CONTENTS

President’s Message 4
Secretary’s Report 5
Treasurer’s Report 10

Articles:
Re-Attachment of A Fractured Maxillary Central Incisor: A Case Report
Muhammad Khiratti Bin Mat Zainal, Dalia Abdullah 14

Non-Surgical Root Canal Treatment of 37 With C-Shaped Canal Configuration: A Case Report
Nurul Ain Ramlan 23

Internal Root Resorption – A Case Report
Wong Lishen 26

Sensitive Teeth as an Adverse Effect of Steroid Therapy. A Case Study
Dalia Abdullah, Alizae Marny Mohamed 29

When to Perform Endodontic Therapy Prior to the Fixed Protheses?
Noor Hayati Azami 34

Information for Contributors 39
Acknowledgement 40
Assalammualaikum warahmatullah I wabarakatuh and Salam Sejahtera.

Dearest esteemed dental colleagues and cherished members of Malaysian Endodontic Society.

I would like to take this opportunity to say thank you for the continuous confidence and support to our committee members in ensuring the success of our beloved society. I am blessed for the opportunity to serve as the President for this term 2016-2017 and surrounded by a group of energetic and hard working committee members in ensuring that our yearly events are successful.

Malaysian Endodontic Society has been grateful to be able to organize a few events this year. In April, we welcomed Dr Clifford Ruddle as our keynote speaker and introducing our local speakers, Dr Bryon Ong, Dr Huwaina Abd Ghani and Dr Nur Laila Sofia. In October, MES also give the special treat to their members for Dr Noor Hayati Azami and Dr Siew Kai Ling in sharing their expertise in MES Study Club Meeting. MES will continue to serve as a platform to nurture our own world renowned speakers in their fields and for our participants to continue to learn and exchange ideas on the latest developments in endodontics.

This November, we are honoured to bring Dr Marga Ree, Prof Zhang Chengfei, Dr Angelina Lee and Dr Dephne Leong as our keynote speakers for the 29th Malaysian Endodontic Society Annual Scientific Meeting and Annual General Meeting that will be held in Pullman Kuala Lumpur City Centre Hotel and Residences.

We also would like to hear feedback from our members on the update of the MES website and Facebook Page. In time to time, we will continue to improve especially in MES Bulletin. We also hope that more members will be sharing their cases in the bulletin.

This event would not been possible without the strong support in sponsorship of our vendors in endodontics and dental suppliers. They will also display their latest equipment’s and material in the trade exhibition. Please take a visit to their booth and you may find what you are looking for. We would like to take this opportunity to thank them for their continuous contribution and support to MES yearly event.

Lastly, we would like to extend our grateful thank you for all the delegates for your participation and continuous support. We wish you a pleasant and rewarding meeting. Hope to see you in all MES events.

Dr Afzan Adilah Ayoub
President
MES SECRETARY’S ANNUAL REPORT 2016/2017

By: Dr Huwaina Abd Ghani

Introduction

The 28th Annual General Meeting (AGM) of the Malaysian Endodontic Society was held on Sunday 13th November 2016 at Pullman Kuala Lumpur City Centre Hotel and Residences, 4, Jalan Conlay, Kuala Lumpur, Malaysia. The MES Executive Committee Members for the year 2016-2017 as listed to the Registrar of Societies (ROS) are as follows:

<table>
<thead>
<tr>
<th>Name</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Afzan Adilah Binti Ayoub</td>
<td>President</td>
</tr>
<tr>
<td>Dr. Mary Soo Wai Kuan</td>
<td>Vice President</td>
</tr>
<tr>
<td>Dr. Huwaina binti Abd Ghani</td>
<td>Secretary</td>
</tr>
<tr>
<td>Dr. Yap Li Ling</td>
<td>Treasurer</td>
</tr>
<tr>
<td>Dr. Siew Kai Ling</td>
<td>Assistant Secretary</td>
</tr>
<tr>
<td>Dr. Hussein Ali Al-Wakeel</td>
<td>Assistant Treasurer</td>
</tr>
<tr>
<td>Dr. Noor Hayati Azami</td>
<td>Editor</td>
</tr>
<tr>
<td>Assoc. Prof Dr. Dalia Abdullah</td>
<td>Committee member</td>
</tr>
<tr>
<td>Dr. Lam Jac Meng</td>
<td>Committee member</td>
</tr>
<tr>
<td>Dr. Jeyavel Rajan</td>
<td>Committee member</td>
</tr>
<tr>
<td>Dr. Maria Angela Gonzalez</td>
<td>Committee member</td>
</tr>
<tr>
<td>Dr. Mohd Haikal B Muhamad Halil</td>
<td>Committee member</td>
</tr>
<tr>
<td>Dr. Shekhar Bhatia</td>
<td>Committee member</td>
</tr>
<tr>
<td>Datuk Dr. Teo Choo Kum</td>
<td>Hon. Auditor I</td>
</tr>
<tr>
<td>Dr. Yoong Lai Thong</td>
<td>Hon. Auditor II</td>
</tr>
</tbody>
</table>

Committee Meetings

In this 2016-2017 term of office, members discuss regularly via emails and WhatsApp groups starting on the 1st day of tenure (13th November 2016). Six face-to-face meetings were scheduled at different places either during the weekdays or weekends. Combination of these virtual and face-to-face meetings became more active towards the end of the term discussing matters pertaining to organizing one major events of the new term; the MES 2017 Annual Scientific Conference and AGM. Listed below is the table depicting the issues discussed among the committee members.
a) WhatsApp

<table>
<thead>
<tr>
<th>Month</th>
<th>Among the issues/topics discussed:</th>
<th>Sender/Initiator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov 2016</td>
<td>’2017 MES Comm. group’ was created announcement Official MES in FB</td>
<td>Dr. Afzan</td>
</tr>
<tr>
<td></td>
<td>Confirmation on official MES address</td>
<td>Dr. Huwaina</td>
</tr>
<tr>
<td></td>
<td>Confirmation on appointment letter, requesting details from committee members</td>
<td>Dr. Huwaina</td>
</tr>
<tr>
<td></td>
<td>Planning for MES website</td>
<td>Dr. Afzan</td>
</tr>
<tr>
<td>Dec 2016</td>
<td>Requesting update details from committee members to fill the comm. member form for the eROSES</td>
<td>Dr. Huwaina</td>
</tr>
<tr>
<td>Jan 2017</td>
<td>Set up a meeting with selected company (IT vendor) for MES website</td>
<td>Dr. Huwaina</td>
</tr>
<tr>
<td></td>
<td>Midyear meeting important issues</td>
<td>Dr. Afzan</td>
</tr>
<tr>
<td></td>
<td>– Speakers &amp; Cost &amp; profit sharing with UiTM</td>
<td>Dr. Afzan</td>
</tr>
<tr>
<td></td>
<td>Issue on mailing printing and MDA mailing for Midyear meeting due to limited time, cost</td>
<td>Dr. Afzan</td>
</tr>
<tr>
<td>Feb 2017</td>
<td>Conference fee</td>
<td>Dr Shekar</td>
</tr>
<tr>
<td></td>
<td>– Rate for graduating student awaiting posting and overpaid fee</td>
<td>Dr. Afzan</td>
</tr>
<tr>
<td></td>
<td>Midyear meeting</td>
<td>Dr. Mary</td>
</tr>
<tr>
<td></td>
<td>– promotion : Email blast through MDA confirmation</td>
<td>Dr. Afzan</td>
</tr>
<tr>
<td></td>
<td>– CPD points</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Enquiries related to registration i.e. recording</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Booths</td>
<td></td>
</tr>
<tr>
<td>Mar 2017</td>
<td>Volunteer as speaker in MIDE C</td>
<td>Dr. Mary</td>
</tr>
<tr>
<td></td>
<td>Honorarium to local speakers</td>
<td>Dr. Jey</td>
</tr>
<tr>
<td></td>
<td>Updates on midyear meeting</td>
<td>Dr. Li Ling</td>
</tr>
<tr>
<td></td>
<td>– number of participants, budgets, speaker’s dinner</td>
<td></td>
</tr>
<tr>
<td>April 2017</td>
<td>CODS meeting- participation of MES</td>
<td>Dr. Afzan</td>
</tr>
<tr>
<td></td>
<td>Speakers for ASMAGM 2017 confirmed, Lecture topic suggestion from members</td>
<td>Dr. Mary</td>
</tr>
<tr>
<td></td>
<td>ASM flyer</td>
<td>Dr. Mary</td>
</tr>
<tr>
<td></td>
<td>Study group meeting- date confirmation</td>
<td>Dr. Mary</td>
</tr>
<tr>
<td></td>
<td>ASMAGM 2017 progress task</td>
<td>Dr. Mary</td>
</tr>
<tr>
<td></td>
<td>Web hosting package</td>
<td>Dr. Mary</td>
</tr>
<tr>
<td></td>
<td>Volunteer for website training</td>
<td>Dr. Afzan</td>
</tr>
<tr>
<td>May 2017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug 2017</td>
<td>Study group meeting updates</td>
<td>Dr. Angela</td>
</tr>
<tr>
<td></td>
<td>Dentist nearby T&amp;C</td>
<td>Dr. Afzan</td>
</tr>
<tr>
<td>Sept 2017</td>
<td>MES website problem</td>
<td>Dr. Shekar</td>
</tr>
<tr>
<td></td>
<td>ASMAGM 2017 updates -registration number</td>
<td>Dr. Dalia</td>
</tr>
</tbody>
</table>

b. Meeting

<table>
<thead>
<tr>
<th>Date</th>
<th>Venue</th>
<th>Agenda</th>
<th>Attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 Jan 2017</td>
<td>Meeting room UM</td>
<td>a) MES website&lt;br&gt;b) Committee members task&lt;br&gt;c) Event with UiTM 1-2 Apr&lt;br&gt;d) 29th ASMAGM 2017 25-26 Nov&lt;br&gt;e) MES auditors</td>
<td>7/13</td>
</tr>
</tbody>
</table>
Activities

a) MES-UiTM Joint Meeting 2017
This meeting was conducted on the 2nd April 2017 (Sunday) at Dental Faculty UiTM, Kampus Sungai Buloh, Jalan Hospital, 47000 Sungai Buloh, Selangor.

