilot study  
Höfers, Wiebke1; CarlSEN, SPJ2; Lannem, AM3  
1University of Macquarie, 2Pymble, 3Sydney, Australia

88. Autonomic dysreflexia during bowel evacuation and bladder filling in high spinal cord injury  
Faaborg, Pia Moeller1; Christensen, P1; Krassioukov, A1; Laurberg, S1; Krogh, K1  
1Surgical Research Unit, Dep. Surgery P, Denmark; 2Surgical Research Unit, Dep. Surgery P, Denmark; 3Dep. Medicine, Div. Phys. Med. & Rehab., Canada; 4Neurogastroenterology Unit, Dep.Hepatology and Gastroenterology, Denmark

89. Mobility potential realization after spinal cord lesions
90. Recent Experience in The Evaluation of Exoskeletal Robotic Prosthetics in Persons With Spinal Cord Injury and other Neurological Disorders
Leslie, Donald
Medical Director, USA

91. Acceptance of disability and its association to quality of life among Taiwanese suffered from spinal cord injuries
Wu, M.Y.; Lee, H.Y.
Graduate Institute of Rehabilitation Counseling, Taiwan

92. The Boberg Quality Score (BobScore)
Thietje, Roland; Hirschfeld, S
SCI Centre Hamburg, Germany

93. Does 6 weeks of maximal strength training improve spinal cord injured individuals performance measured by wheelchair ergometry?
Terhaag, Tom1; Brurok, Berit2; Hoff, Jan1; Helgerud, Jan1; Leivseth, Gunnar1
1Dept of Physical Medicine and Rehabilitation, SCI Unit / Dept of Neuroscience, Norway; 2Dept of Physical Medicine and Rehabilitation, SCI Unit / Dept of Circulation and Imaging, Norway; 3Dept of Physical Medicine and Rehabilitation, SCI Unit / Dept of Circulation and Imaging, Norway; 4Department of Circulation and Imaging, / Hokksund Medical Rehabilitation Centre, Norway; 5Dept of Physical Medicine and Rehabilitation, SCI Unit / Dept of Neuroscience, Norway

94. Long term complications after rehabilitation in SCI patients
Hirschfeld, S; Thietje, R
SCI Centre Hamburg, Germany

95. Early decompression in a setting of acute cervical spinal cord injury
Rerikh, Victor; Demyanchuk, AI; Sadovoy, MA

96. Road collisions as a cause of traumatic spinal cord injury in Ireland, 2001-2010
Kawano, Osamu; Ueta, T; Maeda, T; Mori, E; Yuge, I; Takao, T; Sakai, H; Masuda, M; Hayashi, T; Morishita, Y; Shiba, K
Department of Orthopedic Surgery, Japan

97. Surgical Approach to the Treatment of Malignant and Metastatic Spinal Tumors
Mitjukov, AE; Stupak, WV; Rerikh, VV; Korochkin, SB

98. Static and dynamic factors for cervical spinal cord injury in patients with ossification of the posterior longitudinal ligament
Kawano, Osamu; Ueta, T; Maeda, T; Mori, E; Yuge, I; Takao, T; Sakai, H; Masuda, M; Hayashi, T; Morishita, Y; Shiba, K
Department of Orthopedic Surgery, Japan

99. Arm ergometry exercise stress testing after acute SCI at University clinical institute for rehabilitation of Republica Slovenija
ZEN JURANCIC, MARIJANA1; Erjavec, T; Savrin, R
1CLINIC WARD, Slovenia; 2Department of Rehabilitation of persons with spinal cord lesion, Slovenia

100. Anterior Spinal Reconstruction Surgery with Iliac Autograft for Osteoporotic Vertebral Collapse for Patients with Adjacent Old Vertebral Fractures
Kaneko, Shinijiro; Shioda, Masanobu; Machida, Masafumi; Takemitsu, Masakazu; Fukuda, Kentaro; Yagi, Mitsuru; Fujiyoshi, KANEHIRO; IIZUKA, SHINO; NAGOSHI, NARITOMI; HASEGAWA, ATSUSHI; USUI, HIROSHI
Orthopaedic Surgery, Japan

101. Neuropathic pain the first year after traumatic SCI
Sörensen, Christian1; Werhagen, Lars2; Trok, Katizarina3; Norbrink, Cecilia2; Troels Staehelin, Jørn4; Pihet, Fredrik2; Blix Finnerup, Nanna5
1Department of Neurosurgery, Denmark; 2Clinical sciences, rehabilitation medicine, Sweden; 3clinical neurosciences, Sweden; 4Danish Pain Research Center., Denmark

102. Results of social work counselling from a spinal cord injury rehabilitation unit in Istanbul
Erhan, B; Gunduz, B; Turna, I; Karaman, S; Cay, C; Aksu, S

103. Health Problems of persons with spinal cord injury living in the community and reasons for rehospitalisation
Sarhan, Firas: SARHAN, Firas
United Kingdom

104. Exercise capacity and life satisfaction 5 years after discharge of inpatient rehabilitation in spinal cord injury in the Netherlands
van koppenhagen, Casper; de Groot, S; Post, MWM; van Asbeck, FWA; Lindeman, E; van der Woude, LHV

105. Effective Management of Pressure Sores in the Community
Porter, Kimberley; Push, P; Osman, AE; Chowdhury, JR; El Masiyri, WS
Midlands Centre for Spinal Injuries, United Kingdom

106. Integration of the spinal cord injury centre in the training of medical students: evaluation of the grade of satisfaction of 1112 students
Koike, Yoko B; Kurz, S; Reichel, H

107. Activity-based therapy for recovery of walking in individuals with chronic spinal cord injury: Results from a randomized clinical trial
Jones, ML1; Tefertiller, CR2; Evans, NH3
1Virginia C. Crawford Research Institute, USA; 2Physical Therapy, USA; 3Beyond Therapy Program, USA

