Can Intraoperative Text Messages (Short Message Services (SMS)) Reduce Parental Anxiety of Children Undergoing Posterior Spinal Fusion Surgery for Adolescent Idiopathic Scoliosis (AIS)?

Mun Keong Kwan, Chee Kidd Chiu, Chiao Chin Gan, Chris Yin Wei Chan

Department of Orthopaedic Surgery, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia.

Corresponding Author:

Mun Keong Kwan, MBBS, MSOrth,
Department of Orthopaedic Surgery,
National Orthopaedic Centre of Excellence for Research and Learning (NOCERAL),
Faculty of Medicine,
University Malaya,
50603 Kuala Lumpur, Malaysia.

Telephone number: +60379492061
Email: munkeong42@hotmail.com
Authors:

Chee Kidd Chiu, MBBS, MSOrth,

Department of Orthopaedic Surgery,

National Orthopaedic Centre of Excellence for Research and Learning (NOCERAL),

Faculty of Medicine,

University Malaya,

50603 Kuala Lumpur, Malaysia.

Telephone number: +60379492061

Email: cheekidd@gmail.com

Chiao Chin Gan, BEng,

Spine Research Unit,

National Orthopaedic Centre of Excellence for Research and Learning (NOCERAL),

Faculty of Medicine,

University Malaya,

50603 Kuala Lumpur, Malaysia.

Telephone number: +60379492061

Email: chiaochin11@gmail.com
Chris Yin Wei Chan, MBBS, MSOrth,

Department of Orthopaedic Surgery,

National Orthopaedic Centre of Excellence for Research and Learning (NOCERAL),

Faculty of Medicine,

University Malaya,

50603 Kuala Lumpur, Malaysia.

Telephone number: +60379492061

Email: chrnat01@yahoo.com

The manuscript submitted does not contain information about medical device(s)/drug(s). No funds were received in support of this work. No relevant financial activities outside the submitted work.
Structured Abstract

Study Design: A prospective, non-randomized study.

Objectives: To evaluate the effectiveness of periodic intraoperative text messages (SMS) in reducing parental anxiety level during posterior spinal fusion (PSF) surgery for adolescent idiopathic scoliosis (AIS) patients.

Summary of Background Data: No studies have reported on the use of intraoperative SMS to reduce level of anxiety in parents of patients who are undergoing AIS corrective surgery.

Methods: Parents of 50 AIS patients were studied at two centres. Group 1 did not receive any SMS whereas those in Group 2 received periodic SMS. Parents’ anxiety were assessed using a validated Visual Analogue Scale for anxiety (VAS-A) and the anxiety component of the Hospital Anxiety Depression Score (HADS). The assessment was carried out at five different time periods: (P1) six hours before the surgery; (P2) at separation in the operation theatre; (P3) one hour after commencement of surgery; (P4) immediately after completion of surgery; (P5) one day post-surgery.

Results: 96 subjects (47 fathers, 49 mothers) were involved in this study. Both groups were comparable in terms of demographics and education level. The mean VAS for Group 1 peaked at P2 and the HADS scores peaked at P3. The anxiety level of Group 1 remained high at P2, P3 and P4. There was a steady decline in parental anxiety in Group 2 from P1 to P5. There were significantly lower mean VAS score and HADS score for both father and mother in Group 2 during P3 and P4. The mean HADS scores for parents in Group 1 at P2 and P3 were higher than 8 which indicate abnormal anxiety.
**Conclusion:** The anxiety levels of parents receiving the SMS were significantly lower than parents who did not receive any messages. Thus, intraoperative SMS is an effective intervention to decrease parental anxiety of AIS patients undergoing PSF surgery.