At this meeting, the scientific programme included one international speaker as well as our own local speakers from different sectors; government, academia and private sector. The speakers were Dr. Clifford J. Ruddle (USA), Dr. Huwaina Abd Ghani (Malaysia), Dr. Farinawati Yazid (Malaysia), Dr. Teng-Kai Ong (Dr. Bryon Ong) (Malaysia), and Dr. Nur Laila Sofia Ahmad (Malaysia).

Dr. Huwaina and Dr. Farinawati delivered their talks on regenerative endodontics-changes, chances & challenges especially in the mature permanent tooth. Dr. Bryon Ong spoke on endodontic surgery and shared his experiences during his practice at University of Pennsylvania, USA (Microendodontics & Endodontics Microsurgery). Dr. Nur Laila Sofia elaborated on special features of the endodontically treated teeth, restorative material considerations and treatment options in her lecture.

The keynote speaker. Dr. Clifford Ruddle is considered as a ‘superstar’ in endodontic community. The afternoon workshop was conducted by Dr Ruddle to provide our delegates with hands-on experience

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Tasks</th>
</tr>
</thead>
</table>
| 14 Mar 2017| MDA Kelana Jaya   | a) MES website
               b) MES-UiTM Joint Meeting 2017
               c) Tasks
               d) Deal with UiTM
               e) Sponsorship for UiTM-MES
               f) Deal with Dentistnearby
               g) APDSA 2018
               h) AGM and Scientific Conference 29th
               i) ASMAGM 2017
               j) MIDE
               k) CODS         |
| 25 Apr 2017| Monte’s, BSC      | a) MES-UiTM post mortem
               b) COD collaboration
               c) ASM 2017 tasks
               d) MES website
               e) MES bulletin |
| 13 July 2017| MDA Kelana Jaya   | a) MES study club meeting
               b) ASM 2017-speakers, flyers, duties,
               c) Sponsorship
               d) Workshops
               e) MES bulletin
               f) MES affiliate with MDA
               g) Speakers’ welfare and accommodation
               h) Door gifts  |
| 10 Sept 2017| MDA Kelana Jaya   | a) MES bulletin
               b) ASM 2017 updates duties
               c) Workshops
               d) e-certificate |
| 5 Nov 2017  | Meeting room UM   | a) MES bulletin
               b) ASM 2017 updates duties
               c) Workshops
               d) e-certificate |
on the latest rotary instrumentation techniques. The participants were introduced to the theory and protocol of the Wave One Gold (Dentsply) rotary system and also given hands-on training.

**Selfie with Dr Cliff Ruddle.**

**Dr Huwaina delivered her lecture.**

**b) MES Study Club meeting**

This activity was held on Sunday, 10th September 2017 at MDA secretariat office, Kelana Jaya, Petaling Jaya. The two speakers were Dr. Noor Hayati Azami and Dr. Siew Kai Ling. Dr. Noor Hayati gave an hour lecture on tooth anatomy and its relationship to endodontic access cavity. Dr. Siew Kai Ling spoke on endodontic perforation and its management. She shared some of her clinical cases in her presentation.

**Audience listening to Dr Siew Kai Ling.**

**Dr Noor Hayati gave her lecture.**

**c) 2016 MES Annual Scientific Conference & AGM**

This event was held on Sunday 13th November 2016 at the Pullman Kuala Lumpur City Centre Hotel and Residences, 4, Jalan Conlay, Kuala Lumpur, Malaysia.

The international speakers were Dr. Mike Gordon (New Zealand), Dr Marino Sutedjo (Indonesia), Dr. Jaruma Beau Sakdee (Thailand) and Dr. Philippe Guettier (France).
Dr. Mike Gordon gave a two-hour lecture on challenges in treating complex anatomy. He described various ways of dealing with the challenges with differences cases. Dr. Marino Sutedjo presented the controversies in endodontics and presented his personal view on each issue. Dr Jaruma spoke on the classification, diagnosis, immediate management and complications of dental traumatic injuries. Dr Philippe Guettier presented the evolution of endodontic concepts and their relationship with the new generation of instruments and how it can aid the practitioners to manage endodontic cases successfully.

Dr Philippe Guettier also conducted a pre-conference workshop on Saturday, 12th November 2016 at the Faculty of Dentistry, Universiti Kebangsaan Malaysia.

The 2015-2016 MES Committee Members with the speakers of the 2016 MES Annual Scientific Conference & AGM.

The audience listening to the lecture delivered by Dr Jaruma.
TREASURER’S REPORT

Dear members,

The financial status of the Malaysian Endodontic Society remains positive with profit amount of RM150,074.65 from the events carried out in our financial year while our net assets stand at RM719,279.93.

We are looking forward to organise more seminars and conferences with the help from more volunteers and continuous support from our members in the near future.

Dr Yap Li Ling
MES Treasurer 2017
PERSATUAN ENDODONTIK MALAYSIA  
(MALAYSIAN ENDODONTIC SOCIETY)  

REVENUE AND EXPENDITURE STATEMENT  
FOR THE MONTH OF SEPTEMBER 2016 TO AUGUST 2017

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2017</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sept - Dec</td>
<td>Jan - Aug</td>
<td>RM</td>
</tr>
<tr>
<td></td>
<td>RM</td>
<td>RM</td>
<td>RM</td>
</tr>
<tr>
<td>Annual Subscription and Entrance Fees</td>
<td>13,232.80</td>
<td>2,800.00</td>
<td>16,032.80</td>
</tr>
<tr>
<td>Conferences and Courses Fees</td>
<td>84,940.00</td>
<td>5,330.00</td>
<td>90,270.00</td>
</tr>
<tr>
<td>Interest on Deposits</td>
<td>15,377.52</td>
<td>7,833.79</td>
<td>23,211.31</td>
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<tr>
<td>Sponsorship</td>
<td>28,213.50</td>
<td>14,800.00</td>
<td>43,013.50</td>
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<tr>
<td>UiTM - MES 2017 Seminar</td>
<td>41,050.00</td>
<td></td>
<td>41,050.00</td>
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<tr>
<td><strong>Total Revenue</strong></td>
<td><strong>168,363.82</strong></td>
<td><strong>71,813.79</strong></td>
<td><strong>240,177.61</strong></td>
</tr>
</tbody>
</table>

**EXPENDITURE**

<table>
<thead>
<tr>
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<th>2016</th>
<th>2017</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>RM</td>
</tr>
<tr>
<td>Accounting Fees</td>
<td>500.00</td>
<td>0.00</td>
<td>600.00</td>
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<tr>
<td>Subscription Fee</td>
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<td>1,209.15</td>
<td>1,209.15</td>
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<td>Bank Charges</td>
<td>14.84</td>
<td>102.61</td>
<td>117.45</td>
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<tr>
<td>Committee Meeting Expenses</td>
<td>59.00</td>
<td>568.15</td>
<td>628.05</td>
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<tr>
<td>Conference and Clinical Meeting Expenses</td>
<td>58,554.52</td>
<td>8,987.99</td>
<td>67,542.51</td>
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<tr>
<td>EXP - MES 2017 Seminar</td>
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<td>13,530.00</td>
<td>13,530.00</td>
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<td>Income Tax Expenses</td>
<td>94.92</td>
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<td>94.92</td>
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<tr>
<td>Printing &amp; Stationery</td>
<td>4,167.00</td>
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<td>4,167.00</td>
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<td>Secretarial Work</td>
<td>2,100.00</td>
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<td>2,100.00</td>
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<tr>
<td>Tax Computation</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>Telephone</td>
<td>10.00</td>
<td>0.00</td>
<td>10.00</td>
</tr>
<tr>
<td>Web Hosting</td>
<td>0.00</td>
<td>103.88</td>
<td>103.88</td>
</tr>
<tr>
<td><strong>Total Expenditure</strong></td>
<td><strong>65,601.18</strong></td>
<td><strong>24,501.76</strong></td>
<td><strong>90,102.94</strong></td>
</tr>
<tr>
<td><strong>Surplus of Revenue over Expenditure</strong></td>
<td><strong>102,762.64</strong></td>
<td><strong>47,312.01</strong></td>
<td><strong>150,074.65</strong></td>
</tr>
</tbody>
</table>

I certify hereby that the statement given above is true to my knowledge and belief.