108. Delivering teaching skills to the multidisciplinary team
Green, Debbie
United Kingdom

109. Combination therapy for rats with spinal cord injury: Collagen filaments as a scaffold and NT-3
Suzuki, Hidenori; Taguchi, Toshihiko; Kato, Yoshihiko; Kanchiku, Tsukasa; Imajo, Yasuaki; Yoshii, Satoru
Orthopedic Surgery, Japan

110. Exploring the use of an iPad by persons with tetraplegia C5 or C6 in a Dutch rehabilitation center: functional gain in independence
van Langeveld, Sacha1; de Valk, Q2; van Asbeck, FWA1; Post, MWM1; van Berlekom, SB2
1Center of Excellence for Rehabilitation Medicine, Netherlands; 2Rehabilitation technology, Netherlands; 3Spinal cord injury department, Netherlands

111. SpinalHub.com.au - Connecting and collaborating: The future of spinal cord injury
112. Spinal cord hemangioblastoma; clinical aspect and surgical outcome.
Tsujii, Osahiko; Iwanami, A; Fujiyoshi, K; Ishii, K; Watanabe, K; Hosogane, N; Tsujii, T; Toyama, Y; Matsumoto, M; Nakamura, M
Department of Orthopaedic Surgery, Japan; Department of Advanced Therapy for Spine and Spinal Cord Disorders, Japan

113. Factors affecting surgical outcome of lumbosacral spinal lipoma
Fujiyoshi, Kanehiro; Tsujii, O; Iwanami, A; Ishii, K; Watanabe, K; Hosogane, N; Tsujii, T; Ishii, K; Toyama, Y; Matsumoto, M; Nakamura, M
Orthopedic Surgery, Japan; Orthopedic Surgery, Japan

114. Treadmill training-induced fatigue loading of osteopaenic bone increases susceptibility for insufficiency fracture
Donoho, S; Bourke, K; Clark, J; Drury, O; Marshall, R
Physiotherapy Dept, Australia; South Australian Spinal Cord Injury Research Centre, Australia; South Australian Spinal Cord Injury Service, Australia

115. Revisiting neurogenic shock, blood pressure control in acute period of spinal cord injury
Huang, D; Oxciano, P; Yan, D; Harkema, S; Krassiovuk, A
Department of Emergency Medicine, Canada; Department of Medicine, Canada; Department of Neurological Surgery, USA; Department of Medicine, Division of Physical Medicine and Rehabilitation, Canada

116. Does functional electrical stimulation influence the development of bladder dysfunction and autonomic dysreflexia in spinal cord injured patients?
Bersch, Ines; Froitzl, Angelia; Baumberger, Michael; Pannek, Jürgen
Physiotherapy, Switzerland; Clinical Trial Unit, Switzerland; Clinic, Switzerland; Neurourology, Switzerland

117. Leisure repertoire among persons after a spinal cord injury: interests, performance and well-being
Lundstrom, Ulrica; Lilja, M; Petersson, P; Lexell, J; Isaksen, G
Health and rehabilitation, Sweden; Karolinska Institutet, Sweden; Department of Rehabilitation Medicine, Sweden

118. Using of hydrophilic-coated catheters for intermittent catheterization in the conditions of spinal cord unit
Šámal, Vladimír; Kyrianova, A; Mečel, J; Šrám, J
Dept. of Urology, Czech Republic; Spinal cord unit, Czech Republic

119. Three dimensional motion analysis during walking with eyes open and closed in cervical compression myelopathy: Pre- and postoperative comparison
Nagoshi, Naruhito; Machida, Masafumi; Kaneko, Shinjiro
Orthopedic Surgery, United Kingdom; Orthopedic Surgery, Japan

120. Workshop as a tool in rehabilitation to improve mastery and quality of life for persons with incomplete spinal cord injury and cauda equine syndrome
Bartschick, K; Anmarkrud, GS; Wedge, P
Norway

121. Increases of capillary blood pressure in men with cervical cord injuries
Kouda, Ken; Nakamura, T; Umemoto, Y; Kanno, N; Ito, T; Tajima, F
Rehabilitation Medicine, Japan

122. Extended community interventions to maximise benefits of rehabilitation of Spinal Cord Injuries with severe irreversible paralysis
Path, santosh; Groce, Nora Ellen; Hans, Asha
Orthopedics, India; Leonard Cheshire, Disability & Inclusive Development Centre, United Kingdom; India

123. Mortality after traumatic spinal cord injury in Western Norway and Estonia
Sabre, Liis; Hagen, EM; Rekund, T; Asser, T; Könn, J
Department of Neurology and Neurosurgery, Estonia; Norway

124. Robot-assisted treadmill training in spinal cord injury: a pilot study on bowel, bladder and sexual function
Bouma, NE; Stolwijk-Swustje, JM; van Nunen, MPM; Gerrits, HL; Janssen, TW
Netherlands; Faculty of Human Movement Sciences, Netherlands; DNO, Netherlands

125. Ischemia-like conditions damage spinal cord networks via complex cell death mechanisms
Bianchetti, E; Mladinic, M; Nistri, A
Neurobiology Sector, Italy

126. LONG TERM FOLLOW UP OF NEUROPATHIC BOWEL AND BLADDER DYSFUNCTION IN PATIENTS WITH CHRONIC SPINAL CORD INJURY
STAVRIANOU, AGGELIKI; Rapidì, C-A; Manthos, P; Siamos, G; Kaligerou, S; Petsepes, E; Neochoritis, G; Mermikli, M; Petropoulou, K
NEUROPATHIC BLADDER UNIT, 2ND PRM DEPARTMENT, Greece

Hofmann, Dorte Dath; Madsen, E; Noe, BB; Johannesen, IL
Dept. of Neurology, Spinal Cord Unit, Denmark; Rehabilitationcenter, Denmark

128. Review of spinal spasticity patients in whom cessation of ITB therapy was opted: Twenty years of experience
Nirmal, J; Oo, T; Soni, B
NorthWest England Regional Spinal Injuries Centre, United Kingdom

129. ASSOCIATED INJURIES AFTER TRAUMATIC SCI
Werhaegen, Lars; Trok, Katarzyna; Phiel, Fredrik
Clinical sciences, rehabilitation medicine, Sweden; Clinical neurosciences, Sweden; Neurosciences, Sweden