**Keywords:** parental anxiety, intraoperative SMS, adolescent idiopathic scoliosis, posterior spinal fusion

Level of Evidence: 3
Introduction

Spinal fusion surgery to correct scoliosis is known as an invasive and extensive surgery performed on children and adolescents with scoliosis.\(^1,2\) Elective spinal surgery is associated with high levels of psychological stress and anxiety to the patient.\(^3\) Having a child scheduled for surgery can also cause a significant amount of stress and anxiety to parents.\(^4-6\) Parental anxiety is likely to transmit to the child and has a negative effect on child’s emotional state. Studies have identified that children of highly anxious parents are at a higher risk of developing anxiety and distress during recovery.\(^7,8\) Subsequently, this anxiety may give rise to adverse impact on the patients’ postoperative recovery and influence on his or her family dynamics.\(^9,10\)

Prior to surgery, it has been shown that parents prefer to have comprehensive and detailed perioperative information conveyed to them prior to the surgery.\(^6,11\) Therefore, accurate and appropriate information given by health professionals can help to reduce unnecessary anxiety and distress among the parents.\(^12\) Based on previous studies, intraoperative period has been shown to be the most anxious time for family members.\(^4,13\) The waiting period during surgery was stressful for family members because of the feeling of uncertainty about the outcome of surgery.\(^14\) A number of studies had evaluated the effectiveness of intraoperative interventions in reducing anxiety level of the waiting family.\(^4,15-19\) These interventions were informational cards, face to face informational reports, telephone calls and the use of digital paging devices.

To our knowledge, there is no published research about the use of intraoperative text messages or short message service (SMS) to deliver intraoperative information to the parents when their child with adolescent idiopathic scoliosis (AIS) is undergoing posterior spinal fusion (PSF) surgery. Hence, the aim of this study is to measure the effectiveness of periodic
intraoperative text messages on reducing parental anxiety level, compared to the parents who did not receive any messages.

**Methods**

**Study Design and Subjects**

This was a prospective, non-randomized study that used SMS to reduce the parental anxiety during PSF surgery for AIS patients. This study was conducted at two centers. The parents (both father and mother) of 50 AIS patients who were going for PSF surgeries were selected to participate in this study. Parents were excluded if they had prior anxiety or psychiatric disorders. Prior to the operation, written consents were obtained from the parents regarding intra-operative SMSs. They were informed regarding the methodology of this study. During the intra-operative period, before sending the first message, calls to the numbers provided by parents were made to ensure that the numbers were correct and not sent strangers. Messages were sent to mothers and fathers of the patients only.

Selected parents were divided into two groups. Group 1 (no SMS) who did not receive any SMS underwent surgery in Center 1 whereas Group 2 (with SMS) who received periodic SMS throughout underwent surgery in Center 2. A sample of the SMSs sent to the parents is shown in Table 1. Based on a pilot study of 20 subjects (10 subjects from each group), the average operation time was 188.7±51.3 minutes. Therefore, the interval between each SMS would be about 10 to 20 minutes. The parents were informed of the progress of surgery and physiological condition of the patients. The messages were sent by authorized personnel under instructions from the operating surgeons. All the surgeries were performed by two authors, MKK and CYWC.
Methodology and Anxiety Scales/Scores

The anxiety level of each parent was assessed at five different time periods as follows: (P1) six hours before the surgery; (P2) at separation in the operation theatre; (P3) one hour after commencement of surgery; (P4) immediately after completion of surgery; (P5) one day post-surgery. Parents had to fill up the anxiety questionnaire completely on their own. The questionnaires had two sections, a validated Visual Analogue Scale for anxiety (VAS-A) and the anxiety component of the Hospital Anxiety Depression Score (HADS). VAS-A consists of an unmarked line of length 10cm where ‘0’ was no anxiety or fear at all and ‘10’ was the worst possible anxiety or fear. VAS-A has been proved as a valid and reliable tool to measure the anxiety level of patients.\textsuperscript{20,21} Each parent was required to place a mark on the line that represented his or her current level of anxiety. The second section of the questionnaire was the anxiety component of the HADS which is able to assess the severity of anxiety disorder reliably and effectively.\textsuperscript{22,23} It consists of seven items and scores for each question ranging from ‘0’ to ‘3’ with a higher score indicating higher symptoms frequencies. Scores for the entire anxiety component range from ‘0’ to ‘21’ and a score above 8 indicates abnormal anxiety.\textsuperscript{22}

Sample size analysis and Data Analysis

Sample size was determined based on intraoperative HADS scores as a measure of anxiety. As there were no similar published studies, we performed a pilot study by including 10 subjects for each group. We found the mean scores for Group 1 and Group 2 were 9.0 (SD: 4.9) and 5.1(SD: 3.1) respectively. The marginal error, $\alpha$ was set at 0.05. A statistical power analysis indicated that a minimum sample size of 19 subjects would be needed to obtain 80% power of test to detect the difference in HADS scores between two groups, with an effect size of 0.95. The calculation was performed using G*Power software (version 3.1.9.2).\textsuperscript{24}
Statistical analyses were performed using SPSS Statistical Software version 16 (SPSS, Chicago, IL, USA). Demography differences between groups were assessed using t-test and \( \chi^2 \)-test analysis. Independent samples t-test analysis was used to compare the means of Group 1 and Group 2. The \( \alpha \)-level was set at 0.05 to declare significance.