Dr Yap Li Ling
PERSATUAN ENDODONTIK MALAYSIA  
(IMALAYSIAN ENDODONTIC SOCIETY)  

BALANCE SHEET AS AT 31ST AUGUST  

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed Assets</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer at cost</td>
<td>5,475.00</td>
<td>5,475.00</td>
</tr>
<tr>
<td>Computer - Accm Depreciation</td>
<td>(5,474.00)</td>
<td>(5,474.00)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

|                  |       |       |
| **Current Assets** |     |       |
| Balance in Fixed Deposits | 518,922.58 | 494,711.27 |
| Balance in Saving Account | 0.00  | 0.00  |
| Balance in Current Account | 179,188.10 | 63,247.84 |
| Cash in Hand | 3,849.65 | 3,849.65 |
| **Total** | 701,960.33 | 561,808.76 |

|                  |       |       |
| **Other Assets** |     |       |
| Deposit - Conference Hotel Deposit | 0.00  | 0.00  |

|                  |       |       |
| **Current Liabilities** |     |       |
| Provision of Taxation | (17,318.60) | (13,554.60) |

|                  |       |       |
| **Net Assets** |       |       |
| **Total** | 719,279.93 | 575,364.36 |

|                  |       |       |
| **Represented By :-** |     |       |
| Surplus of Revenue over Expenditure b/ forward | 572,213.76 | 555,449.00 |
| Current Period Surplus of Revenue over Expenditure | 147,066.17 | 18,996.62 |
| Surplus of Revenue over Expenditure c/ forward | 719,279.93 | 574,445.62 |

Dr Afzan Adlah Ayoub  
President, M.E.S  

Dr Yap Li Ling  
Treasurer, M.E.S  

AUDITORS’ REPORT  
The above statement of Revenue and Expenditure for the year ended 31st August 2017  
and the Balance Sheet as at 31st August 2017 have been prepared from the books and from  
the information and explanations given to us and in our opinion the accounts reflect a true and  
fair view of the financial position of the Malaysian Endodontic Society as at 31st August 2017  

Dated:  

Dato' Dr Teo Choo Kum  
Hon.Auditor, M.E.S  

Dr Yoong Lai Thong  
Hon.Auditor, M.E.S
**PERSATUAN ENODONTIK MALAYSIA  
(MALAYSIAN ENODONTIC SOCIETY)  
BALANCE SHEET AS AT 31ST AUGUST 2017**

<table>
<thead>
<tr>
<th>Description</th>
<th>RM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Assets</td>
<td></td>
</tr>
<tr>
<td>Computer at cost</td>
<td>5,475.00</td>
</tr>
<tr>
<td>Computer - Accm Depreciation</td>
<td>(5,474.00)</td>
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<tr>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>Current Assets</td>
<td></td>
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<tr>
<td>Balance in Fixed Deposits</td>
<td>518,922.58</td>
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<td>Balance in Saving Account</td>
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<td>Balance in Current Account</td>
<td>179,188.10</td>
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<tr>
<td>Cash in Hand</td>
<td>3,849.65</td>
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<tr>
<td></td>
<td>701,960.33</td>
</tr>
<tr>
<td>Other Assets</td>
<td></td>
</tr>
<tr>
<td>Deposit - Conference Hotel Deposit</td>
<td>0.00</td>
</tr>
<tr>
<td>Current Liabilities</td>
<td></td>
</tr>
<tr>
<td>Provision of Taxation</td>
<td>(17,318.60)</td>
</tr>
<tr>
<td>Net Assets</td>
<td>719,279.93</td>
</tr>
</tbody>
</table>

Represented By:
- **Surplus of Revenue over Expenditure of forward**: 671,957.92
- **Current Period Surplus of Revenue over Expenditure**: 147,098.17
- **Surplus of Revenue over Expenditure of forward**: 819,034.09

Dr Afzan Adilah Ayoub  
President, M.E.S

Dr Yap Li Ling  
Treasurer, M.E.S

**AUDITORS’ REPORT**

The above statement of Revenue and Expenditure for the year ended 31st August 2017 and the Balance Sheet as at 31st August 2017 have been prepared from the books and from the information and explanations given to us and in our opinion the account reflect a true and fair view of the financial position of the Malaysian Endodontic Society as at 31st August 2017.

Dated:

Daluk Dr Teo Choo Kum  
Hon Auditor, M.E.S

Dr Yoong Lai Thong  
Hon Auditor, M.E.S
RE-ATTACHMENT OF A FRACTURED MAXILLARY CENTRAL INCISOR: A CASE REPORT

1Muhammad Khiratti Bin Mat Zainal, BDS(Mal)
2Dalia Abdullah, BDS (Mal) MClinDent Endo (Lond) FDSRCEd

1Angkatan Tentera Malaysia, Ministry of Defense & Specialist Trainee in Doctor of Clinical Dentistry (Endodontology), Universiti Kebangsaan Malaysia
2Department of Operative Dentistry, Universiti Kebangsaan Malaysia

ABSTRACT
Crown reattachment is the most conservative treatment which can be used to restore fractured tooth, presumably with sufficient strength, while maintaining original contour, incisal translucency, and reducing chair time and cost. In case of crown fracture with pin-point pulp exposure, irritation to the pulp should be minimised and consideration must be taken for pre-treatment pulpal status, choice of pulp capping materials, choice of bonding system and treatment sequence during crown reattachment procedures. This article reports a crown fracture case with pin-point pulp exposure that was treated using crown reattachment with direct pulp capping. At 6 month’s review, the tooth remained vital, the appearance of restoration was acceptable with no colour change to the crown.

INTRODUCTION
Crown fracture can be defined as fracture of the crown involving enamel and dentine. If the fracture also exposes the dental pulp the injury is defined as a 'complicated crown fracture' or a Class 3 fracture (Ellis & Davey 1970, Andreasen & Andreasen 1993). The incidence of complicated crown fractures ranges from 2% to 13% of all dental injuries and the most commonly involved tooth is the maxillary central incisor (Andreasen & Andreasen 1993). The most frequent causes are falls, traffic accidents, domestic violence, fights, and sports (Andreasen 1970).

Complicated crown fractures of permanent teeth possess both endodontic and restorative challenges (Olsburgh & Krejci 2003). The type of pulpal treatment to be undertaken depends on the stage of root development, the size of the exposure, and the time elapsed between the injury and the emergency treatment. Several other factors, such as the health of the pulp before the trauma, the age of the patient, the presence of a concomitant luxation injury, the effect of the surgical procedures, and the type of pulp-capping agent employed may also influence the selection of the most appropriate treatment (Andreasen & Andreasen 1994a,b).

The degree of pulp exposure may vary from a minute pinpoint exposure to total exposure of the coronal pulp. The aim of pulpal treatment should be the preservation of a vital, non-inflamed pulp, biologically walled off by a continuous hard tissue barrier (Olsburgh & Krejci 2003). In most cases, this can be achieved by pulp capping, partial pulpotomy (Cvek) or full pulpotomy. However, if it left exposed, the pulp will become necrotic through bacterial contamination (Yu & Abbott 2016). Thus, pulpectomy procedure may offer a better chance of success rather than risking the development of apical periodontitis following direct pulp capping or pulpotomy procedures (Minhas & Patel 2016).

On the other hand, at the restoration level, the choice of the aesthetic restorative treatment of fractured anterior teeth remains the biggest challenge for the dentist (Taguchi et al. 2015). Various methods and techniques were employed to restore fractured teeth which include pin retained resin, orthodontic bands, stainless steel crowns, porcelain jacket crowns, and complex ceramic restorations. However all these restorations require significant tooth preparation and were not aesthetically adequate; moreover they cannot be used in an emergency aesthetic situation (Badami et al.)
One of the options for managing coronal tooth fractures, especially when there is no or minimal violation of the biological width, is the reattachment of the dental fragment when it is available (Baratieri, Monteiro & Andrada, 1990). Reattachment of the fractured coronal fragment to the remaining tooth structure has been shown to be an excellent alternative to conventional restorations such as resin composite build-up, veneer, or crown (Wiegand, Rodig & Attin 2005). This procedure may offer several advantages such as improved aesthetics since enamel's original shape and colour, brightness and surface texture are maintained (Toshihiro & Rintaro 2005). In addition, the incisal edge wears at a similar rate to adjacent teeth, whereas, a composite restoration will likely wear more rapidly (Baratieri, Monteiro & Andrada, 1990). Furthermore, this technique is less time consuming and provides more predictable long-term wear (Baratieri, Monteiro & Andrada, 1990). Besides that, it can result in a positive psychological response (Maia et al. 2003). In addition, tooth fragment reattachment allows restoration of the tooth with minimal sacrifice of the remaining tooth structure (Andreasen 2001).