130. A challenge for persons with a SCI: hand cycling the Alpe d’Huez
Valent, L; Postma, K; Broeksteeg, R; Fickert, R; van Bezeij, T
Research & Development, Netherlands; Dept. of Rehabilitation Medicine, Netherlands; Physical Therapy, Netherlands

131. Imaging protocol for transfer of subacutely spinal cord injured patients from an acute centre to spinal unit
Tom, Meagher; Lopez de Heredia, L; Jamous, A; Hughes, RJ
National Spinal Injuries Centre, United Kingdom

132. Electrical stimulation-induced paralyzed muscle activity increases “resting” energy expenditure in individuals with spinal cord injuries
Janssen, Thomas W J; Harmesen, W; Vink, A; Smit, CA; Stolwijk, J; de Groot, S
Netherlands

133. Secondary health conditions, care, and quality of life in Dutch persons with SCI: design of the long-term aftercare study within the ALLRISC-program
Post, MWM; Adriaansen, JJE; de Groot, S; van der Woude, LHV; van Asbeck, FWA
134. Why is there not a single colostomy in China?  
Wang, Dajue; Wen, Jun; Liu, Genlin; Guo, Jidong  
1National Spinal Injuries Centre (retired), United Kingdom; 2China; 3Department of Functional Recovery, China; 4Orthopaedic Department, China

135. Perceptions of family caregivers at discharge of spinal cord unit: a qualitative study of needs and emotional experiences  
Conti, Alessio; Garrino, L  
1Spinal Cord Unit, Italy; 2Public Health and Microbiology, Italy

136. Preliminary data from a service evaluation of a cauda equina specialist clinic(76,603),(932,808)

137. Antibiotic use in an acute spinal cord injuries unit: a retrospective study  
Barnett, AG; Spacie, RC; Porter, BR; Belci, M  
United Kingdom

138. Physical exercise, stress, burnout and fatigue in persons with incomplete spinal cord injury  
Lannem, AM; Sørensen, M  
Department of Coaching and Psychology, Norway

139. Translation and pilot testing of the Swedish CHART-SF  
Augutis, M; Kreuter, M  
1Dept of Research and Development, Vasternorrland County Council, Sweden; 2Dept of Neuroscience and Rehabilitation, Sweden

140. The importance of Work: A qualitative study of spinal cord injured persons in Norway  
Leiksfjord, Annelise; Graf, S; K, Ruoranen; Post, M.W.M; Reinhardt, J.D  
1Norway; 2Switzerland; 3Netherlands

141. Efficacy of “careCall”: Randomized Controlled Trial of a Telehealth Intervention for Persons with Spinal Cord Dysfunction  
Houlihan, BV; Jette, A; Friedman, RH; Paasche-Orlow, M; Ni, P; Wierbicky, J; Williams, K; Ducharme, S; Zazula, J; Cuevas, P; Rosenblum, D; Williams, S  
1New England Regional SCI Center, USA; 2Health & Disability Research Institute, USA; 3Medical Information Systems Unit, USA; 4Section of General Internal Medicine, Department of Medicine, USA; 5Physical Medicine and Rehabilitation, USA

142. A retrospective study of recurrence rate of pressure ulcers following surgical repair in a tertiary care centre  
Lari, Salman; Magimairaj, H; White, J; Thumbikat, P; Hussain, N; Mathew, K  
1The Princess Royal Spinal Injuries and Neurorehabilitation Centre, United Kingdom; 2Princess Royal Spinal Injuries and Rehabilitation Centre, United Kingdom

143. Gainful employment and risk of mortality after spinal cord injury: Effects beyond that of demographic, injury, and socioeconomic factors  
Saunders, L; Krause, J  
USA

144. A review of clinical out comes and complications of intrathecal baclofen pumps in the management of adult spasticity in Sheffield spinal injury centre  
Magimairaj, Henry; Lari, S; White, J; Mathew, KM; Thumbikat, P; Hussain, N  
The Princess Royal Spinal Injuries and Neurorehabilitation Centre, United Kingdom

145. Cortical reorganization of dorsal columns and spinothalamic tract input after spinal cord injury  
Jutzeler, CR; Haefeli, J; Kramer, JK; Freund, P; Curt, A  
Switzerland

146. PNF techniques to improve pelvic stability and gait in incomplete paraplegic patients  
Rawat, Nisha  
Physiotherapy, India

147. Review of knowledge translation and implementation strategies in spinal cord injury  
Noonan, VK; Wolfe, D; Boily, K; Thorogood, N; Park, S; Hsieh, J; Eng, JJ  
Canada

148. Cognitive adjustment and coping after SCI in relation to work status  
van Nes, LW; van Diemen, T; van Lankveld, W  
1Rehabilitation, Netherlands; 2Research, Development & Education, Netherlands

149. Evaluation of Social Participations of Spinal Cord Injured Individuals in a Turkish Sample  
Kesiktas, N; Paker, N; Soy, D; Gun, K; Karamehmetoglu, S  
PMR, Turkey

150. Modifiable risk factors for depression after spinal cord injury: opportunities for treatment  
Fann, Jesse; Bombardier, CH; Tate, D; Richards, JS; Heinemann, AW; Wilson, C; Warren, AM; Temkin, N  
1Psychiatry and Behavioral Sciences, USA; 2Rehabilitation Medicine, USA; 3Physical Medicine and Rehabilitation, USA; 4Rehabilitation Psychology, USA; 5Division of Trauma, USA; 6Neurological Surgery, USA

151. How are we changing people’s homes? A Queensland perspective on home modifications following a spinal cord injury  
DiMichele, R  
Queensland Spinal Cord Injuries Service, Australia

152. The role of alpha dornase in re-inflating chronically collapsed lung in high cervical SCI patients  
Naidoo, A; Prasad, A; Jamous, A  
The Spinal Injuries Unit, United Kingdom

