The Canadian Spine Society is a collaborative organization of spine surgeons advancing excellence in research, education and patient care.

15\textsuperscript{th} ANNUAL SCIENTIFIC CONFERENCE OF THE
CANADIAN SPINE SOCIETY
Tuesday, February 25\textsuperscript{th} - Saturday, March 1\textsuperscript{st}

ABSTRACTS FOR PRESENTATION
2015

Halifax Marriott Harbourfront Hotel
1919 Upper Water Street
Halifax Nova Scotia B3J 3J5 Canada

Accreditation: This event is an Accredited Group Learning Activity (Section 1) as defined by the Maintenance of Certification Program of the Royal College of Physicians and Surgeons of Canada, approved by The Canadian Orthopaedic Association.

Course Objectives: The Annual Scientific Conference of the Canadian Spine Society provides a comprehensive perspective on the state of spine care in Canada. It includes presentations on both adult and paediatric spinal issues and highlights recent advances in both surgical and non-operative treatment. Symposia will focus on the diagnosis and management of metastatic disease of the spine, cervical spine fixation in the paediatric patient and on both the techniques and the evidence for non-operative invasive interventions such as facet ablation or epidural steroids. The agenda creates frequent opportunities for discussion and debate during the podium presentations and in the small group special poster sessions. The structure generates extensive professional interaction both with its formal program and through the inevitable informal encounters produced by the carefully interwoven social activities. Every attendee will gain a better understanding of contemporary Canadian practice.
CONFLICT OF INTEREST (COI)
DISCLOSURE INFORMATION
available for all presenters for
2015 ABSTRACTS

To view, please refer to:
PART II – COI Download
Available online: www.spinecanada.ca
## Podium Presentations

### Thursday, February 26th, 2015

### Abstracts for Oral Presentation

<table>
<thead>
<tr>
<th>ABSTRACT #</th>
<th>PROGRAM CODE</th>
<th>PRESENTER LAST NAME</th>
<th>PRESENTER FIRST NAME</th>
<th>AWARDS TO BE CONSIDERED FOR</th>
<th>Part I ABSTRACTS PAGE</th>
<th>Part II CONFLICT OF INTEREST DISCLOSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>01.1.1</td>
<td>Bailey</td>
<td>Chris</td>
<td>Best Overall Paper</td>
<td>Page 6</td>
<td>Page 83</td>
</tr>
<tr>
<td>94</td>
<td>02.1.1</td>
<td>Stratton</td>
<td>Alexandra</td>
<td>Best Overall Paper Fellow’s Best Paper</td>
<td>Page 7</td>
<td>Page 84</td>
</tr>
<tr>
<td>74</td>
<td>03.1.1</td>
<td>Manson</td>
<td>Neil</td>
<td>Best Overall Paper</td>
<td>Page 8</td>
<td>Page 85</td>
</tr>
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<td>49</td>
<td>04.1.2</td>
<td>Layne</td>
<td>Elliot</td>
<td>Best Overall Paper</td>
<td>Page 9</td>
<td>Page 86</td>
</tr>
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<td>45</td>
<td>05.1.2</td>
<td>Taylor</td>
<td>Emily</td>
<td>Best Overall Paper</td>
<td>Page 10</td>
<td>Page 87</td>
</tr>
<tr>
<td>63</td>
<td>06.1.2</td>
<td>Harris</td>
<td>Simon</td>
<td>Best Overall Paper Fellow’s Best Paper</td>
<td>Page 11</td>
<td>Page 88</td>
</tr>
<tr>
<td>36</td>
<td>07.1.3</td>
<td>McIntosh</td>
<td>Greg</td>
<td>Best Overall Paper</td>
<td>Page 12</td>
<td>Page 89</td>
</tr>
<tr>
<td>62</td>
<td>08.1.3</td>
<td>Rampersaud</td>
<td>Y. Raja</td>
<td>Best Overall Paper</td>
<td>Page 13</td>
<td>Page 90</td>
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<td>38</td>
<td>09.1.3</td>
<td>McIntosh</td>
<td>Greg</td>
<td>Best Overall Paper</td>
<td>Page 14</td>
<td>Page 91</td>
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<td>24</td>
<td>10.1.4</td>
<td>Miyanji</td>
<td>Firoz</td>
<td>Best Overall Paper</td>
<td>Page 15</td>
<td>Page 92</td>
</tr>
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<td>11.1.4</td>
<td>Joukhadar</td>
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<td>Best Overall Paper</td>
<td>Page 16</td>
<td>Page 93</td>
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<tr>
<td>18</td>
<td>12.1.4</td>
<td>Miyanji</td>
<td>Firoz</td>
<td>Best Overall Paper</td>
<td>Page 17</td>
<td>Page 92</td>
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<td>Firoz</td>
<td>Best Overall Paper</td>
<td>Page 18</td>
<td>Page 92</td>
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<td>Page 19</td>
<td>Page 92</td>
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<td>15.1.5</td>
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<td>Firoz</td>
<td>Best Overall Paper</td>
<td>Page 20</td>
<td>Page 92</td>
</tr>
</tbody>
</table>
### Podium Presentations
#### Friday, February 27th, 2015