Several aspects may govern the choice of reattachment technique. Studies have reported that the primary cause of fragment loss is new dental trauma or the non-physiological use of the restored tooth (Andreasen et al. 1995). Therefore, most concerns about reattachment techniques have been directed toward the fracture strength of the restored tooth (Reis et al. 20004). Chosack and Eldeman published the first case report on reattachment of a fractured incisor fragment in 1964. Since then, different preparation techniques (bevel, circumferential chamfer, buccal chamfer, over-contour, internal dentin groove) as well as adhesive materials have been described throughout the literature, designed to increase the chemical and mechanical retention of fragments (Reis et al. 20004).

Despite the recent developments in adhesive materials and restorative techniques, there is no restorative material that can reproduce the aesthetic, functional needs and the natural dental structures (Davari & Sadeghi 2014). Therefore, when the fractured fragment is available and ample enough to be used after dental fracture, reattachment should be considered the treatment of choice as the most conservative treatment approach (Wiegand, Rodig & Attin 2005). Therefore, we should try to plan the ideal procedure not only to get a good bonding of the fragment but also to minimize the pulpal irritation during the whole procedure.

**CLINICAL CASE REPORT**

An 18-year-old female patient attended the Primary Care Clinic of Universiti Kebangsaan Malaysia (UKM) with a chief complaint of a crown fracture of the right maxillary central incisor. She sustained the injury as a result of a fall on the slippery floor at her college, 4 hours prior to the visit. The fractured tooth segment was recovered at the site of the injury and was kept in her handkerchief.

Past medical history was non-contributory. At her last dental visit (a month ago), she had been advised by her orthodontist to undergo the orthodontic treatment to correct her malocclusion.

Extraorally, there was no apparent trauma to the soft tissues. Intraoral clinical examination revealed a complicated crown fracture (incisal one-third) of the right maxillary central incisor, with a small pulp exposure of approximately 1 mm (Figure 1 and Figure 2).

The remaining maxillary and mandibular anterior teeth were all intact. Tooth was not tender on palpation and percussion. It responded to cold test and electric pulp test. Tissues around the affected tooth was normal without any swelling, abscess, draining sinus or loss of stippling of gingiva. There was no bleeding on probing and the periodontal pocket was within normal depth (2-3mm) with no mobility. The crown fragment was in good
condition and it fitted reasonably well on the fractured tooth (figure 3).

Periapical radiographic examination revealed horizontal fracture line on the crown of the tooth, complete root development, closed apices, no periapical pathology, and absence of root or alveolar bone fractures (figure 4).

After routine history taking and examination, the patient and the mother were provided with several treatment options and associated benefits and disadvantages of each. They opted to have the crown fragment reattachment with direct pulp capping. The procedure was explained to them and informed consent was obtained.

PROCEDURES
1. One cartridge of local anesthesia (Scandonest 2% with levonordefrin 1:20,000) was administered via buccal infiltration.
2. The affected tooth and adjacent teeth were isolated with rubber dam (Figure 5).
3. The pulpal exposure was carefully irrigated with alternate solutions of normal saline and 0.12% chlorhexidine gluconate (PerioGard Colgate).
4. Direct pulp capping was performed by applying self-hardening calcium hydroxide (CaOH) (Dycal; Dentsply Caulk, Milford, DE, USA) on the exposed pulp (Figure 5).
5. This was followed by a layer of resin modified glass ionomer (RMGIC) (Vitrebond; 3M Espe, St Paul, MN, USA) and photopolymerized for 40s.
6. Preparation of tooth: The remaining tooth structure was acid etched using 37% orthophosphoric acid (Ultra-Etch; Ultradent Products, Inc., SJ, UT, USA) for 30s on the enamel margins. The acid was removed by rinsing with water, and the substrate was gently dried with cotton pellets. A bonding agent was applied on the surface of the remaining tooth structure with an ethanol-based adhesive system (Adper Single Bond Plus, 3M ESPE) and was cured with visible light for 10s. Utmost attention was given to the dentin bonding agent so as not to cause any thickening on the surface.

Figure 1. Frontal view of the fractured 11.

Figure 2. Palatal view with a small pulp exposure of approximately 1 mm.

Figure 3. Fractured fragment of tooth 11.

Figure 4. Pre-operative radiograph
7. Preparation of tooth fragment: Tooth fragment was stored in water for 30 minutes before being repositioned to avoid dehydration. To ease the handling, it was secured by a “pick-and-stick” device (the vestibular surface of the fractured segments was glued with to a handbrush using sticky wax (Figure 6). The fractured surface was treated with 37% phosphoric acid gel for 30s, followed by delicate rinsing (Figure 6). The adhesive system was then applied to the etched surface and was light cured for 10s.

8. The fractured segment was then accurately placed on the tooth, paying special attention to the fit between the segments (Figure 7). When the original position had been re-established, the flowable resin composite (Tetric Flow; Ivoclar Vivadent, Schaan, Liechtenstein) was applied to the fracture surfaces of both parts, spread over the surface with a dental probe, and the fragments were reattached to their places. The overflowing resin composite was removed and cured with visible light for 20s from both the labial and palatal surfaces (Figure 8).

9. Subsequently, along the fracture line, a V-shaped external ‘double chamfer’ margin of 1mm coronally and apically to the fracture line, was created using a diamond round bur (Figure 9). The chamfer was etched, applied with adhesive resin and restored with a composite resin (Filtek Z350 XT, A2, 3M ESPE, St Paul MN, USA). The composite was cured for a time of 20s per increment.

10. The margins were polished with diamond burs and a series of Sof-Lex disks (3M ESPE) and diamond polishing paste (Figure 10 & 11).

11. The occlusion was checked and adjusted, and the patient was dismissed after receiving instructions to avoid exerting heavy function on this tooth.

12. The patient and the patient’s mother were informed that the reattachment line might be visible, and, if necessary, this could be managed in future visits.

13. The patient was reviewed after one week, one month, three month (Figure 12) and six months after treatment. At six months after the trauma, tooth 11 was found to be vital without periodontal or periapical pathology (Figure 13) and the restoration was functional and aesthetically acceptable.
Figure 9. A V-shaped external ‘double chamfer’ margin of 1mm coronally and apically to the fracture line was created using a diamond round bur. A transparent A2 shade of composite resin is then applied and cured along the fracture line.

Figure 10. Frontal view of tooth 11.

Figure 11. Palatal view of tooth 11.

Figure 12. Three-month follow-up – smile view.

DISCUSSION
The complicated crown fracture in this case requires careful consideration with regards to the pulpal status and pulp capping materials during crown reattachment procedures besides crown reattachment procedures itself. This procedure has several extra different clinical steps. The first step is ensuring a dry operative field by placing rubber dam to isolate the tooth being treated. This is to prevent any bacterial contamination which could further cause pulpal irritation and subsequently pulpal necrosis (Kakehashi, Stanley & Fitzgerald 1965). The area of exposed pulp was carefully irrigated with alternate solutions of normal saline and 0.12% chlorhexidine gluconate (PerioGard Colgate). Furthermore, this isolation procedure could also prevent the negative effect of the adhesive procedures for reattachment (Yoo, Oh & Pereira 2006).

Figure 13. Radiographic image of the tooth after six month.

In the present case, direct pulp capping procedure was performed by placing calcium hydroxide directly over the exposed pulp tissue. This procedure was indicated because the exposure was small and it can be treated shortly after injury which, according to experimental studies, seems to mean within 24 hours (Cox et al. 1985). It has been shown that a tooth is more likely to survive direct pulp capping because the initial exposure was due to trauma rather than caries (Baume & Holz 1981). This procedure was also chosen considering the age of the patient (Baume & Holz 1981), no concomitant luxation injuries (Andreasen & Andreasen 1994), and maturity of the roots (Andreasen & Andreasen 1994).
The most commonly used wound dressing is calcium hydroxide. Its high pH and low water solubility are responsible for its antimicrobial activity and ability to induce hard tissue formation (Mejare, Hasselgren & Hammarstrom 1976). When placed over the vital pulp, pure calcium hydroxide causes a superficial tissue necrosis, approximately 1-1.5 mm in depth (Mejare, Hasselgren & Hammarstrom 1976). This low-grade irritation from coagulation necrosis will induce defensive reactions in the pulp, resulting in formation of a demarcating hard-tissue barrier (Schroder 1973). The underlying tissue seems to react to this irritation by producing collagen that is subsequently mineralised, while the coagulated tissue is calcified, which is later followed by differentiation of dentin. However, pulp healing may be threatened by later contamination due to microleakage of defective restorations, since all calcium hydroxide compounds gradually lose their antibacterial ability (Granath 1982). To encounter this problem, in this case, calcium hydroxide was placed over vital tissue and not a blood clot and then covered with a resin-modified glass ionomer in order to eliminate microbial leakage to the exposure.

Having said that, in the last decade, mineral trioxide aggregate (MTA), a bioactive material has become a frequently used as a pulp capping materials due to its biocompatibility and hard tissue conductive and inductive properties which a good protective barrier against bacterial penetration (Hilton et al. 2013). It has also been shown that the bioactive property of MTA is superior (when compared with calcium hydroxide and other materials) in dentin bridge formation after pulp capping and pulpotomies (Nair et al. 2007). But because of the unavailability of the material in the clinic during that time, CaOH seems to be a suitable option and well-tested pulp dressing agent which repeatedly gives predictable results in the form of a non-inflamed pulp under a well-formed hard-tissue barrier.