153. Cardiovascular risk factors in patients with traumatic spinal cord injury in Brazil  
Sousa Diniz, Clara; Martins, CGB; Carvalho, VG; Ramalho, SHR; Campos da Paz, A Jr  
Brazili

154. Outcomes of youth with spinal cord injury of short and long duration  
Kelly, EH; Russell, H; Garma, S; Klaas, S; Zebracki, K; Vogel, LC  
USA

155. INDEPENDENT variables that influence cardiovascular risk estimates (Framingham Risk Score) in adults with traumatic spinal cord injury  
Gornide Carvalho, V; Souza Diniz, C; Guapindaia Braga Martins, C; Rodolpho Ramalho, SH; Campos da Paz Jr, A  
Brazil

156. Why have doors you can’t open? Environmental control technology, home automation and smart homes: Are we achieving optimal outcomes in SCI?  
Allan, E; DiMichele, R  
Occupational Therapy, Australia
YILMAZ, Bilge; Guzelkucuk, Umut; Duman, Iltekin; Alaca, Ridvan
Turkish Armed Forces Rehabilitation Center, Turkey

158. Dentist outreach model for supply of an oral appliance in patients with quadriplegia and obstructive sleep apnoea
Le Guen, MC; Cistulli, PA; Gikas, A; Barnes, M; Berlowitz, DJ

159. Recurrent subluxation of the hip in an adult tetraplegia patient causing autonomc dysreflexia treated with phenol neurolysis. A case report
YILMAZ, Bilge; Guzelkucuk, Umut; Duman, Iltekin; Tan, Kenan
Turkish Armed Forces Rehabilitation Center, Turkey

160. Coordination of spinal cord injury care in under-resourced areas
Emery, Leah; Creasey, G
1Spinal Cord Injury Center, USA; 2Neurosurgery, USA

161. Recurrent pressure sores due to scoliosis in a patient with spinal cord injury
YILMAZ, Bilge; Guzelkucuk, Umut; Duman, Iltekin; Alaca, Ridvan
Turkish Armed Forces Rehabilitation Center, Turkey

162. Cortical activity during imagined wrist actions mirrors plastic changes due to motor rehabilitation after spinal cord injury
Di Rienzo, Franck; Mateo, S; Collet, C; Daligault, S; Delpuech, C; Rode, G; Guillot, A
1France; 2MEG department, France

Cho, Mi Hwa; Jeong, Jeong In; Shin, Ji Cheol
1Division of Nursing, Korea, Republic of; 2Department and Research Institute of Rehabilitation Medicine, Korea, Republic of

164. Effect of Combined PTH and Locomotor Training on Bone Density in Chronic Spinal Cord Injury
Gordon, KE; Maskala-Streff, L; Barkema, DD; Schnitzer, TJ
1Orthopaedic Surgery, Japan; 2Department of Advanced Therapy for Spine and Spinal Cord injured patients

165. A stitch in time... Identifying and monitoring psychosocial predictors of outcome following spinal cord injury
Nicholson Perry, K; Craig, A; Guest, R; Middleton, JW
1School of Social Sciences and Psychology, Australia; 2Rehabilitation Studies Unit, Australia

166. Developing a community of practice and research in dual diagnosis (SCI with traumatic brain injury)
Beattie, Michael; McKenna, S; Creasey, G; Inoue, T; Manley, GT; Bresnahan, JC; Ferguson, AR
1Neurosurgery, USA; 2USA

167. Effects of combined unilateral cervical spinal cord injury (SCI) and traumatic brain injury (TBI) in the rat
Bresnahan, JC; Inoue, T; Creasey, G; McKenna, S; Ferguson, AR; Manley, GT; Beattie, MS
1Neurosurgery, USA; 2USA

168. Conservatively Treated Ossification of Posterior Longitudinal Ligament Increases Risk of Spinal Cord Injury: A Nationwide Cohort Study
Wu, Jau-Ching; Huang, Wen-Cheng; Chen, Yu-Chun; Ko, Chin-Chu
1Department of Neurosurgery, Taiwan; 2Department of Research and Education, Taiwan

169. Intravenous administration of granulocyte colony-stimulating factor for treating neuropathic pain associated with compression myelopathy
Kato, Kei; Koda, M; Yamazaki, M; Okawa, A; Furuya, T; Mannoji, C; Takahashi, H; Sakuma, T; Kamiya, K; Inada, D; Takahashi, K
Dept. of Orthop. Surg., Japan

170. Intramedullary myxopapillary ependymoma of the conus medullaris: surgical technique and outcomes
Iwanami, A; Tsuji, O; Hosogane, N; Watanabe, K; Tsuji, T; Ishii, K; Toyama, Y; Matsu-moto, M; Nakamura, M
1Orthopaedic Surgery, Japan; 2Department of Advanced Therapy for Spine and Spinal Cord Disease, Japan

171. The reliability of interface pressure mapping parameters
Swaine, Julian; Romeo, M; Nguyen, V; Stacey, M.C.
1School of Social Sciences and Psychology, Australia; 2Rehabilitation Studies Unit, Australia

172. Rasch-analysis of the Van Lieshout hand function test for Tetraplegia
Spooren, Annemie IE; Arnould, C; Snoek, G; Smeets, RJEM; Bongers-Janssen, HMH; Seelen, HAM
1Centre of Expertise in Rehabilitation, Netherlands; 2Healthcare, Belgium; 3Rehabilitation, Netherlands; 4Rehabilitation Medicine, Netherlands

173. The influence of Reflex locomotion according to Vojta on locomotion system in spinal cord injured patients
Chrenkova, Radka; Špaňhelova, Š
1Department of Rehabilitation and Sport Medicine, Czech Republic; 2PhD School of Forensic Science, Italy

174. Impact and effect of vertebral artery trauma in spinal cord injury
Lopez de Heredia, Luis; McKean, D; Hughes, RJ; Belci, M; Meagher, TM
1National Spinal Injuries Centre, United Kingdom; 2Department of Clinical Neurology, United Kingdom