**Results**

There were a total of 96 subjects (47 fathers, 49 mothers) involved in this study. Two AIS patients had single parent, one patient from Group 1 and one from Group 2. The mean age of father Group 1 was 50.6 ± 5.9 years (42 to 63) whereas the mean age of mother was 46.4 ± 5.9 years (38 to 61). For Group 2, the mean age of father was 47.0 ± 4.8 (38 to 58) whereas the mean age of mother was 44.6 ± 5.6 years (32 to 59). No significant differences were found between groups for any of the demographic variables except for the age of father (p<0.05). Table 2 presents the demographic data of parents participated in this study.

The mean VAS and HADS scores for parents in Group 1 reached a peak during separation in the operation theatre (P2) and one hour after commencement of surgery (P3) whereas the highest mean VAS and HADS score for parents in Group 2 was recorded during six hours before the surgery (P1). Parents in Group 2 had lower mean scores for VADS and HADS in nearly all time periods compared to those in Group 1, except for the VAS score in six hours before the surgery (P1). (Table 3, Figure 1 and Figure 2)

The mean VAS score and HADS score for both father and mother in Group 2 were significantly lower at one hour after commencement of surgery (P3) and immediately after
The mean VAS score and HADS score for the fathers and the mean HADS score for the mothers were significantly lower in Group 2 on day one post-surgery (P5). There were no significant differences for both VAS and HADS at six hours before surgery (P1) and during separation in operation theatre (P2) between Group 1 and 2. There was no significant difference in the mothers’ VAS score one day post-surgery between the groups. The mean HADS scores for father and mother in Group 1 at separation (P2) and one hour after commencement of surgery (P3) were higher than the cut-off score of 8 which denotes abnormal anxiety.

Discussion

Several studies had evaluated the effectiveness of intraoperative interventions in reducing anxiety level of the waiting family. These studies have used various interventions and reported variable findings. Most of these studies on parental or family anxiety did not specify the types of surgery or procedure that was performed on the patient with the exception for the research conducted by Trecartin et al wherein the patients underwent cardiac procedures. Kanthol provided in-person progress reports to family members thirty minutes after the surgery started and post operation. There was no significant reduction in anxiety levels reported in this study. Leske provided a single 5- to 10-minute progress report to inform the family members about halfway through a surgical procedure. The family members who received the progress report had been shown to have lower anxiety levels and lower mean arterial pressure (MAP) levels. Leske had also found that in-person progress report was more effective than telephone progress report in reducing family members’ anxiety level during intraoperative waiting period. Topp et al provided family members of patients undergoing surgery with a digital paging device and noted that those who received a paging
device had a significantly higher state anxiety and had a greater percentage of time spent outside the surgical waiting room. Trecartin el al\textsuperscript{18} studied on the effect of informational report and post procedure visit and found that only post procedure visit significantly reduces family members’ anxiety. To the best of our knowledge, this is the first study that investigates the effect of intraoperative progress information via text messages on the anxiety of parents of AIS patients undergoing PSF.

The purpose of this study was to examine the effects of intraoperative text messages in reducing the parental anxiety of scoliosis surgery. The anxiety level of Group 1 (no SMS) parents remained high throughout the perioperative period i.e. P2 to P4. Parents in Group 2 (with SMS) saw a steady decline in anxiety level from six hours before surgery (P1) to one day after surgery (P5). (Figure 1 and Figure 2) There were significantly lower mean VAS score and HADS score for both father and mother in Group 2 during one hour after commencement of surgery (P3) and immediate after completion of surgery (P4). The mean VAS score and HADS score for the fathers and the mean HADS score for the mothers were significantly lower in Group 2 at day one post-surgery (P5). (Table 2) This pattern suggests that keeping the parents informed regarding the progress of the surgery reduces their level of anxiety. This lower anxiety levels in Group 2 were then extended throughout the immediate postoperative period evidenced by significantly lower scores one day post-surgery (P5).