If the pulp is minimally exposed, acidic etchant should not be in direct contact with pulp. Pameijer & Stanley (1998) reported that if acidic etchant came in contact with the exposed pulp, hemostatic effectiveness and resin sealing was greatly reduced. Thus, in this case, acidic etchant was applied after placement of self-hardening calcium hydroxide Dycal and RMGIC, were set to the enamel surface only. The layer of RMGIC provides protection to the CaOH lining. Burke & Watts (1986) reported that during an etching and washing cycle, CaOH lost 14.4% of its mass. The loss of material from Dycal as a result of acid contact is generally regarded as disadvantageous. RMGIC can be etched as it provides an added micromechanical retention for composite resin.

Reattachment of the fractured tooth segment is one of the best techniques for the restoration of a fractured anterior tooth. It is aesthetically more predictable for translucency, opalescence, fluorescence, characterizations and texture of the surface (Lehl & Luthra 2004). In addition, it is less time consuming compared with other direct and indirect restorations. The rate of wear and abrasiveness is the same as that for the intact tooth, while composite resin will be abraded more quickly than enamel by the opposing dentition (Baratieri et al. 1994). Moreover, the technique also restores stress resistance comparable to intact tooth tissue and, thus, in case of further dental trauma, is preferable to composite restoration (Simonsen 1982). The technique also prevents the patient, especially children and young adolescent and their parents, from an emotional trauma of loss of a body part. They are at least satisfied of the original fragment being used in the restoration of their fractured tooth (Yilmaz et al. 2008).

In this case, a flowable resin composite was used to reattach the fractured incisal part to the tooth. An external double chamfer technique along the fracture line was then created and filled with resin composite. This procedure has been shown to provide better strength as compared to simple reattachment and prevents fragment detachment. Cengiz et al. (2005) reattached the tooth fragment using a flowable resin composite and reported successful results after 2.5 years. It has been shown that a simple reattachment with no further preparation of
the fragment or tooth was able to restore only 37.1% of the intact tooth’s fracture resistance, whereas a buccal chamfer recovered 60.6% of that fracture resistance; bonding with an over-contour and placement of an internal groove nearly restored the intact tooth fracture strength, recovering 97.2 and 90.5% of it, respectively (Reis et al. 2001).

Most in vitro studies that have tested adhesive systems show that the kind of adhesive system used alters the fracture strength of the reattached teeth (Farik, Mushkaard & Andreasen 2000) & Badami, Dunne & Scheer (1995) and is in the range of 40-60% of the fracture strength of sound teeth. Conversely, Reis et al. (2004) have shown, in a study, that the sole use of an adhesive system or its combination with higher mechanical property materials such as foldable resins, resin cements and resin composites have led to similar results when the fragment was reattached with no additional preparation.

The quality of fit between segments is an important factor to be considered in this technique. Regardless of which method is selected, obtaining well-sealed margins between the tooth fragment, composite and tooth interface minimizes further irritation to the pulp. Creating a double chamfer after the fragment is reattached causes minimal loss of fit as compared to techniques in which the fragment is manipulated before bonding (Reis et al 2004). Besides that, using ‘pick-and-stick’ device prior to bonding to tooth surface helps to stabilise the fragment to fit the attachment with tooth surface.

Aesthetic problems that might arise from reattachment procedure include discoloration or degradation of the composite bonding materials at the fracture line or discoloration of the incisal fragment with time (Andreasen, Daugaard-Jensen & Munksgaard 1991). The problem of discoloration of the fracture line is most pronounced in earlier cases of bonding, due to discoloration of the catalyst system of the chemically-cured resin used (Robertson et al. 2000). This problem has been solved in part by the use of light-cured composite materials due to colour stability and more flexible working time. Besides that, aesthetic has also been enhanced by the use of a double-chamfer preparation along the fracture line after fragment bonding and restoration with a composite resin. Fragment discoloration, usually to a mat white colour, can occur is due to dehydration of the underlying dentin (Andreasen, Daugaard-Jensen & Munksgaard 1991). Simonsen (1982) reported the reattachment of the discoloured crown fragment kept in dry condition for 1 week can regain some of its original colour and translucency after 8 days. This result suggests that the reattachment of the crown fragment should be done even if the crown fragment is discoloured.

Studies have shown that prognosis of complicated crown fractures is good, pulp survival following pulp capping varies between 72% and 88% (Kozlowska 1960), (Ravn 1982) & (Fuks et al. 1982). Furthermore, fragment bonding apparently has not been found to lead to pulpal complications in a larger long-term study (Robertson et al.2000). The few cases of pulp necrosis and pulp canal obliteration were all found in relation to concomitant luxation injuries. This low complication rate is more likely a response to the injury itself than to the treatment procedure.

CONCLUSIONS
The reattachment of fractured crown fragment with a bonding technique is an effective method for restoring anterior fractured teeth that offers advantages when compared to composite restorations or ceramic crowns. It provides a viable technique that restores function and aesthetics in a very conservative approach, and it should be considered when treating patients with coronal fractures of anterior teeth, especially younger patients. The best outcome can be expected when the crown fragment is in a single piece and can be re-approximated with its source (remaining tooth) with minimal loss of tooth structure.

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INTRODUCTION
One of the common anatomical variations of root canal morphology for lower second molar teeth is the C-shaped canal configuration. Cooke & Cox (1979) first documented it in endodontic literature. It was described as having a continuous ribbon-shaped isthmus that connects individual root canals with thin walls. This is due to the failure of Hertwig’s epithelial root sheath to fuse onto the buccal or lingual root surface (Manning 1990). C-shaped canals in mandibular second molar were most frequently found in single/ fused roots and most commonly in Asian population especially Chinese, the incidence ranging from 31.5%-44.5% (Yang et al. 1988, Jin et al. 2006). Identification and proper management of teeth diagnosed as having a C-shaped configuration is prudent for a successful root canal treatment. This case report describes the diagnosis and treatment of a C-shaped lower left second molar tooth.

CASE REPORT
A 35-year-old Malay gentleman was referred to UKM Endodontic Specialist Clinic for root canal treatment of suspected calcified tooth 37. There was history of spontaneous pain and swelling 2 months ago. The tooth has been extirpated one month ago at the outpatient clinic. Patient was able to chew on the affected site with mild discomfort. There were multiple histories of restoration dislodgement before. The patient is medically fit and healthy with no known allergy.

Upon extraoral examination, there was no abnormality detected. Patient had fair oral hygiene. At the site of complaint, tooth 37 presented with a temporary restoration occlusally extending to the buccal surface with marginal leakage (Figure 1). The tooth was tender to percussion while not tender on palpation. It was slightly mobile with no deep pocketing nor swelling detected.

Figure 1. Buccal view of tooth 37 with occlusobuccal temporary restoration.

Radiographically there was an occlusal restoration extending deep into the pulp. The pulp chamber appears to be large in occlusal apical dimension with a low bifurcation (Figure 2). The roots are fused and the canal outline cannot be traced from the middle third to the apex, which indicated a C-shaped canal. There is presence of periapical radiolucency surrounding the roots.

Figure 2. Pre-operative radiograph

The tooth was diagnosed with previously initiated therapy, symptomatic apical periodontitis and root canal treatment was
carried out for the patient. ID block was performed and tooth 37 was isolated using rubber dam. Upon examination and under the dental operating microscope, two canals were located and it was confirmed that this tooth was having a C-shaped canal configuration (Figure 3).

Initial canal-system recognition is important. It may be achieved with the help of fibreoptic and translumination from the buccal surface and the aid of dental operating microscope. The use of CBCT may provide the clinician with a better tool to diagnose this complex anatomy and choose appropriate instrumentation and obturation techniques. The orifice portions of the slit must be widened considerably early in treatment but not too deep to avoid a perforation (Weine, 1998).

The main canals spaces can be prepared and obturated as standard canals. However, cleaning and sealing the buccal isthmus is challenging. Isthmus should be prepared with file no larger than #25 using circumferential filing motion to avoid strip perforation, because of the thin wall. Copious irrigation with 5.25% NaOCl is necessary for thorough debridement.

EDTA 17% as an adjunct irrigation solution used to chemically soften the root canal dentine and dissolve the smear layer, as well as to increase dentine permeability by opening-up the dentinal tubules (chelator)(Jerome, 1994).

Another important aspect of cleaning a C-shaped canal is the use of ultrasonics. Manual instrumentation can be augmented with ultrasonic devices to debride the canal more effectively, since this can result in greater volumes of irrigants entering and penetrating the canal system, thus promoting more thorough cleaning of the narrow areas of the canal. Ultrasonic activation of irrigants (Sodium hypochloride) by using endo sonofiles or Endoactivator resulted in acoustic microstreaming and hydrodynamic cavitation, a phenomenon that shows to enhance the chemomechanical debridement of the canals especially the isthmus area.

Thermoplasticised or injectable materials is the most appropriate technique to obturate a C-
shape canal. Proper placement of sealer may be achieved by the aid of ultrasonic, regardless of the choice of obturation technique (Jafarzadeh and Wu, JOE 2007).