175. Recurrent TIAs as premonitoring sign of spinal cord infarction: Case report
Petraiev, D; Tudor, KI; Radoš, M; Ribarice, B; Mahovice Lakulias, D; Hajnšek, S; Tudor Car, L
1Department of Neurology, Croatia; 2Department of Radiology, Croatia; 3United Kingdom

176. SEXUAL-UROLOGICAL DYSFUNCTION AND PSYCHOLOGICAL DISTRESS IN PATIENTS WITH SPINAL CORD INJURY (SCI)
Di Lucente, Lina; Ricci, F; Benevento, M; Schiavon, GL; Scivoletto, G; D’Amico, A; Molinari, M
1Spinal Cord Unit, Italy; 2PhD School of Forensic Science, Italy

177. Risk factors of shoulder pain and shoulder functionality in athletes and sedentary wheelchair users
Herrero, Azael J; Rossignoli, Isabel; Menéndez, Héctor; Martin, Juan; Ferrero, Cristina; Martin, Pedro J
1Research Center in Physical Disability, Spain; 2Faculty of Sports Sciences, Spain

178. ACTIVITY OF DAILY LIFE (ADL) INDEPENDENCE AND PSYCHOLOGICAL DISTRESS IN PATIENTS WITH SPINAL CORD INJURY (SCI)
Di Lucente, Lina; Ricci, F; Greco, I; Laurenza, L; Scivoletto, G; Molinari, M
1Spinal Cord Unit, Italy; 2PhD School of Forensic Science, Italy

179. Correlation between orthostatic hypotension and nocturnal polyuria in spinal cord injured patients
Yanaguchi, Akihiro; Nomi, Masashi; Sengoku, Atsushi; Fujisawa, Masato
1Spinal Cord Unit, Italy; 2PhD School of Forensic Science, Italy
180. Monitoring of respiratory dysfunctions after traumatic spinal cord injury
Kriz, J; Sulec, J
Spinal Cord Unit, Czech Republic

181. Long-term follow-ups of urodynamic studies in spinal cord injury patients
Shin, JC; Yoon, SY; Yu, SJ; Kim, NY; Jeong, MJ; Cho, MH
Korea, Republic of

182. Reeducation for SCI patients in the Spinal Cord Unit (SCU) through sport rehabilitation activities: inside or outside the hospital? Our model
Villa, Davide; Guerra, F; Capirossi, R; Brillianti Ventura, D
1Day Hospital, Italy; 2Italy

183. Basal sympathetic activity in the microcirculation in human tetraplegic man by wavelet transform of laser doppler flowmetry
Deitrick, George; Bernjak, A; Bauman, WA; Tuckman, J
1USA; 2Department of Physics, United Kingdom; 3Spinal Cord Damage Research Center, USA

184. A case study: the importance of a well-fitting tracheostomy tube in a patient on prolonged ventilation
Jansz, L; Singhal, B; Mulgrew, V; Mann, W
1Spinal Unit, New Zealand; 2Speech and Language Therapy, New Zealand; 3ENT, New Zealand

185. Technology-assisted task-oriented skill training in tetraplegia: a feasibility study
Spooren, Annemie IF; Vanmulken, D; Bongers-Janssen, HMH; Seelen, HAM; Timmermans, AAA
1Centre of Expertise in Rehabilitation, Netherlands; 2Rehabilitation, Netherlands

186. Long-term results of radiation and medication decompression vs. surgical of the spinal cord in patients with extradural metastatic spine tumors
Ptashnikov, Dmitry; Usikov, Vladimir; Michaylov, Dmitriy; Topusov, Eldar
1Neurosurgery and oncology, Russia; 2oncology, Russia

187. Validation of Bone Marrow Cell harvesting and enriching procedure for transplantation in persons with Acute Spinal Cord Injury
Chhabra, HS; Sarda, K; Arora, M
1Department of Spine Service, India; 2Basic Research, India; 3Clinical Research, India

188. Multidisciplinary “Inreach” model of care for patients with spinal cord injury-a pilot study
Shanbhag, S V; Kolli, S; Brouwers, J
1Neurosciences, United Kingdom; 2Specialist Neurorehabilitation Physiotherapy/Neurosciences, United Kingdom

189. Asymptomatic intraabdominal pathologies in patients with traumatic spinal cord injury
Onder, Burcu; Ozer, Neslihan; Onder, Fatih Oguz; Selcuk, Barin; Kurtaran, Aydan; Yalcin, Elif; Akyuz, Mufit
Turkey

190. The relation of physical fitness between ambulation and depression in spinal cord injury patients
Yildirim, Ozge; Ozer, Neslihan; Yalcin, Elif; Onder, Burcu; Akyuz, Mufit
Turkey

191. Situation on admission and discharge of a group of newly injured spinal cord injury (SCI) patients admitted to a spinal cord injury centre (SCIC).
Khare, J; DeSouza, L; Middleton, FR; Gawronski, J; Ferguson-Pell, M
1Community Liaison, United Kingdom; 2Centre for Rehabilitation Research, United Kingdom; 3Rehabilitation Medicine, United Kingdom; 4Faculty of Rehabilitation Medicine, Canada

192. Post Traumatic Syringomyelia (PTS) after spinal cord injury (SCI) - 47 Years Oswestry Experience
Patil, Siddeshwar; Roy Chowdhury, Joy; Bandi, Surendra; Osman, Aheed; Flint, Graham; El Masri, Wagih
United Kingdom

193. Preventing spinal cord injuries from falls: different approaches in different regions
Murray, Herndon
ISCOS Prevention Committee, USA

194. FES-rowing improves bone micro architecture and strength in the paralyzed lower extremity
Morse, LR; Gupta, R; Battaglino, RA; Tan, CO; Taylor, JA
1PMR, USA; 2Radiology, USA; 3Cytokine Biology, USA

195. The acute inflammatory response is attenuated after administration of Docosahexaenoic Acid in a clip compression model of spinal cord injury
Irene, Paterniti; Impellizzeri, D; Mazzon, E; Esposito, E; Michael-Titus, A.T.; Priestley, J.V.; Cuzzocrea, S
1Department of Clinical and Experimental Medicine and Pharmacology, School of Medicine, University of Messina, Italy; 2The Royal London School of Medicine and Dentistry, Queen Mary University of London, Whitechapel, London, United Kingdom, United Kingdom