#### Abstracts for Oral Presentation

<table>
<thead>
<tr>
<th>ABSTRACT #</th>
<th>PROGRAM CODE</th>
<th>PRESENTER LAST NAME</th>
<th>PRESENTER FIRST NAME</th>
<th>AWARDS TO BE CONSIDERED FOR</th>
<th>Part I ABSTRACTS PAGE</th>
<th>Part II CONFLICT OF INTEREST DISCLOSURE</th>
</tr>
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<tr>
<td>71</td>
<td>16.2.1</td>
<td>Larouche</td>
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<td>Page 22</td>
<td>Page 94</td>
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<td>17.2.1</td>
<td>Aoude</td>
<td>Ahmed</td>
<td>Best Overall Paper Resident’s Best Paper</td>
<td>Page 23</td>
<td>Page 95</td>
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<td>18.2.1</td>
<td>Hardy-St-Pierre</td>
<td>Godefroy</td>
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<td>Page 24</td>
<td>Page 96</td>
</tr>
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<td>Darren</td>
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<td>Page 25</td>
<td>Page 97</td>
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<td>20.2.2</td>
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<td>Page 98</td>
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<td>Page 27</td>
<td>Page 99</td>
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<td>Clifford</td>
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<td>Page 28</td>
<td>Page 100</td>
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<td>Best Overall Paper</td>
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<td>Page 101</td>
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<td>24.2.3</td>
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<td>Meghan</td>
<td>Best Overall Paper</td>
<td>Page 30</td>
<td>Page 102</td>
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<td>8</td>
<td>25.2.4</td>
<td>Glennie</td>
<td>R. Andrew</td>
<td>Best Overall Paper</td>
<td>Page 31</td>
<td>Page 103</td>
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<td>Rampersaud</td>
<td>Y. Raja</td>
<td>Best Overall Paper</td>
<td>Page 32</td>
<td>Page 104</td>
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<td>Page 33</td>
<td>Page 105</td>
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<td>Page 34</td>
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<td>Page 107</td>
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<td>Simon</td>
<td>Best Overall Paper Fellow’s Best Paper</td>
<td>Page 36</td>
<td>Page 108</td>
</tr>
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</table>
# Abstracts for Oral Presentation

<table>
<thead>
<tr>
<th>ABSTRACT #</th>
<th>PROGRAM CODE</th>
<th>PRESENTER LAST NAME</th>
<th>PRESENTER FIRST NAME</th>
<th>AWARDS TO BE CONSIDERED FOR</th>
<th>Part I ABSTRACTS PAGE</th>
<th>Part II CONFLICT OF INTEREST DISCLOSURE</th>
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<td>Page 39</td>
<td>Page 109</td>
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<td>Lindsay</td>
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<td>Page 40</td>
<td>Page 110</td>
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<td>John</td>
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<td>Page 41</td>
<td>Page 111</td>
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<td>Page 83</td>
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<td>Michael</td>
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<td>Page 43</td>
<td>Page 112</td>
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<td>Erin</td>
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<td>Page 44</td>
<td>Page 113</td>
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<td>Antonio</td>
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<td>Page 45</td>
<td>Page 114</td>
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<td>Andrew</td>
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<td>Page 115</td>
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<td>Mohammed</td>
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<td>Page 47</td>
<td>Page 116</td>
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<td>Shamji</td>
<td>Mohammed</td>
<td>Best Overall Paper</td>
<td>Page 48</td>
<td>Page 116</td>
</tr>
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<td>42.3.3</td>
<td>Nakashima</td>
<td>Hiroaki</td>
<td>Best Overall Paper</td>
<td>Page 49</td>
<td>Page 117</td>
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<td>43.3.4</td>
<td>Rampersaud</td>
<td>Y. Raja</td>
<td>Best Overall Paper</td>
<td>Page 50</td>
<td>Page 118</td>
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<td>Michael</td>
<td>Best Overall Paper</td>
<td>Page 51</td>
<td>Page 119</td>
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<td>Manson</td>
<td>Neil</td>
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<td>Page 52</td>
<td>Page 85</td>
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<td>Lindsay</td>
<td>Best Overall Paper</td>
<td>Page 53</td>
<td>Page 120</td>
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<td>R. Andrew</td>
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<td>Page 121</td>
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<td>Nathan</td>
<td>Best Overall Paper</td>
<td>Page 55</td>
<td>Page 122</td>
</tr>
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</table>
# POSTERS FOR PRESENTATION

<table>
<thead>
<tr>
<th>ABSTRACT #</th>
<th>PROGRAM CODE</th>
<th>POSTER #</th>
<th>PRESENTER LAST NAME</th>
<th>PRESENTER FIRST NAME</th>
<th>PRESENTATION DAYS</th>
<th>Part I ABSTRACTS PAGE</th>
<th>Part II CONFLICT OF INTEREST DISCLOSURE</th>
</tr>
</thead>
</table>
| 15th Annual Scientific Conference of the Canadian Spine Society  
Halifax Marriott Harbourfront Hotel  Halifax  Nova Scotia  CANADA  
Wednesday, February 25 – Saturday February 28, 2015  
www.spinecanada.ca  
Page 5 | | | | | | | |

## SPECIAL POSTERS

1. **ABSTRACT #44**: Morris Susan  
   - Program Code: 49.1.1  
   - Poster #: 1  
   - Presentation Days: THURSDAY & SATURDAY  
   - Page: 57  
   - Page #: 123

2. **ABSTRACT #2**: Spurway Alan  
   - Program Code: 50.1.2  
   - Poster #: 2  
   - Presentation Days: THURSDAY & SATURDAY  
   - Page: 58  
   - Page #: 124

3. **ABSTRACT #72**: Bateman Anthony  
   - Program Code: 51.1.3  
   - Poster #: 3  
   - Presentation Days: THURSDAY & SATURDAY  
   - Page: 59  
   - Page #: 125

4. **ABSTRACT #88**: Abduljabbar Fahad  
   - Program Code: 52.1.4  
   - Poster #: 4  
   - Presentation Days: THURSDAY & SATURDAY  
   - Page: 60  
   - Page #: 126

5. **ABSTRACT #30**: Shamji Mohammed  
   - Program Code: 53.1.5  
   - Poster #: 5  
   - Presentation Days: THURSDAY & SATURDAY  
   - Page: 61  
   - Page #: 116

6. **ABSTRACT #77**: McLachlin Stewart  
   - Program Code: 54.1.6  
   - Poster #: 6  
   - Presentation Days: THURSDAY & SATURDAY  
   - Page: 62  
   - Page #: 127