CONCLUSION
It is challenging in diagnosing and treating a C-shaped canal configuration, therefore its proper management is critical. Technique modifications are required for management of a C-shaped roots. Because of the large area of canal space that is doubtful to be properly instrumented and debride, therefore irrigation procedures is very important to clean the entire continuum of the isthmus area.

REFERENCES
INTERNAL ROOT RESORPTION – A CASE REPORT

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INTRODUCTION
Root resorption is the loss of dental hard tissues as a result of clastic activities. It might be broadly classified into external or internal resorption by the location of the resorption in relation to the root surface (Patel et al. 2010).

Internal root resorption is the progressive destruction of intraradicular dentin and dentinal tubules along the middle and apical thirds of the canal walls. Internal root resorption is a relatively rare clinical entity in permanent teeth compared with the external root resorption. Internal root resorption is generally asymptomatic and detected coincidentally through routine radiographs. The diagnosis of internal root resorption is primarily based on radiographic examination and supplementary information gained from the patient’s history and clinical findings (Patel et al. 2010).

This case report describes the management of asymptomatic apical periodontitis associated with internal root resorption of tooth 12.

CASE REPORT
A healthy 22-year-old Malay female patient was referred by an undergraduate student to the Endodontic Specialist Clinic in 2015 for the management of tooth 12. At the time of consultation, tooth 12 was asymptomatic. The patient’s medical history was non-contributory. She had no history of traumatic injury or orthodontic treatment.

Clinical examination revealed a defective composite restoration on mesial-palatal surfaces of tooth 12. The probing depth was within normal limit for this tooth. The tooth was not tender to percussion, palpation or biting. The tooth was not mobile. There was no evidence of swelling or sinus tract formation in this region. The patient’s oral hygiene was fair. The electric and thermal pulp sensibility tests were both negative for tooth 12.

Figure 1. Labial view of tooth 12.

From pre-operative radiograph, presence of secondary caries under the composite restoration on mesial aspect was noted. There appeared to be a symmetrical “ballooning” out of the root canal at the apical part. This was diagnosed as an internal resorption since the wall of the canal was continuous with the resorpive lesion. Periapical radiolucency was evident (Figure 2).

Figure 2. Pre-operative radiograph of tooth 12

A second radiograph of tooth 12 was taken with the x-ray tube head shifted to the mesial
(parallax technique). The lesion remained in the same position in the canal when compared to the first radiograph confirming it was an internal resorption.

The patient was advised of the clinical findings and the following treatment options were discussed and included nonsurgical root canal treatment, leave alone or tooth extraction. The patient decided to proceed with the nonsurgical root canal treatment because she desired to retain a functional tooth for as long as possible. The patient was informed of the technical difficulties and potential risks of the endodontic treatment. The patient gave written consent for the proposed treatment. At the first visit, the tooth was isolated with a dental dam and was accessed under surgical microscope. The working length was determined using an electronic apex locator and verified radiographically (Figure 4).

![Figure 4. Working length radiograph](image1)

The canal was prepared using NiTi rotary files and 2.5% NaOCl was used as an irrigant, Ca(OH)$_2$ paste as intracanal medicament. The access cavity was double sealed with Cavit and IRM. After a week, the root canal was re-entered and irrigated with 2.5% NaOCl to remove the temporary dressing. Fitting of MGP was verified with radiographically.

Canal was irrigated with 2.5% NaOCl, 17% EDTA, normal saline and 2% CHX (final irrigation protocol) using passive sonic irrigation (EndoActivator system). The root canal were dried with calibrated absorbent paper points. There was no blood or exudation in the root canal space before premixed bioceramic material (TotalFill® Bioceramic Root Repair Material (RRM) Putty (Brasseler, Savannah, Georgia, United States) was applied. Bioceramic material was compacted into the canal to fill the 6mm apical part of the canal and resorbed defect (Figure 5). The remaining portion of the canal was back-filled with thermoplastic GP (Figure 5). The tooth was restored with bonded core followed by an All Ceramic crown.

![Figure 5. Canal of tooth 12 obturated.](image2)

The patient was reviewed at 12 months after the completion of the endodontic treatment. The tooth was asymptomatic (Figure 6). The periapical radiolucent area showed a marked decrease in size.

**DISCUSSION**

Intraradicular internal resorption is an inflammatory condition that results in progressive destruction of intraradicular dentine and dentinal tubules along the middle and apical third of the canal walls (Patel et al. 2010).

Chemomechanical debridement and obturation could be a challenge in case with internal root
resorption due to the limited accessible to the resorption region. Therefore, sonic device was used on tooth 12 which presented with internal root resorption at apical third of the canal to further improve the efficacy in removing necrotic debris as well as biofilms from the inaccessible areas of the root canal (van der Sluis et al. 2007). Besides, inter-apartment dressing of calcium hydroxide was used to enhance chemomechanical debridement of the resorption defect (Siqueira et al. 2002).

Figure 6. Radiograph at 12-months review.

In this case, bioceramic-based material is the obturation material of choice because it is bioactive, able to precipitate apatite crystalline structure that increased over time (Shokouhinejad et al. 2012). It has antibacterial activities against Enterococcus faecalis possibly because of its alkaline pH (Lovato and Sedgley 2011). Besides, it is highly biocompatible (Ma et al. 2011) and its’ sealing ability is comparable to MTA (Nair et al. 2011). The long-term prognosis of tooth 12 is deemed favourable as the lesion is small and located in the apical area (AAE 2014). Additionally, the use of highly aseptic techniques and advanced materials can further improve the prognosis of tooth 12.

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SENSITIVE TEETH AS AN ADVERSE EFFECT OF STEROID THERAPY. A CASE STUDY

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INTRODUCTION

Corticosteroids are widely used in the treatment of severe asthma and chronic obstructive pulmonary disease, severe allergic reactions, organ transplant recipients, and autoimmune disorders often with symptoms mimicking allergic reactions (Knarborg et al 2013). It however, may cause a range of side effects and its manifestation depends on its route of administration and duration of use (Hougardy et al 2000).

According to the data of eHealthMe (2017) by FDA reports, 247,408 people were reported to have side effects when taking Prednisolone, a type of corticosteroid. Among them, 214 people (0.09%) suffer from tooth sensitivity. The other reported side effects include pain, osteonecrosis of jaw, joint pain, stress and anxiety and bone disorder.

Interestingly, there is no documented evidence in the academic literature that addresses sensitive teeth as an adverse effect of steroid therapy. In contrast, there are various informal reports on social media [personal blogposts (Figure 1 - 2) and Facebook pages] from patients who were on steroids that claimed they experienced sensitive teeth after taking the medication. The only study that could be found in the literature with regards to the causal relationship between steroid therapy and tooth sensitivity was by Shoji et al (2016). They surveyed 220 patients who had undergone steroid therapy to determine the potential relationship between steroid therapy and dentine hypersensitivity (DH)-like tooth pain. The prevalence of tooth sensitivity in these patients was 17.7%. They concluded that steroid therapy can evoke DH-like tooth sensitivity during treatment as positive correlation was found between steroid dose and pain score.

To our knowledge, this case report is the first to record the occurrence of sensitive teeth in a patient who had been on high dose of Prednisolone.

CASE REPORT

A 47-year-old female patient attended the UKM Endodontic Specialist Clinic complaining of generalised sensitivity/pain from her teeth. The pain started a few months ago (sometimes from April 2017). It was triggered upon taking cold,
hot and sweet food and drink. At the initial stage, she reported that even taking in a large breath through her mouth could evoke the pain. The pain was throbbing, severe in nature and was continuous for more than a few minutes before it subsided. She claimed that the pain occurred in multiple teeth and she was not able to pin point any particular tooth. Because of the pain, she refrained heself from taking cold, hot or sweet food. She was not an pain-killers as the pain will only appeared upon stimuli.

The medical history revealed that the patient was diagnosed with Ulcerative Colitis in 2008 and had been on Azathioprine (75mg) and Mesalazine (1g tds). She suffered from Pyoderma Gangrenosum in November 2016 and was administered high dose of Prednisolone (30mg bd) for four months followed by tapering dose of 5mg/week until end of May 2017. The patient was a medical practitioner (with a doctorate degree in Pharmacology) so she was able to give an accurate medical history.

During the examination, patient kept complaining of severe pain upon blowing short blast of cold air from the 3-in-1 syringe to dry the teeth for inspection. Clinical examination revealed that she has good oral hygiene, with minimal plaque accumulation at the upper anterior teeth (Figure 3). The gums appeared pink and healthy. Basic periodontal examination revealed probing depths of normal limit (2 – 3mm). Minimal root exposure could be detected on tooth 32 only.

Defective amalgam restoration was noted on the distal-occlusal aspect of tooth 36 (Figure 4). The rest of the teeth and restorations on teeth 15, 27, 45 and 47 were sound (Figure 3-7).