196. Spinal cord ischemia: epidemiology, functional outcomes and comparative analysis with other non-traumatic spinal cord lesions
Salvador-De La Barrera, Sebastian;Felipe-Lopez, P; Vazquez-Guimaraens, M; Balado-Lopez, AM; Montoto-Marques, A; Ferreiro-Velasco, ME
1Spinal Cord Injuries Unit, Spain; 2Rehabilitation Service, Spain

197. Effect of Fasudil, a selective inhibitor of Rho Kinase activity, in the secondary inflammatory process after spinal cord compression injury in mice
Emanuela, Esposito; Impellizzeri, D; Mazzon, E; Paterniti, I; Cuzzocrea, S
Department of Clinical and Experimental Medicine and Pharmacology, School of Medicine, University of Messina, Italy, Italy

198. Acute Psychological Responses in Outdoor and Indoor Virtual Reality Arm and FES-leg Cycling in individuals with Spinal Cord Injury
Hasnan, Nazirah; Fornusek, C; Middleton, J; Husain, R; Davis, GM
1Clinical Exercise Rehabilitation Unit, Faculty of Health Sciences,, Australia; 2Rehabilitation Studies Unit, Australia; 3Department of Physiology, Malaysia

199. Traumatic versus non-traumatic spinal cord injuries: a comparative study of neurological and functional outcomes
Salvador-De La Barrera, Sebastian; Felipe-Lopez, P; Arias-Pardo, AI; Martin-Mourelle, R; Rodriguez-Sotillo, A; Vazquez-Guimaraens, M
1Spinal Cord Injuries Unit, Spain; 2Rehabilitation Service, Spain

200. Effect of formal ISNCSCI training on classification accuracy
Schulz, C; Franz, S; Kamradt, T; Smoor, I; Weidner, N; Rupp, R
Spinal Cord Injury Center, Germany

201. Absence of endogenous Toll-like receptors (TLRs) worsened secondary inflammatory process after spinal cord compression injury in mice

202. Cause of death of patients with Spinal Cord Injury (SCI) treated in the Midland Centre for Spinal Injuries (MCSI): 65 Yrs Mortality Analysis
Patil, Siddeshwar; Roy Chowdhury, Joy; Osman, Aheed; El Masri, Wagih
United Kingdom

203. Estimating glomerular filtration rate and detecting patients with impaired renal function in patients with spinal cord injury
Onder, Burcu; Onder, Fatih Oguz; Ozer, Nesilhan; Aslan, Sirin; Yalcin, Elif; Kurtaran, Aydan; Akvuz, Mufti
Turkey

204. Upper limb function after incomplete Spinal Cord Injury
Britten, Laura1; Astill, S.; Ichiyama, R.; Whitehouse, L.; Jamil, F.; Raza, W
1Centre for Sport and Exercise Sciences, United Kingdom; 2United Kingdom

205. Ventilator weaning supported by abdominal muscle stimulation in acute tetraplegia
Golle, H1; McLachlan, AJ1; McCaughhey, EJ1; McLean, AN2; Purcell, M3; Fraser, MH1; Allan, DB1
1Centre for Rehabilitation Engineering, United Kingdom; 2Queen Elizabeth National Spinal Injuries Unit, United Kingdom

206. Long term outcome after repeated intradetrusor botulinum neurotoxin A injections in patients with neurogenic bladder dysfunction
Solyanik, Irina1; Weidner, Norbert2
1Neuro-Urology, Germany; 2Germany

207. Motor level determination in different revisions of the ISNCSCI assessment sheet
Schild, C; Langpape, A; Schließmann, D; Weidner, N; Rupp, R
Spinal Cord Injury Center, Germany

208. ASIA Impairment Scale: AIS D is not AIS D
Rolleniger, Marc1; Starkey, ML2; Curt, A2
1SCI Research, Switzerland; 2SCI Research, Spinal Cord Injury Center, Switzerland

209. Neurological recovery after traumatic paraplegia
Marino, RJ
Rehabilitation Medicine, USA

210. Heart rate variability (HRV) analysis and autonomic reflexes in a patient with C1 lesion
Malmqvist, L1; Bartholdy, K1; Biering-Sorensen, T1; Biering-Sorensen, F; Krassiovouk, A1; Hansen, B1; Svendsen, JH1; Kruse, A1; Welling, KL1; Ballegaard, M1; Ballegaard, M1
1department of neuropsychology, Denmark; 2Clinic for Spinal Cord Injuries, Denmark; 3Department of Medicine, Div. Phys .Med. & Rehab., Canada; 4Department of Cardiology, Denmark; 5(6) The Spine Unit, Department of Orthopedic Surgery, Denmark; 6Department of Neuroanaesthesiology, Denmark

211. The Conditional Neuromodulator with electrodes on the intrathecal roots: an engineer’s view
Donaldson, Nick
Medical Physics & Bioengineering, United Kingdom

212. The relation of physical fitness over ambulation and depression in spinal cord injury patients
Yildirim, Maksude Ozge; Ozer, Nesilhan B; Yalcin, Elif; Onder, Burcu; Akyuz, Mufti
Department of Physical Medicine and Rehabilitation, Turkey

213. A descriptive study of patients with chronic spinal cord injuries
Palazon, Ramon1; Esclarn, A2; Alcobendas, M2; Casado, RM2; Ceruelo, S2
1Physical Medicine and Rehabilitation, Spain; 2Spain

214. Health Care Needs and Services for Women Aging with a Spinal Cord Injury
Bellon, K1; Shem, K2; Kolakowsky-Hayner, SA1
1Rehabilitation Research Center, USA; 2PM&R, USA

215. A kinetic evaluation of a novel forearm crutch with a shock absorption system
MacGillivray, Megan1; Manocha, Ranita; Sawatzky, Bonita2
1Rehabilitation Sciences, Canada; 2Medicine, Canada; 3Orthopaedics, Canada