7. **ABSTRACT #48**: Manson Neil  
   - Program Code: 55.2.7  
   - Poster #: 7  
   - Presentation Days: FRIDAY & SATURDAY  
   - Page: 63  
   - Page #: 85

8. **ABSTRACT #84**: Palkovsky Rachelle  
   - Program Code: 56.2.8  
   - Poster #: 8  
   - Presentation Days: FRIDAY & SATURDAY  
   - Page: 64  
   - Page #: 128

9. **ABSTRACT #92**: Ailon Tamir  
   - Program Code: 57.2.9  
   - Poster #: 9  
   - Presentation Days: FRIDAY & SATURDAY  
   - Page: 65  
   - Page #: 129

10. **ABSTRACT #61**: Tetreault Lindsay  
    - Program Code: 58.2.10  
    - Poster #: 10  
    - Presentation Days: FRIDAY & SATURDAY  
    - Page: 66  
    - Page #: 130

11. **ABSTRACT #70**: Johnson Michael  
    - Program Code: 59.2.11  
    - Poster #: 11  
    - Presentation Days: FRIDAY & SATURDAY  
    - Page: 67  
    - Page #: 131

12. **ABSTRACT #40**: Street John  
    - Program Code: 60.2.12  
    - Poster #: 12  
    - Presentation Days: FRIDAY & SATURDAY  
    - Page: 68  
    - Page #: 111

## REGULAR POSTERS

13. **ABSTRACT #89**: Street John  
    - Program Code: 61.1.13  
    - Poster #: 13  
    - Presentation Days: THURSDAY & SATURDAY  
    - Page: 69  
    - Page #: 111

14. **ABSTRACT #99**: Bourassa-Moreau Etienne  
    - Program Code: 62.1.14  
    - Poster #: 14  
    - Presentation Days: THURSDAY & SATURDAY  
    - Page: 70  
    - Page #: 132

15. **ABSTRACT #66**: Nouri Aria  
    - Program Code: 63.1.15  
    - Poster #: 15  
    - Presentation Days: THURSDAY & SATURDAY  
    - Page: 71  
    - Page #: 133

16. **ABSTRACT #37**: McIntosh Greg  
    - Program Code: 64.1.16  
    - Poster #: 16  
    - Presentation Days: THURSDAY & SATURDAY  
    - Page: 72  
    - Page #: 134

17. **ABSTRACT #27**: Street John  
    - Program Code: 65.1.17  
    - Poster #: 17  
    - Presentation Days: THURSDAY & SATURDAY  
    - Page: 73  
    - Page #: 111

18. **ABSTRACT #21**: Phan Philippe  
    - Program Code: 66.1.18  
    - Poster #: 18  
    - Presentation Days: THURSDAY & SATURDAY  
    - Page: 74  
    - Page #: 135

19. **ABSTRACT #35**: Hardy-St-Pierre Godefroy  
    - Program Code: 67.2.19  
    - Poster #: 19  
    - Presentation Days: FRIDAY & SATURDAY  
    - Page: 75  
    - Page #: 136

20. **ABSTRACT #80**: Simoes Leonardo  
    - Program Code: 68.2.20  
    - Poster #: 20  
    - Presentation Days: FRIDAY & SATURDAY  
    - Page: 76  
    - Page #: 137

21. **ABSTRACT #26**: Street John  
    - Program Code: 69.2.21  
    - Poster #: 21  
    - Presentation Days: FRIDAY & SATURDAY  
    - Page: 77  
    - Page #: 111

22. **ABSTRACT #3**: Parsons David  
    - Program Code: 70.2.22  
    - Poster #: 22  
    - Presentation Days: FRIDAY & SATURDAY  
    - Page: 78  
    - Page #: 138

23. **ABSTRACT #9**: Chukwunyerenwa Chukwudi  
    - Program Code: 71.2.23  
    - Poster #: 23  
    - Presentation Days: FRIDAY & SATURDAY  
    - Page: 79  
    - Page #: 139

24. **ABSTRACT #96**: Nadeau Melissa  
    - Program Code: 72.2.24  
    - Poster #: 24  
    - Presentation Days: FRIDAY & SATURDAY  
    - Page: 80  
    - Page #: 140
01.1.1

Surgery versus standardized non-operative care for the treatment of lumbar disc herniations: A Canadian trial

Chris Bailey¹,², Stewart Bailey¹,², Patricia Rosas-Arellano¹,², Shauna Dehens¹,², Keith Sequeira³, Tom Miller²,³, Jim Watson²,³, Fawaz Siddiqi¹,², Kevin Gurr¹,², Jennifer Urquhart¹,²
¹London Health Sciences Centre, London, Ontario, Canada, ²Western University, London, Ontario, Canada, ³St. Josephs Health Care, London, Ontario, Canada

Objectives

The beneficial treatment effect surgery demonstrates over conservative care for radiculopathy secondary to acute lumbar disc herniation (LDH), occurs in the first three to six months, thereafter outcomes are recognized to be similar. This is not surprising given the favourable natural history; 90% will experience gradual resolution of their symptoms within 4 months. In Canada, due to the inherent wait time to see a surgeon and the referring physician’s expectation that most patients will improve without surgery, symptomatic patients presenting to surgeons are often the 10% that have remained symptomatic longer than the expected 4 months. The purpose of this study is to determine if surgery is superior to conservative care in a patient population that has had persistent symptoms for more than four months and therefore create a study population which is generalizable to the Canadian health care experience.

Method

This single blinded (assessor) RCT enrolled 18-60 year old patients with a unilateral, single radiculopathy from a posterolateral L4-5 or L5-S1 disc herniation. Radiculopathy duration was >4 months but <12 months. Patients on a waiting list to see surgeons at one academic hospital centre were randomized to early microdiscectomy or standardized non-operative care including medications, education, physiotherapy, and steroid injections. Patients were excluded if they had previously received these conservative modalities. The primary outcome was intensity of sciatica (scale 0-10) measured at 6 months following randomization. Secondary outcome measures included back pain, ODI, SF-36, work status, and satisfaction.