Responses from sensibility tests (cold test and electric pulp test) indicated that tooth 36 was vital. It was neither tender to percussion nor palpation. The periapical radiograph showed that the restoration was near the pulp horn but there was no abnormality at the apices (Figure 8).
pulpal pain followed by treatment for dentine hypersensitivity. At the first visit, local anaesthesia (Scandonest 2%) via inferior dental block on the lower left side was administered. Upon removal of the amalgam using high speed handpiece with water, patient experienced intense pain from the other teeth and amalgam filling was removed intermittently until completion. The Visual Analogue Scale (VAS) score at this time was 10/10. Patient could not stand the pain and a zinc oxide eugenol temporary filling was placed.

![Figure 7. Buccal left view](image)

Figure 7. Buccal left view

Figure 8. Preoperative radiograph for tooth 36.

The surfaces of the teeth were dried with gauze after which the Sodium flouride (SF) varnish (Colgate® Duraphat® Varnish 50mg/ml Dental Suspension 2.26% SF) was applied. She was advised to use the desensitizing toothpaste to maintain her oral hygiene. The patient was reviewed twice after the first visit (at 3 days interval) and the procedure was repeated. She reported that the sensitivity became more bearable after the varnish was applied although it did not disappear completely if she takes cold or hot drink. The patient will be due to a 6-month review in the coming month.

We searched the literature and found commentaries on social media from patients who were on steroids claiming that their teeth became extremely sensitive after taking the drug. The study by Shoji et al 2016 further described the positive correlation between steroid dose and tooth pain. Based on these findings, we suspected that the patient’s tooth sensitivity could be an adverse effect of the steroid taken in high dosage.

**DISCUSSION**

Prednisone is a synthetic corticosteroid drug that is particularly effective as an immunosuppressant drug. It is used to treat certain inflammatory diseases (such as moderate allergic reactions), some autoimmune diseases, and (at higher doses) some types of cancer, but it has significant adverse effects (Tsang et al 1985). Data from FDA reports stated that the prevalence of tooth sensitivity as an adverse effect of Prednisolone is relatively low i.e. 0.09% (eHealthMe). It is found more frequently among patients who are female, age 60 years old and above, have been taking the drug for more than 1 month and who also also take the drug together with Zometa (Zoledronic acid). Although this condition is not common, the awareness of this adverse effect is important for the dentist to reassure the patient and recommend treatment measure during the period of tooth sensitivity.

Steroid has a strong anti-inflammatory and immunoragulatory effect and has not been shown to induce pain or increase pain sensation in any organ (Shoji et al 2016). Therefore the mechanism underlying the tooth sensitivity is currently not known. Endo et al (2014) carried out an experimental study in rats and reported that following steroid administration, particular glial cells were activated in the subnucleus caudalis of the trigeminal sensory complex of rats, where trigeminal primary afferent fibres innervating orofacial areas project. This finding indirectly shows the possible relationship between steroid administration and trigeminal nociception (Shoji 2016). However, there is no
explaining why pain only occurs on the teeth without involving other oral tissues as the trigeminal primary afferent fibres from the subnucleus caudalis innervate all the oral tissues including the dental pulp. Shoji et al. (2016) hypothesised that it could be that a peripheral afferent nerve fibre mechanism (rather than the central afferent fibre) is the likely mechanism that causes the teeth to be sensitive to stimuli.

The symptoms of tooth sensitivity derived from steroid therapy mimic the symptoms of dentine hypersensitivity. Based on the survey study by Shoji et al. (2016), the differences between these conditions are as follows; (i) the pain is not transient, but continuous and severe, (ii) the pain is triggered by both hot and cold drink/food, (iii) the pain occurs in multiple teeth (not localised to any particular tooth), (iv) the pain arises from tooth without obvious root exposure, (v) standard treatment for dentine hypersensitivity is effective only temporarily and (vi) the pain diminishes or resolved with reduction or discontinuation of the steroid.

The main proposed mechanism for dentine hypersensitivity suggests that pain sensation is induced by fluid movement within the dentinal tubules in response to external stimuli (either hot, cold, mechanical, evaporative or osmotic stimuli) on exposed dentine. The mineralocorticoid activity of Prednisolone was reported to induce the peripheral oedema in the skin, and if this influences the pulp tissues, then the induced oedema in the confined space of the pulp chamber could facilitate fluid movement within the dentinal tubules in response to the external stimuli causing hypersensitivity-like pain (Shoji et al. 2016). The tooth sensitivity induced by steroid therapy is not transient but continuous, suggesting that the stimuli evoke neurogenic inflammation mediated by sensory neuropeptides such as calcitonin gene-related peptide and substance P (Shoji et al. 2016).

Taking the corticosteroids may cause a range of side effects. But they give significant benefits to many different diseases and conditions which leave patients with no other choices but to take the drug. As the possible cause of tooth sensitivity in this case in internal in nature, the standard treatment generally perform for dentine hypersensitivity will only provide relieve of pain temporarily. Sodium flouride varnish is one of the in-office desensitizing agents used to occlude and seal the exposed dentinal tubules. In this case, it works to a certain extent but it was not able to relieve the pain completely. Patients need to be reassured that the pain is temporary and will dissapear in time after discontinuation of the drug. Advice to the patients can include; (i) taking food and drink at room temperature, (ii) to drink from a straw if they want to take cold drink and (iii) use warm water during tooth brushing. It is very important to stress on keeping good oral hygiene as they may compromise on tooth brushing due to the pain evoked by cold water.

CONCLUSIONS
Tooth sensitivity can occur as one of the adverse effects of steroid therapy. The pain bears similarity to the pain arises from the condition of dentine hypersensitivity but is distinguished by the severity of pain occurring in multiple vital teeth without obvious root exposure. Patients who suffer from this adverse effect may find that their dietary choices will be limited and effective oral hygiene be impeded.

REFERENCES:

WHEN TO PERFORM ENDODONTIC THERAPY PRIOR TO THE FIXED PROSTHESES?

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Introduction
A question that we often ask ourselves that how do we decide on elective endodontic therapy prior to placement of a fixed prosthesis? This is a dilemma that most clinician face when dealing with a tooth that has a questionable pulp status. The answer is usually somewhere in the middle and requires considerations.

What is the relationship between crowned teeth and a need for root canal therapy?
A number of studies have evaluated crowned teeth over the long term to see what type of events they tend to experience. As we report previously, it is commonplace that crowned teeth with no previous history of problems with their nerve (pulp) tissue ultimately develop complications that necessitate their having endodontic therapy. Bergenholtz (1991) found that on a long-term basis 9% of crowned teeth as opposed to only 2% of those without them required root canal treatment. Felton (1989) found that 13.3% of crowned teeth required root canal treatment over the long-term as opposed to only 5% of teeth without restorations. Cheung et al (2005) evaluated 122 teeth that received crowns that had no previous history of root canal treatment. At 10 years, 16% of the study teeth had experienced endodontic complications and at 15 years 18%. Valderhaug et al (1997) placed these numbers at 8% at 10 years, 13% at 20 years and 17% at 25 years.

What causes crowned teeth to require root canal therapy?
For the most part, the answer lies in the fact that crowns are usually used to rebuild teeth that have experienced some type of significant structural damage. And as it happens, these same types of events can also insult or compromise the tooth’s nerve tissue and therefore create a need for root canal treatment too. The incidence is higher when the size of the restoration is large prior to the crown preparation. Higher incidence of necrotic teeth seen in bridge abutment due to the rocking phenomenon that occur in bridges. Would this pulpal changes happen in time is due to individual patient, oral hygiene or quality of the crown or bridge or whether it’s hermetic seal of the underlying dentine from bacterial contamination; that has not been studied in much details. Bear in mind that these numbers goes higher with time, deterioration of restoration and its margins.

The most important predictors of symptoms following crown preparation and cementation:- 1) pre-operative pulpal and apical diagnosis; 2) operator’s technique for crown preparation and luting or bonding cementation. Pre-operative diagnosis of the pulp and apical status of the tooth is paramount to ensure good outcome to the treatment provided. A thorough history of the tooth must be obtained to establish the pre-operative state of the tooth. Clinical examination, special investigations and necessary radiographs should be performed before a crown preparation and to help in deciding the next course of treatment for your patient.

Crows are most frequently used to rebuild teeth that have experienced some type of structural catastrophe (crack, fracture, large cavity, lost filling). And due to having experienced this traumatic event, it can be that the pulp tissue, while still able to survive, exists in a compromised state. (As in it’s no longer as resilient as it once was and therefore isn’t as able to healthily rebound from trauma or insult.) While in this state, it’s possible that some type of stimulus (such as the crown preparation procedure) will trigger the final degenerative process of the pulp tissue and its subsequent need for root canal treatment.
Normal Pulpal Response to Injury

Untreated dental caries is the most common cause of pulpal disease; however, among the various forms of dental treatment, operative dental procedures are the most frequent cause of pulpal injury in human teeth (Brannstrom & Lind 1965). Three basic reactions tend to protect against insult to the pulp: (1) a decrease in the permeability of the dentine through dentinal sclerosis; (2) formation of new secondary and reparative dentine; (3) inflammatory and immune reactions in the pulp. The most common response to such localized injury is dentinal sclerosis (Stanley et al 1983).