216. Memokath trans sphincteric stent insertion for detrusor sphincter dyssynergia - short term gain but long term pain?
Hardaker, Henry; Fulford, S
Urology, United Kingdom

217. Patient and staff satisfaction following implementation of Spinal Cord Essentials, an education initiative for patients with spinal cord injury
Delparte, J-J; Mills, S; Burns, AS
Spinal Cord Rehabilitation Program, Canada

218. Post-laminectomy rotokphoscoliosis causing paraplegia in long-term. A case report
Duman, Iltekin; Guzelkucuk, Umut; Yilmaz, Bilge; Tan, Arif Kenan
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219. Cortical activation of the tenodesis grasp after C6 quadriplegia: a MEG control case study.
Mateo, S1; Di Rienzo, F2; Delpuech, C2; Daligault, S2; Jacquin-Courtois, S2; Guillot, A2; Collet, C2; Rode, G2
1Hospices Civils de Lyon, Hôpital Henry Gabrielle, Lyon ; CRIS, EA 647, laboratoire P3M, UCLyon1, France; 2France; 3Hospices Civils de Lyon, Hôpital Henry Gabrielle, Lyon, France; 4Institut Universitaire de France, Paris, France

220. Exploring the feasibility and scalability of central recruitment for patients with subacute SCI in tertiary academic rehabilitation centres
Craven, B. Catharine1; Brisbois, LM1; Carson, JR1; Verrier, MC3
1Department of Medicine, Toronto Rehabilitation Institute-UHN, Canada; 2Research, Canada;
3Department of Physical Therapy and Graduate Department of Rehab Sciences, Toronto Rehabilitation Institute-UHN, Canada

221. Predicting Health Preference in Spinal Cord Injury
Craven, B. Catharine1; Hitzig, SL1; Giangregorio, LM1; Katz, J1; Noreau, L1; Wolfe, D1; Mittman, N1
1Department of Medicine, Toronto Rehabilitation Institute-UHN, Canada; 2HOPE Research Centre, Sunnybrook Health Sciences Centre, Canada; 3Department of Kinesiology, Canada; 4Department of Psychology, York University and Division of Behavioural Science & Health, Toronto General Hospital-UHN, Canada; 5Department of Rehabilitation, Faculty of Medicine and Centre for Interdisciplinary Research Rehabilitation & Social Integration, Canada; 6Department of Physical Medicine & Rehabilitation and Lawson Health Research Institute, Canada; 7Department of Pharmacology and HOPE Research Centre, Sunnybrook Health Sciences Centre, Canada
222. Isokinetic assessment of diurnal variation of spasticity: Pilot study
Göde, Kadri; Cakır, Tuncay; Koldaş Doğan, Pehlivan; Erçal, Tufan; Yalçın, Umit; Can, Pynar; Toraman, Nacije Füsun.
Physical Medicine and Rehabilitation, Turkey

223. Measuring skin thickness on bony prominences by ultrasound in spinal cord injury patients: A possible predictive tool for pressure sore
Yalçın, Elif; Akyüz, M; Onder, B; Unalan, H; Degirmenci, Y.
Turkey

224. Spinal Cord Essentials: A customized patient education initiative for spinal cord injury
Delparte, Jude; Chau, BA; Mills, S; Burns, AS.
Spinal Cord Rehabilitation Program, Canada

225. The upper extremity neuropathies in Turkish wheelchair users and the additive/alternative value of ultrasonography to the evaluation of entrapments
Yalçın, Elif; Onder, B; Özer, N; Kurtaran, A; Yıldırım, MO; Akyüz, M.
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226. From Clinical Practice Guidelines to front-line best practice implementation: it’s so easy, or is it?
Hsieh, Jane1; Wolfe, DL2; Koning, C3; Scovil, CY; Kras-Dupuis, A4; Laramée, MT5; Hunter, JA1; SCI - KMN, 1
1Canada; 2Aging, Rehabilitation & Geriatric Care Research Centre, Canada; 3Spinal Cord Rehab Program, Canada; 4Rehabilitation Program, Canada

227. Development of a sham condition for a future whole body vibration intervention trial
Craven, B. Catharine1; Rashidi, A2; Alizadeh-Meghrazi, M2; Szeto, M2; Delparte, JJ2; Masani, K2; Giangregorio, LM3; Popovic, MR3
1Department of Medicine, Toronto Rehabilitation Institute-UHN, Canada; 2Research, Canada; 3Department of Kinesiology and Toronto Rehabilitation Institute-UHN, Canada

228. Studying sensorimotor control in locomotion after human spinal cord injury using robotics and electrophysiology
Tansev, Keith
SCI Research/Neurology & Physiology/SCI Clinic, USA

229. The effects of repetitive transcranial magnetic stimulation on refractory neuropathic pain in patients with spinal cord injury
YILMAZ, BILGE1; Sato Azeka, M1; Greve, JM1; Furlan, J1; Forchheimer, M1; Tast, D1; Baptista, A1; Fregni, F1
1Instituto de Ortopedia e Traumatologia, Brazil; 2Dept. of Neurology, Canada; 3Physical Medicine and Rehabilitation, USA; 4Brazil; 5USA

230. Association between arterial stiffness, cardiovascular risk factors, and injury related risk factors in people with chronic spinal cord injury
Miyatani, M1; Moore, C1; Oh, P1; Masani, K1; Craven, B.C2
1Research, Canada; 2Department of Medicine, Toronto Rehabilitation Institute - UHN, Canada

231. Professional reintegration after spinal cord injury
Gorris, Catherine1; Rens, A1; De Smet, F1; Donceel, P1; Kiekens, C1
1Rehabilitation Medicine, Belgium; 2Public Health, Belgium

232. Development of specific spinal cord injury community rehabilitation models for Mid- and South Wales (UK)
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1Rehabilitation Medicine, Belgium

233. Aging and menopause in women with Spinal Cord Injury: Comparison to men with SCI and able-body women
Jackson, Amy; DeVivo, Mike; Taylor, Pat
Dept of Physical Medicine and Rehabilitation, USA