Results

This interim analysis reports on 40 non-operative and 39 surgical patients. No difference existed between their demographic or preoperative data. At 6 months follow-up 32/39 surgical patients and 36/40 non-operative patients had data available. Treatment effect for all outcome measures favoured surgery for the intent-to-treat, as-treat, and last-value carried forward analysis (p<0.05). To date 13/40 non-operative patients have undergone microdiscectomy (performed after the primary outcome measure of 6 months); they have had persistent inferior scores compared to early surgical patients (p<0.05).

Conclusions

At the interim analysis microdiscectomy is superior to non-operative care for patients presenting with sciatica secondary to LDH. This study will continue to confirm robustness and validity of results.
Wait Times for Elective Spine Surgery Across Canada: Data from the Canadian Spine Outcomes and Research Network

Alexandra Stratton¹, Ken Thomas¹, Greg McIntosh², Lauren Hirsch¹
¹University of Calgary, Calgary, Canada, ²Canadian Spine Outcomes and Research Network, Everytown, Canada

Objectives

Wait time data from the CSS registry were obtained on patients with lumbar radiculopathy or neurogenic claudication, at participating sites across Canada. The objectives were to: 1) determine the national median for wait times for elective spine surgery, 2) determine the most lengthy wait time, 3) compare individual sites’ wait times to the national median, and 4) investigate wait times in relation to motor deficit.

Method

Wait time data collected between October 2008 and October 2014 (n=631) from 11 participating sites were used to determine the national median. Eight sites with >10 patients were used to compare four wait time periods: T1=time between initial referral and first appointment with a spine surgeon; T2=time between first appointment with a spine surgeon and date of surgical booking; T3=time between surgical booking and surgery date; and total wait time.

Results

The median national wait time (days) for T1=56, T2=1, T3=54 with a total median wait time of 213 days. Comparison of individual sites’ median wait times to the national median revealed for: T1 and T2, one site was below and four above the national median; T3, one site was below and five were above. The median wait times of patients with motor deficit were T1=33.5, T2=0, T3=30 and total=114 days which were all significantly shorter than the national medians for patients without motor deficits (p<0.01).

Conclusions

The time from first appointment with a spine surgeon to the date of surgical booking (T2) is where spine surgery candidates spend the least time. There is considerable regional variation for all waiting periods. Those with a motor deficit have significantly shorter wait times than the national mean suggesting that these patients may be given relative priority.
03.1.1

Pre-Surgical Physician Utilization in Elective Thoracolumbar Spine Surgery Candidates: A Nationwide Analysis from the CSORN Database

Neil Manson\textsuperscript{1,2}, Edward Abraham\textsuperscript{1,2}, Alana Green\textsuperscript{1,2}, Greg McIntosh\textsuperscript{3}
\textsuperscript{1}Canada East Spine Centre, Horizon Health Network, Saint John, NB, Canada, \textsuperscript{2}Dalhousie University of Medicine, Saint John, NB, Canada, \textsuperscript{3}Canadian Spine Outcomes and Research Network, Canada, Canada

Objectives

Our objective was to assess the frequency of physician utilization in spine surgery candidates in the six months prior to surgical booking, and present differences by region.

Method

We conducted a retrospective analysis of prospectively collected data from the Canadian Spine Outcomes and Research Network (CSORN). Twelve spine surgery sites across Canada contributed data for spine surgery candidates from 2008-2014. Patients (n=537) had degenerative spinal pathology or deformity of the thoracolumbar region. Frequencies of physician visits (excluding the attending spine surgeon) were tabulated to estimate some of the healthcare utilization consumed by spine surgery candidates prior to surgeon consultation.

Results

Patients reported 1-2 physician visits 572 times, 3-10 visits 366 times, 10+ visits 81 times. This equals at least 2561 visits, and a conservative maximum (if >10=11) of 5695 visits. Not surprisingly, family doctors accounted for the most visits and naturopaths the fewest. Consultations with another spine surgeon represented the second highest utilization; this ‘doctor shopping’ was most prevalent in Ontario (p<0.05).

Analysis by region revealed twice as many emergency department visits in Saint John than in Vancouver. Saint John and Vancouver had significantly fewer pain management visits than other sites, and Quebec had significantly fewer family doctor visits (p<0.05).

For patient-reported disability (ODI), patients who never saw an emergency physician reported significantly less disability than those who saw an emergency physician (p<0.05). There were no differences in baseline ODI for other spine surgeon, rheumatologist, family doctor, naturopath or “other”. Patients who never saw a pain management specialist reported significantly less disability than those who saw one >10times (p<0.05).

There were no differences in baseline pain ratings or health score for those who went to another physician, with the exception of family doctors; those with >10 visits had higher baseline leg pain and lower health scores (p<0.05).

Conclusions

Given the similarities in baseline characteristics pertaining to pain, disability and health state in this study, spine patient utilization of physician resources is high and variable. A focused strategy to provide appropriate, targeted care to the spine patient is needed across Canada. Future research should investigate the impact of spine triage systems on decreasing the number of visits to other physicians.
04.1.2

Activities performed and treatments conducted prior to consultation with a spine surgeon: Are patients and clinicians following evidence-based clinical practice guidelines?

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Objectives

Clinical practice guidelines (CPGs) are designed to ensure that evidence-based care is easily put into action. Whether patients and clinicians follow these guidelines is equivocal. What is clear though is: a) Canadian spine surgeons receive a large amount of referrals; b) there is no indication to suggest patients are adequately undertaking conservative treatments that can manage - or diminish - their condition. We examined how many patients complaining of low back pain (LBP) underwent evidence-based treatment in line with CPG recommendations prior to consultation with a spine surgeon.