Dentinal sclerosis has the effect of decreasing dentine permeability, thereby sealing the pulp from potential irritants, such as bacteria and bacterial byproducts. Similarly, secondary and reparative dentine reduces dentinal permeability while creating more distance between the irritant and the pulp (Bergenholtz 1990). Once bacteria or bacterial byproducts reach the pulp, inflammatory and immune reactions further attack and help destroy the antigens.

Pulpal reaction is observed as soon as bacteria reach the dentine (Massler 1967). It is important to realize that the bacteria do not have to reach the actual pulp before pulpal changes begin taking place. Early changes occur as a response to the diffusion of the inflammatory stimuli into the pulp. Such substances include bacterial toxin, enzymes, antigens, chemotoxins, organic acids, and products of tissue destruction (Bergenholtz 1990). Substances also pass outward from the pulp through the dentinal tubules into the carious lesion. Plasma proteins, immunoglobulin, and complement proteins have been found in carious dentine (Okamura et al 1980). Therefore, a dynamic interaction between the dentinal surface and the pulp exists at all times. As soon as the dentine is exposed, should the tubules be patent and permeable, an exchange takes place across the dentine, resulting in changes in the pulp.

The act of cutting tooth structure creates friction and therefore heat that the operator must ensure adequate water coolant in check so the tooth doesn't become overheated. Zach and Cohen (1965) suggests that the greatest risk of creating tooth trauma is heat generation during tooth preparation. The tooth preparation produces vibrations that are transmitted throughout the tooth (physical trauma). Because the dentine layer is porous, the mechanical action of the bur can pump bacteria into this layer towards the nerve tissue, which can result in pulpal irritation. Similarly, Castelnuovo and Tjan (1997) suggests that the tooth's exposure to various chemicals used throughout the entire crowning process can result in trauma to its pulp tissue too. Dentinal tubules are conical in nature. Therefore, the deeper the dentine is cut, the wider the diameter of the tubules and the larger the permeable area of the surface. Deeper preparations allow for more permeability and therefore a higher chance of bacterial contamination of the pulp (Pashley 1986).

Luckily, there is a constant outward flow of fluid in the dentinal tubules, which essentially flushes them clean of such antigens (Okamura et al 1980). This outward flow is caused by the physiological presence of intrapulpal pressure, the pressure of blood circulating in the pulp and that of pulp tissues on the walls. In the absence of this flow, a higher incidence of pulpal reactions to surface salivary contamination could potentially occur. Most pulpal reactions are a result of the contamination of the pulp by bacteria or bacterial byproducts.

The Role of Bacteria in Pulpal Injury

Today, we know that the cause of pulpal infection is always bacteria and/or bacterial byproducts. In the landmark study on germ-free mice by Kakehashi et al 1965, the animal's pulps were completely unaffected despite deep restorations and even pulpal exposures that were left open to the oral cavity (the saliva of such animals contains no bacteria either). As long as they were not contaminated with bacteria, the pulps remained vital despite exposure to the oral cavity during a period of several months. In the absence of bacteria,
restorative fillings were placed directly into the pulp chamber with very little tissue reaction from the pulp. This study demonstrates the importance of bacteria and bacterial antigens in pulpal reactions and further demonstrates the need for aseptic techniques during operative procedures. Another important study by Bergenholtz and Reit (1980) speculated on the cause of postoperative pain and sensitivity. In this study, restorative materials that were either bactericidal or prevented bacterial leakage through their margins resulted in the least amount of postoperative sensitivity. In contrast, bacteria were found in histological sections under all the restorative materials where postoperative pain was present. It was therefore proposed that the cause of postoperative pain in restored teeth has little to do with the toxicity of the material itself and more to do with the material’s ability to prevent bacterial leakage.

**Acid Etching**

Acid etching of dentine to enhance long-term adhesion has been questioned; furthermore, this practice greatly increases dentine permeability, enhancing bacterial penetration of the dentine (Stanley et al 1975). However, the direct effect of the acid on the pulp appears to be negligible, possibly as a result of the buffering of the acid by intratubular fluids found in dentine. Only in very deep preparations can the actual acid become the primary source of pulpal injury. Therefore, acid etching of dentine is generally not a primary cause of pulpal injury; however, the increased permeability caused by such action could potentially become a source of bacterial conduction into the pulp and be an indirect cause of injury.

**Desiccation of Dentine**

When freshly cut dentine is dried with a prolonged blast of air, a rapid outward flow of fluids is caused in the dentinal tubules. This fluid can draw along the odontoblasts into the tubules, virtually destroying them in the process (Brannstrom 1984). However, according to Brannstrom 1984 the desiccation of dentine by operatory procedures or with a blast of air does not injure the pulp. There are generally too few cells that die through this process to evoke a significant reaction. Furthermore, odontoblasts that die through this process are replaced by new ones from the cell-rich zone of the pulp, and in 1 to 3 months, reparative dentine is formed.

**Thermal Injury**

Production of heat during the restorative procedures is the most severe form of stress induced on the pulp (Zach 1972). Thermal changes leading to pulpal injury can take place as a result of cutting of the dentine and enamel without a coolant and by using dull burs at low revolutions per minute (RPMs) with excessive cutting pressure. Blushing of the teeth during a crown preparation has also been attributed to thermal injury to the pulp. This occurs more readily if a ligamental injection has been used to anesthetize the tooth. The best way to avoid thermal injury of the pulp is by meticulous use of sharp burs at high speed, with light pressure, and adequate water coolant.

**Effects of Local Anaesthetics on the Pulp**

A few studies have shown the profound effect of vasoconstrictor-containing local anaesthetics on pulpal blood flow. Kim et al (1984) showed the significant reduction in pulpal blood flow after administration of lidocaine 2% with 1:100,000 adrenaline. Because the rate of oxygen use by the pulp is generally low this tissue can withstand a period of reduced blood flow. Research has shown this to be true for periods as long as 3 hours (Olgart and Gazelius 1977).

Irreversible pulp damage resulting from tooth preparation is most likely caused by the release of substantial amounts of vasoactive agents, including but not limited to substance P into the extracellular compartment of the underlying pulp (Okamura et al 1980). During normal circumstances, these vasoactive substances are quickly removed from the pulp by the bloodstream. However, when blood flow to the pulp is drastically decreased or completely arrested, the removal process is greatly delayed and accumulation of these substances and other metabolic waste products may result in permanent damage to the pulp (Pashley 1979).
It is therefore recommended to avoid ligamental injections of adrenaline-containing anaesthetics in vital but compromised teeth requiring crown preparations.

Discussion

It is true that the exact cause of the severe pulpal reaction in this case may never be fully known. In the absence of dental decay, virgin teeth requiring veneers do not normally suffer irreversible damage from the preparations, even if the cutting is deep into dentine. However, when a combination of potentially caustic factors, such as the use of an adrenaline-containing ligamental injection, deep, heavy cutting into dentine, etching, desiccating, and allowing contamination of the permeable tubules before cementation is followed by traumatic occlusion, the pulps of patients with a lower physiologic compliance and capacity to recover from injury may become irreversibly inflamed. In such situations, multiple root canal therapy and pulpal extirpation may become the only choice to relieve symptoms.

Because the primary cause of postoperative pulpitis is bacterial contamination of the pulp through the dentinal tubules, immediate sealing of the freshly cut dentine with bonding agents may be a potential way of reducing this sensitivity from bacterial leakage (Magne 2002).

In general, the optimal approach to avoid pulpal complications is to avoid ligamental injections containing adrenaline and use sharp burs with light pressure at high RPMs. Using copious water coolant during the operative procedure is also very important to limit heat-induced pulpal injury. Most importantly, aseptic techniques such as using a rubber dam and dentine disinfection during the preparation and cementation of any restoration are of paramount importance. Furthermore, traumatic occlusion should be avoided at all cost in anterior restorations and teeth should be restored with proper posterior support to avoid accumulation and magnification of pulpal symptoms. In itself, occlusal trauma is generally not considered a cause of pulpal necrosis; however, it has been shown to increase neurogenic inflammation and create pulpal symptoms which could put an already inflamed pulp over the edge (De Carteret Edlin 1970, Kvinnsland and Heyerras 1992).

Conclusions

The confluence of several potential factors of pulpal injury makes this case unique. Although each factor on its own is not enough to elicit such severe postoperative pulpal reaction, the combination of multiple factors in this case culminated into severe and irreversible pulpal injury requiring multiple root canal treatments. The primary cause of the pulpitis was probably bacterial in nature; however, the role of occlusion had a magnifying effect on the symptoms.

Each patient is unique and so is his or her individual response to seemingly safe treatments recommended by their healthcare professionals. The wise clinician pays close attention to proper case selection to decrease the chance of complications. Adhering to the basic biological and clinical care principals of occlusion and pulpal-periodontal health preservation can further optimize treatment outcome and decrease the chance of potential complications during elective aesthetic procedures. In cases where the pulp status is in doubt, placing a core and well-made provisional crown and monitor the tooth for at least 8 weeks prior to retesting the tooth with pulp sensibility tests before the final crown is cemented.

As clinicians, our primary goal should be to do no harm. Our adherence to sound scientific principles and the biological basis of our work can decrease the possibility of untoward treatment outcomes and enhance the quality of our treatment and the satisfaction and service we render our patients.

References

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