234. A questionnaire development study exploring the views on the use of Functional Electrical Stimulation in Spinal Cord Injury
Tedesco Triccas, Lia1; Dononvan-Hall, MH2; Burridge, JH1; Dibb, B3; Ellis-Hill, C4
1Faculty of Health Sciences, United Kingdom; 2United Kingdom

235. The frequency and severity of adverse events during whole body vibration (WBV) and passive standing among individuals with chronic spinal cord injury
Craven, B. Catharine1; Szeto, M2; Delparte, JJ2; Giangregorio, LM3; Popovic, MR4
1Department of Medicine, Toronto Rehabilitation Institute - UHN, Canada; 2Research, Canada; 3Department of Kinesiology and Toronto Rehabilitation Institute-UHN, Canada; 4Institute of Biomaterials and Biomedical Engineering, Toronto Rehabilitation Institute-UHN, Canada

236. Reliability of the Portuguese Version of the International Bowel Function Basic Spinal Cord Injury (SCI) Dataset
Yamauti, Rafael1; Sato Azeka, M1; Greve, JM1; Furlan, J1; Forchheimer, M1; Tast, D1; Baptista, A1; Fregni, F1
1Instituto de Ortopedia e Traumatologia, Brazil; 2Dept. of Neurology, Canada; 3Physical Medicine and Rehabilitation, USA; 4Brazil; 5USA

237. Immediate skin response and late T-cell functions in spinal cord injury patients with autonomic dysfunction: a preliminary report
YILMAZ, BILGE1; Gulec, Mustafa1; Kartal, Ozgur2; Musabak, Ugur3; Guzelkucuk, Umut4; Senel, Osman5; Tan, Kenan5
1Turkish Armed Forces Rehabilitation Center, Turkey; 2Dept. of Allergy and Immunology, Turkey

238. A qualitative study exploring views about the use of Functional Electrical Stimulation (FES) in Spinal Cord Injury (SCI)
Dononvan-Hall, Maggie1; Burridge, JH1; Dibb, B3; Ellis-Hill, C4; Tedesco Triccas, L1; Rushton, D2
1Clinical Research, USA; 2Radiology, USA; 3Physiology, USA

239. Intravesical gentamicin instillations for the treatment of refractory urinary tract infections
Gudla, Vijay Rao; Agarwal, M
Urology, United Kingdom

240. Validity of the anorectal examination as the sole indicator of spinal cord injury severity: preliminary results
Krisa, L1; Middleton, D2; Gaughan, J1; Mohamed, F1; Mulcahey, MJ1
1Clinical Research, USA; 2Radiology, USA; 3Physiology, USA

241. Bases for a combined cellular therapy to improve chronic spinal cord injury outcome
Moviglia, Gustavo1; Moviglia Brandolino, MT2; Blasetti, N3; Milesi, V4; Gaeta, CA5
1CIITT, Argentina; 2Physiology, Argentina

242. Cellular Therapy for Chronic Spinal Cord Injured Patients
Moviglia, Gustavo A; Moviglia Brandolino, MT; Albanes, GA; Piccone, S; Blasetti, N;
243. The effect of everyday outdoor tasks on wheelchair propulsion patterns: results linking EMG analysis and a new lightweight force sensing wheel
Holloway, Catherine¹; Richards, Rosie¹; Smitham, Peter¹; Orr, Shepley¹; Gall, Angela¹; Tyler, Nick¹; Suzuki, Tatsuto²
¹United Kingdom; ²Department of Mechanical Engineering, Japan

244. Feasibility, safety, and clinical parameters within a 6 week pilot study of the Ekso wearable exoskeleton after SCI
Kolakowsky-Hayner, S¹; Crew, J; Medel, R¹; Moran, S¹
¹Rehabilitation Research Center, USA; ²Physical Medicine and Rehabilitation, USA; ³Therapy Services, USA

245. Using iPad technology for continued education and mentoring after SCI to social improve integration and quality of life
Kolakowsky-Hayner, S; Wright, J; Bellon, K
Rehabilitation Research Center, USA

246. Advances in the care of the spine in chronic spinal cord injury
Betz, Randal; Mulcahey, MJ; McDonald, CM; Anderson, CJ; Vogel, LC
USA

Onders, Raymond
Surgery, USA

248. The impact of interface pressure mapping on pressure ulcer prevention education
Swaine, Jillian; Romeo, M.; Nguyen, V; Swaine, M.C.
Australia

249. Collection of user requirements in a population of spinal cord injury patients and medical staff for the assistive lower limb exoskeleton
Pisotta, Iolanda¹; Scivoletto, G²; Federica, T³; Sylos Labini, F¹; Motard, E¹; Gancet, J¹; Ilizkoviez, M¹; Molinari, M¹; Ivanenko, Y¹
¹Italy; ²Spinal Cord Injury Unit, Italy

250. Flavectomy of Cervical Vertebrae in Treating Cervical Spinal Canal Stenosis
Song, Xiujun
Orthopaedics and Microsurgery, China

251. Electromyographic analysis of replacement movement patterns used by persons with tetraplegia
Furmanuk, Lech
Department of Kinesiotherapy, Poland
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Ekso Bionics is a visionary company helping spinal cord injury patients and people with other neurological disorder walk. The company is applying the latest technology and engineering to help people rethink current physical limitations redefining life for those in a wheelchair.

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Gerard McDermott

Gerard was called as a Barrister in England and Wales 1978 and was made Queen’s Counsel in 1999. He has been admitted as Attorney-at-Law in New York for over 20 years. He is based in London (Outer Temple Chambers) and Manchester. Much of his caseload involves catastrophic personal injury, particularly spinal cord injury. He has a very busy trial practice across the United Kingdom, generally in the High Court, as well as reaching impressive out of court settlements through negotiation. An increasing number of his cases have a cross border element, with particular emphasis on US issues.

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The Spinal Injuries Association (SIA) is the national organisation for spinal cord injured people in the UK. SIA offer a range of services supporting individuals and their families from the moment an injury occurs for the rest of their lives.

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