Method

This is a sub-analysis of a prospective randomized controlled trial. Eligible adult lumbar spine patients aged 18-80 years with no defective conditions (e.g. scoliosis) were restricted to those triaged as P2 ("routine") or P3 ("non-urgent"); P1 ("urgent") patients were excluded. Questionnaires were sent immediately after their referral from a primary physician was received by one of two spine surgeons at The Ottawa Hospital. Data collected included health care utilization, exercise specifics, medication usage and general demographics.

Results

Out of 210 patients analyzed, 65% reported exercising, for an average of 3.72 hours/week. Walking/running (59%), stretching/yoga (19%) and cycling (14%) were the most common exercise modalities. The main reason among the 35% of patients who did not exercise was "Too painful". Out of 220 patients analyzed, 52% underwent active rehabilitation (i.e. physiotherapy), 28% massage therapy, and 23% spinal manipulation (i.e. chiropractor). Pain medications for LBP were taken by 75% of the 230 patients (over-the-counter (OTC) medications: n=36; prescription medications: n=71; OTC + prescription medications: n=65).

Conclusions

Evidence-based treatments are not being taken advantage of prior to consultation. If more patients were to undertake CPG-endorsed conservative activities, it may result in fewer unnecessary referrals, and patients might not degrade as much while on wait lists. Further studies incorporating knowledge translation to patients and clinicians are necessary.
Patient-Reported Disability vs. Objective Physical Performance Measures in Assessing Patient Recovery

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Objectives

Degenerative thoracolumbar spine pathologies may cause compression of adjacent neurologic structures, leading to lower extremity pain and disability. Previous literature suggests discordance between surgeon/patient perception of outcomes and true physical performance. The purpose of this study was the compare standard subjective patient questionnaires to objective functional measurements and range of motion (ROM) in patients following elective thoracolumbar spine surgery.

Method

Measurements were collected during standard clinical follow-up (n=141). Subjective questionnaires included the Oswestry Disability Index (ODI), Numerical Rating Scale for back (NRS-back) and leg pain (NRS-leg) and SF-36 Physical and Mental Component Summaries (PCS; MCS). A Fastrak™ electromagnetic motion-capture system (polhemus.com) was used to monitor thoracolumbar ROM during flexion, axial twist and lateral bend tests. The relationship between subjective and objective measures was analyzed using linear regression. Due to the high dimensionality of Fastrak™ measurements, principal components analysis was used before the linear regression was performed.

Results

As expected, subjective questionnaire scores were significantly correlated. NRS-back was associated with ODI (estimate(est)=5.9, p<0.001), PCS (est=-2.0, p<0.001) and MCS scores (est=-1.2, p<0.01). Similarly, NRS-leg was related to ODI (est=3.7, p<0.001), PCS (est=-1.8, p<0.001) and MCS scores (est=-1.2, p<0.001). Variance explained ranged from 23-55%. The relationship between ODI and Fastrak™ measurements, however, was weak. Although some minimum and maximum Fastrak™ ROM measures reached statistical significance, the variance explained was <6%. Diagnostic linear regression plots demonstrated a lack of model fit.

Conclusions

These results suggest that patient-reported disability and functional capacity may not have the linear relationship we anticipated. It appears it is possible that each assessment provides different insight regarding patient recovery. Future research should assess the value of using both measurements together to provide a more comprehensive understanding of post-operative function. In addition, further investigations are required to understand the time-specific nature of the findings.
Risk Factors for Work Status in Low Back Pain Patients: A Cross-sectional Analysis of Patients Presenting to the Inter-professional Spine Assessment and Education Clinics

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Objectives

It is estimated that 25% of LBP patients account for 75% of the societal cost, with productivity losses representing the majority of the cost. The purpose of the study was to identify independent risk factors for work status in a cohort of LBP patients presenting to the Ontario Inter-professional Spine Assessment and Education Clinics (ISAEC). We hypothesized that the STarTBack chronicity risk tool would be predictive of work status.

Method

This is a cross-sectional study at initial ISAEC consultation utilizing comprehensive demographic, clinical and functional data. Work status for those eligible to work (study subpopulation) was our primary outcome and dichotomized as Employed (E) or Under-Employed (UE; unemployed, modified work duty or disability). Multivariate logistic regression modelling was used to determine independent predictor variables for UE.

Results

Data on 462 (E = 344, UE = 118) consecutive patients underwent univariate analysis. This identified 9 statistically significant variables (p<0.01) including the presence of a Legal/Insurance Claim (LIC; legal, insurance, Workers’ Compensation Board), LBP at rest and with activity (Numerical Pain Rating Scale [NPRS] 1-10), opioid use, lower utilization of allied health practitioners, depression, smoking, a higher Oswestry Disability Index (ODI) and a high-chronicity risk score (STarT Back). Multivariate analysis identified LIC (Odds Ratio 2.77, [95% Confidence Interval 1.0503 - 7.3181]), depression (OR 2.28, [1.15 - 4.54]), smoking (OR 3.80, [2.43 – 6.43]) and higher STarTBack score (OR 1.19, [1.07 - 1.32) as independent predictors for UE. Due to co-linearity and/or mediation effects between the STarTBack and ODI scores, they were modelled separately (ODI (OR 1.05, [1.03-1.09]).

Conclusions

Smoking, involvement with litigation/insurance, depression, and a higher STarTBack or ODI score are independent predictors of a negative working status in the LBP population. This study confirms the psychosocial association of LBP and working status and confirms the utility of multi-dimensional screening tools such as the STarTBack.
Comparison of symptomatic, functional and demographic characteristics of post-surgical versus non-operative LBP patients.

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Objectives

The purpose of this study was to compare the characteristics and symptoms of two distinct groups of low back pain (LBP) patients commencing rehabilitation: 1) those with a recent history of spine surgery (n=1097), and 2) those without surgical intervention (n=2092).

Method

This prospective study of LBP cases was a collaborative effort of spine care rehabilitation clinics in New Zealand and Canada. Patient enrolment occurred between January 2008 and October 2012. Baseline data was recorded at the initial assessment across a range of demographic and symptomatic variables for each patient. All patients had mechanical LBP as determined by the Saskatchewan Spine Pathway triage methodology.