The HADS scores for father and mother in Group 1 at separation at the operation theatre (P2) and at one hour after commencement of surgery (P3) exceeded the cut-off score of eight, indicating the fathers and mothers in Group 1 could had experienced abnormal anxiety.\textsuperscript{22} These high levels of anxiety may lead to adverse effects to parents and possibly the patients leading to abnormal coping mechanisms, behavioural changes and unnecessary stress related ailments. Thus we think that parents of AIS patients undergoing PSF surgery would benefit
from the intraoperative text messages (SMS). Parents receiving periodic SMS were kept informed of the surgery’s progress and the physiological condition of their child were found to develop less stress and anxiety.

We found that intraoperative text messages (SMS) is a convenient and cost effective way to convey information to patient’s family members. Receipt of the SMS can be verified with the acknowledgement by the patient’s family members. The SMS is a direct update given verbally by the attending surgeon to an assistant who will send the SMS via a mobile phone. This information can be verified by the attending surgeon before sending. Multiple messages can be sent throughout the surgery to update the family members. When compared to in-person progress report, no operation theatre personnel needs to leave the room to attend to patient’s family members and the report is not given via a third party which, in certain situations can convey wrong information. Telephone report is also conveyed by a third party and may cost more than text messages. However, with text messages, limited information can be delivered at a time and the communication is usually unidirectional.

Although this is a non-randomised study, we found no significant differences in terms of parents’ demographics and their education status. We did not include the scoliosis curve type in the analysis as this study was carried out to evaluate the parents and not on patient outcome. Other factors which could have affected anxiety level such as blood loss or duration of operation was not studied. However, as the assessment was done at a pre-determined time (eg. 1 hour into the surgery), the parents would not be aware of the surgical time and at the point of assessment, we would not be able to predict the surgical time as well. Another limitation of this study was that we did not look into the differences and perform standardization of family constructs as this might impact on the stress levels of parents. The
parents were also not exposed to a systematic preoperative spine-teaching program, which might potentially reduce the stress during surgery.

The findings of this study showed that intraoperative text messages (SMS) is an effective intervention to reduce parental anxiety of adolescent idiopathic scoliosis (AIS) patients undergoing posterior spinal fusion (PSF) surgery. Parents who received the intraoperative text messages demonstrated significantly lower anxiety levels compared to parents who did not receive any messages.

Acknowledgements

We would like to acknowledge Suet Mooi Tang, Winnie Lai Sing Loke, Siau Ting Ang, Yew Hong Ho, See Teng Ong and Sian Ho Chew for their efforts in data collection and compilation.
References


Figure 1

A

B

Mean VAS Score for Father

- Time Periods:
  - P1: 6 hours before the surgery
  - P2: At separation in the operation theatre
  - P3: 1 hour after commencement of surgery
  - P4: Immediate after completion of surgery
  - P5: 1 day post-surgery
Figure 2

C

D

P1 - 6 hours before the surgery
P2 - At separation in the operation theatre
P3 - 1 hour after commencement of surgery
P4 - Immediate after completion of surgery
P5 - 1 day post-surgery
Table 1. An illustration of the sequence of the SMSs which was sent to the parents. In our practice, we would address the patient’s name in the SMSs.