Results

There were 929 cases from New Zealand and 2260 from Canada.

At initial rehabilitation assessment, the two groups differed in several characteristics; the post-surgical group had less sleep disturbance (p<0.001) and slightly lower pain levels (p<0.001), but had a significantly longer symptom duration (mean = 195 days vs 86 days, p<0.001), poorer baseline function (p<0.001), were more likely to have leg dominant pain (p<0.001), positive straight leg raise (p<0.001) and were more likely to be off work (p<0.001) than the non-surgical group.

Similarities included likelihood of intermittent pain (p<0.001), never using medication (p<0.001) and abnormal illness behaviour (p<0.001).

Conclusions

The rehabilitation priorities for patients recovering from spine surgery differ from those that are managed non-operatively. Post-operative patients have lower functional ability and are less likely to be working and therefore require a higher focus on functional and vocational reactivation.
08.1.3

Are primary care patients with different patterns of low back pain epidemiologically distinct?

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Objectives

To characterize and compare a persistent low back pain (LBP) primary care population based on four clinical pain patterns.

Method

This is a cross-sectional study of patients from 220 primary care practitioners in three cities in Ontario, Canada, seeking care for LBP. Inclusion criteria: LBP symptoms lasting from 6 weeks to 12 months, or unmanageable recurrent symptoms; ages 18+ years. Exclusions: pregnant or one year post-partum, involved in active litigation or injured in a motor vehicle accident, emergent spinal presentations, established pain disorder, work injury claim, or symptoms persisting >12 months post-onset. Main outcome measures: Descriptive statistics for demographic and health characteristics were generated stratified by four pain pattern subgroups: back dominant pain aggravated by flexion (P1) or extension (P2), or leg dominant constant (P3) or intermittent (P4) pain. Multinomial logistic regression analysis investigated adjusted associations between demographic and health characteristics and clinical subgroups (multinomial outcome; referent: P1).

Results

The sample consisted of 1,020 individuals (41% ‘P1’, 31% ‘P2’, 17% ‘P3’, 11% ‘P4’). The P2 and P4 groups had greater proportions of older individuals, and individuals with comorbidities (high cholesterol, high blood pressure, diabetes and obesity). The P3 group reported greater activity limitations/disability. From adjusted models, older age was significantly associated with greater odds of being in the P2 and P4 groups (odds ratio: 1.02 and 1.07, respectively, p<0.001). Being male was associated with greater odds of being in the leg dominant pain groups (OR 1.68, p<0.04)). Increasing number of comorbidities was more strongly associated with being in the P2 and P4 groups (p<0.05).

Conclusions

Low back pain subgroups classified according to pain patterns appear to have distinct epidemiological profiles, suggesting potentially unique risk factors and underlying etiology. A stratified approach rather than the conventional homogenous approach to LBP is supported in both the clinical and research setting.
09.1.3

Lack of prognostic model validation in low back pain prediction studies

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Objectives

An essential factor to evaluate when critically appraising clinical prediction papers is the occurrence of prospective validation. The minimum standard should be statistical validation of the predictor variables in patients in whom the model was developed, but prospective validation in a different group is essential. Without validation, so called prediction models are only described traits or characteristics of the sample studied. These studies have limited generalizability (external validity).

The purpose of this review was to examine the frequency with which LBP prediction studies utilize either statistical or prospective methods of prognostic model validation.

Method

A literature search was conducted of all articles published in either Spine or the Spine Journal between January 2013 and January 2014. An initial screen of prognosis or prediction papers identified 56 potential studies (Spine=44,Spine Journal=12); 32 were excluded (21-not prediction studies, 11-review articles). Based on the standards set by Wasson and Laupacis et al., full texts of the remaining 24 articles were further scrutinized for prediction study quality.

Results

Of the 24 included papers, 16 were surgical studies. None of the studies employed any methods of statistical validation (reproducibility of predictor variables, or of the final model).

Based on the study designs and lack of statistical validation, only 2 studies used the correct terminology for describing associations/relationships between independent and dependent variables; the other studies provided no validation for the predictors that they documented.

Conclusions

Surgeons and researchers must consider sophisticated and rigorous methods of statistical/external validity for prediction/prognostic findings; otherwise, incorrect assumptions and conclusions may be made about some patients in your clinical practice.

Without any validation methods, studies that claim to have developed prediction models actually only describe traits or characteristics of the studied sample.
10.1.4

Larger Scoliosis Curve Magnitude is associated with Increased Surgical and Peri-operative Complications: A Multicenter Analysis of 1173 Adolescent Idiopathic Scoliosis Curves

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Objectives

Timely access to surgery is a challenge in some healthcare systems, leading to increasing spinal deformity in the setting of adolescent idiopathic scoliosis (AIS). Treatment of larger curves has been suggested to increase peri-operative complexity and involve more extensive surgery. Limited data exists focusing on complications in such patients. The aim of our study was to quantify the relationship between curve magnitude and the rate of complications in AIS surgery, and to identify potential predictors associated with an increased complication rate.

Method

A prospective, longitudinal multi-center study identified a homogeneous population of AIS patients with a main thoracic curve $\geq 50^\circ$. Univariate analysis explored the association between curve severity and complication rate by dividing patients into 4 subgroups based on 10° increments in curve magnitude. Multivariate regression identified potential predictors and a logistic regression determined the odds ratio for the likelihood of complications within each group compared to the group with the smallest curve magnitude.

Results

There were 298 complications (25.4%) in 1173 patients. Curve magnitude was associated with a significantly higher complication rate in larger curves ($\geq 70^\circ$) compared to smaller ones ($50^\circ$-$59^\circ$). Multivariate logistic regression found curves $\geq 70^\circ$ to have a 1.5-fold increase (C.I.: 1.0-2.3) and curves $\geq 80^\circ$ to have a 2.1-fold increase (C.I.: 1.27-3.63) in the overall complication rate. The odds of a medical, neurological, pulmonary complication, intraoperative neuromonitoring (IONM) event, excessive blood loss, blood transfusion risk, and multiple complications significantly increased with increasing curve size.

Conclusions

Treatment of larger curves was associated with significantly higher complication rates, number of complications, and the odds of experiencing a complication. Curves $\geq 70^\circ$ were 1.5 to 2.1 times more likely to experience a complication compared to curves between $50^\circ$-$59^\circ$, suggesting that delayed identification and any prolonged delay for corrective AIS surgery may negatively influence the surgical care of these patients.
11.1.4

Superior Extension of Upper Instrumented Level in Distraction Based Surgery: A Surrogate for Clinically Significant PJK

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Objectives

Purpose: Determine the rate of clinically significant Proximal Junctional Kyphosis (PJK) during rib-based distraction surgery in a cohort of children from an Early Onset Scoliosis (EOS) registry. A secondary goal was to define the proximal junctional angle (PJA) at the time of revision surgery, with the hypothesis that PJA will be increased in this group of patients.

Method

This is a retrospective clinical/radiographic review of a multi-center registry for children with EOS. All children treated with rib-based distraction surgery, with minimum 2 year follow up, were evaluated in order to identify the rate of clinically significant PJK (i.e. children who required a revision surgery that involved superior extension of the Upper Instrumented Level (UIL)). Two definitions of PJA were used (PJA-A: angle between the caudal endplate of the Upper Instrumented Vertebrae (UIV) to the cephalad endplate 2 vertebrae above UIV. PJA-B: 2 levels below UIV to 2 levels above UIV).

Results

397 children were identified. At time of implantation, the mean age was 5.5 years, mean scoliosis of 69.9°, and mean kyphosis of 49.8°. Forty of these children required revision surgery that involved superior extension of the UIL (10.1% rate of clinically significant PJK). Despite being younger (4.9 vs 5.5 years, p<0.05), the revision group had similar pre-implantation characteristics as the entire study population with mean scoliosis of 70.0° and mean kyphosis of 50.0°. Average time to revision was 2.3 years with mean scoliosis of 66.7° and mean kyphosis of 54.7° at time of revision. PJA-A was 5.6° pre-op and 11.8° at time of revision (p<0.05). PJA-B was 13.1° pre-op and 21.4° at time of revision (p=0.07).

Conclusions

A 10% rate of clinically significant PJK was found within this group of children who were treated with rib-based distraction surgery. At the time of revision surgery, PJA-A had increased significantly from pre-operative values.
12.1.4

The Optimal Surgical Approach For Lenke 5 Curves: Is The Anterior Approach Ready For A Comeback?

Firoz Miyanji\textsuperscript{1}, Tracey Bastrom\textsuperscript{2}, Amer Samdani\textsuperscript{3}, Burt Yaszay\textsuperscript{2}, Jahangir Asghar\textsuperscript{4}, Suken Shah\textsuperscript{5}, Randal Betz\textsuperscript{3}, Harry Shufflebarger\textsuperscript{4}, Peter Newton\textsuperscript{2}, Christopher Reilly\textsuperscript{1}

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Objectives

Historically the anterior approach was the treatment of choice for Lenke 5 curves; recently the posterior approach has gained popularity for its ease, versatility and correction with screw fixation. The objective of this study was to prospectively compare both radiographic and clinical outcomes between anterior and posterior instrumented fusions in Lenke 5C curves.

Method

A prospective, longitudinal multicenter surgical Adolescent Idiopathic Scoliosis (AIS) database identified consecutive patients with Lenke 5C curves treated either by open anterior instrumentation and fusion (ASIF) with a dual rod system, or posterior instrumentation and fusion (PSIF) with a pedicle screw-rod construct and wide posterior release. Pre and 2 year post-operative radiographic data, SRS outcome scores, and peri-operative comparisons were made between the 2 approaches.

Results

69 patients were treated with ASIF (2002-2008) and 92 with PSIF (2002-2011). The stable and end vertebrae were similar in the 2 groups (p=0.91; p=0.62). The only differences pre-operatively were a greater curve flexibility and coronal trunk shift in the anterior group (p=0.008; p=0.05). Post-operatively the lowest instrumented vertebrae (LIV) distribution in the ASIF group was L1: 2.9%, L2: 23.2%, L3: 69.6% and L4: 4.3%, compared to L2: 5.4%, L3: 67.4% and L4: 27.4% for the posterior cases (p<0.001). There were no differences in the % correction (ASIF:59.2%, PSIF:59.6%; p=0.82), length of hospital stay (ASIF:5.6, PSIF:5.7; p=0.75), post-op day conversion to oral pain medication (ASIF:3.2, PSIF:3.2; p=0.66), and SRS outcome scores (p=0.1). Although number of levels fused was significantly lower in the anterior group (4.7 versus 6.3; p<0.001), PSIF resulted in significantly less disc angulation below LIV (ASIF:3.4, PSIF:1.8; p=0.008), greater lordosis (p<0.001), and greater % correction of lumbar prominence (p=0.01).

Conclusions

This prospective, multicenter study found that although ASIF resulted in shorter fusions, this was at the expense of increased disc angulation below the LIV, less lumbar lordosis, and a lower % correction of the lumbar prominence than PSIF.
13.1.5

Improving Quality and Safety in Paediatric Spine Surgery: The Team Approach

Firoz Miyanji, John Choi, Janice Mok, Michael Nitikman, Sameer Desai, Christopher Reilly

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Objectives

The operative care of paediatric spinal disorders remains among the most complex and complication-ridden surgeries. There is growing evidence that standardized system and institutional team approaches can help reduce risk and improve safety following such complex procedures. Our aim was to evaluate the quality and safety improvement of paediatric spine surgery following the implementation of an institutional paediatric spine surgical team (PSST) approach.