<table>
<thead>
<tr>
<th>SMS</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMS 1</td>
<td>The operation has started. Patient’s condition is stable.</td>
</tr>
<tr>
<td>SMS 2</td>
<td>We have begun screw insertion. Patient’s condition is stable.</td>
</tr>
<tr>
<td>SMS 3</td>
<td>We have completed 50% of screw insertion. Patient’s condition is stable.</td>
</tr>
<tr>
<td>SMS 4</td>
<td>We have completed 75% of screw insertion. Patient’s condition is stable.</td>
</tr>
<tr>
<td>SMS 5</td>
<td>All screws have been inserted. Correction process will begin soon. Patient’s condition is stable.</td>
</tr>
<tr>
<td>SMS 6</td>
<td>Correction is in progress. Patient’s condition is stable.</td>
</tr>
<tr>
<td>SMS 7</td>
<td>Balancing is in progress. Patient’s condition is stable.</td>
</tr>
<tr>
<td>SMS 8</td>
<td>We are applying the bone graft currently. Patient’s condition is stable.</td>
</tr>
<tr>
<td>SMS 9</td>
<td>We are closing the wound now. Patient’s condition is stable.</td>
</tr>
<tr>
<td>SMS 10</td>
<td>Operation is successfully completed. Waiting for patient to wake up.</td>
</tr>
<tr>
<td></td>
<td>Group 1 Father</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Number of participants</td>
<td>23</td>
</tr>
<tr>
<td>Age</td>
<td>50.6±5.9</td>
</tr>
<tr>
<td>Education, n (%)</td>
<td></td>
</tr>
<tr>
<td>Less than high school</td>
<td>13(56.5)</td>
</tr>
<tr>
<td>High school (STPM/HSC/A-level)</td>
<td>3(13.0)</td>
</tr>
<tr>
<td>Less than 4 years of college/university</td>
<td>4(17.4)</td>
</tr>
<tr>
<td>4 years of college/ university</td>
<td>2(8.7)</td>
</tr>
<tr>
<td>Postgraduate</td>
<td>1(4.3)</td>
</tr>
<tr>
<td>Work status, n (%)</td>
<td></td>
</tr>
<tr>
<td>Full time</td>
<td>19(82.6)</td>
</tr>
<tr>
<td>Part time</td>
<td>2(8.7)</td>
</tr>
<tr>
<td>Not working</td>
<td>2(8.7)</td>
</tr>
<tr>
<td>Took day off to be present, n (%)</td>
<td>18(78.3)</td>
</tr>
<tr>
<td>Yes</td>
<td>5(21.7)</td>
</tr>
<tr>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Previous experience waiting for family during surgery, n (%)</td>
<td>2(8.7)</td>
</tr>
<tr>
<td>Yes</td>
<td>21(91.3)</td>
</tr>
<tr>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>
Table 3. Mean VAS and HADS Scores for Parents between Group 1 (no SMS) and Group 2 (with SMS)

<table>
<thead>
<tr>
<th>Father</th>
<th>Group 1 (n=23)</th>
<th>Group 2 (n=24)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VAS</td>
<td>HADS</td>
<td>VAS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td>3.1±2.5</td>
<td>7.7±4.0</td>
<td>4.0±2.7</td>
</tr>
<tr>
<td>P2</td>
<td>4.7±2.6</td>
<td>8.3±2.9</td>
<td>3.5±2.2</td>
</tr>
<tr>
<td>P3</td>
<td>4.2±2.4</td>
<td>8.8±5.1</td>
<td>2.8±1.6</td>
</tr>
<tr>
<td>P4</td>
<td>3.2±2.4</td>
<td>6.5±5.1</td>
<td>1.6±1.5</td>
</tr>
<tr>
<td>P5</td>
<td>2.1±1.9</td>
<td>5.7±3.5</td>
<td>0.9±1.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mother</th>
<th>Group 1 (n=24)</th>
<th>Group 2 (n=25)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VAS</td>
<td>HADS</td>
<td>VAS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td>3.6±2.9</td>
<td>7.1±3.3</td>
<td>4.3±2.5</td>
</tr>
<tr>
<td>P2</td>
<td>5.1±3.6</td>
<td>8.2±4.5</td>
<td>3.8±1.9</td>
</tr>
<tr>
<td>P3</td>
<td>4.7±3.1</td>
<td>8.3±4.9</td>
<td>3.0±1.9</td>
</tr>
<tr>
<td>P4</td>
<td>3.9±2.9</td>
<td>7.1±3.9</td>
<td>1.8±2.0</td>
</tr>
<tr>
<td>P5</td>
<td>2.1±2.4</td>
<td>5.3±4.1</td>
<td>1.1±1.5</td>
</tr>
</tbody>
</table>

P1 – Six hours before the surgery
P2 - At separation in the operation theatre
P3 – One hour after commencement of surgery
P4 - Immediate after completion of surgery
P5 – One day post-surgery