Method

A retrospective consecutive case review of all paediatric spine surgeries done pre- (January 2008-December 2009) and post-implementation (January 2012-December 2013) of the PSST was performed. A comparative analysis of a priori determined outcome variables to include surgical site infection (SSI), operative time (ORT), estimated blood loss (EBL), length of hospital stay (LOS), unplanned staged procedures, and blood transfusion rates was performed between cases pre-PSST to those post-PSST. The PSST consisted of a homogeneous core group of spine OR nurses, paediatric spine anaesthetists, and neuro-monitoring technicians.

Results

130 cases pre-PSST were compared to 277 post-PSST. No significant difference in age, gender, BMI, pre-operative major Cobb and number levels instrumented existed between the groups. We found statistically significant differences in SSI, ORT, LOS, allogenic blood transfusion volume, and unplanned staged procedures between the groups. There was a 94% decrease in the rate of SSI’s following PSST implementation (6.9% pre-PSST compared to 0.4% post-PSST). Patients post-PSST had on average a reduction in ORT by 53±7.7min (p=0.013), LOS by 5.4±1.8days (p=0.019), and allogenic blood transfusion volume by 226.3ml±28.4 (p=0.000). There were significantly more unplanned staged procedures pre-PSST (6.2%) compared to post-PSST (2.9%) (p=0.001).

Conclusions

The implementation of a homogeneous and consistent PSST significantly improves surgical and peri-operative outcomes in paediatric spine surgery; namely SSI, ORT, LOS, allogenic blood transfusion rates, and unplanned staged procedures. In addition to quality and safety, other benefits may relate to efficiency of care and reduction in hospital costs.
14.1.5

Posterior Vertebral Column Resection In Paediatric Deformity: The Advantages Of Staging

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Objectives

Vertebral column resection (VCR) through a single all posterior approach has been described for the treatment of severe rigid spinal deformity. Due to the length and complexity, some authors favour a planned staged approach for posterior VCR procedures. The aim of our study was to evaluate radiographic and peri-operative outcomes of patients who underwent a planned two-stage VCR (PS-VCR) compared to those who had a single-stage procedure (SS-VCR).

Method

After institutional IRB approval, a retrospective consecutive case review of 35 patients who underwent an all-posterior VCR procedure was performed. All surgeries were between 2007 and 2014. The charts were reviewed for patient demographic data, operative time (ORT), estimated blood loss (EBL), length of hospital stay (LOS) and surgeon-reported intra-operative, immediate post-operative and most recent follow-up complications. Radiographic measurements were made pre-operatively and at most recent follow up.

Results

Eleven patients were in the PS-VCR group and 24 patients were in the SS-VCR group. The PS-VCR and SS-VCR groups were comparable pre-operatively. Post-operatively, the PS-VCR group had significantly better mean percent curve correction (57.8%) compared to the SS-VCR group (46.1%). No statistical significant differences were found in EBL and LOS between both groups (p=0.790, p=0.643, respectively). ORT was significantly longer in the PS-VCR group (p=0.001), however, the PS-VCR group had on average a significantly lower complication rate (36.4%) than the SS-VCR group (58.4%). Four patients in the SS-VCR group had their procedures aborted due to intra-operative complications.

Conclusions

Although staging posterior VCR surgeries resulted in significantly longer ORT, there was no difference in EBL and LOS compared to SS-VCR procedures. Staging has the advantage of a significantly lower complication rate with better deformity correction compared to SS-VCR procedures.
15.1.5

Minimally Invasive Surgery In Adolescent Idiopathic Scoliosis: Lessons Learned At Mean 2-Year Follow-up

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Objectives

Previous reports of Minimally Invasive Surgery (MIS) in Adolescent Idiopathic Scoliosis (AIS) have found favourable outcomes in the early post-operative, however, longer-term follow-up data is limited. The aim of this study was to compare peri-operative, radiographic and clinical outcomes between MIS and standard open posterior spinal instrumentation and fusion (PSIF) at mean 2-year follow-up.

Method

After IRB approval, a retrospective chart review of patients with AIS who underwent MIS was performed. MIS cases were matched for age, sex, Lenke classification, curve size, date of procedure, and single-surgeon with conventional PSIF. Pre-op, peri-op and most recent follow-up data were evaluated. SRS-22 scores were available pre-op and at final follow-up.

Results

55 cases (27 MIS and 28 PSIF) with average 2.5-year follow-up were analyzed. Preoperatively, MIS group had a lower mean major Cobb (52.9° compared to 61.6°). Operative time (ORT) was significantly less in the PSIF group on average by 149.1 ±4.7 (p=0.000). Estimated blood loss (EBL), cell saver volume transfused, and length of hospital stay (LOS) were all significantly reduced in the MIS group (p<0.05). At average 2 years post-op, % curve correction was significantly better in the PSIF group (73.2%) compared to the MIS group (60.9%) (p=0.000). A total of 8 reported complications (2 hardware failure, 4 delayed infections, and 2 pseudarthrosis) were noted in the MIS group compared to 3 complications (2 delayed infections, 1 adding-on) in the PSIF group. SRS scores at average 2-year follow-up were not significantly different between the groups (p=0.524).

Conclusions

Advantages of MIS in AIS relate to intra-operative blood loss, transfusion rates, and LOS; this needs to be carefully weighed against the significant increase in ORT, limited % curve correction and a higher noted complication rate of MIS compared to standard PSIF. Despite these variations, no clinical differences in SRS-22 scores were found at mean 2-years post-op.
## PODIUM PRESENTATIONS

**FRIDAY**

**FEBRUARY 27th, 2015**

### Abstracts for Oral Presentation

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<th>PROGRAM CODE</th>
<th>PRESENTER LAST NAME</th>
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<th>AWARDS TO BE CONSIDERED FOR</th>
<th>Part I ABSTRACTS PAGE</th>
<th>Part II CONFLICT OF INTEREST DISCLOSURE</th>
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<tr>
<td>71</td>
<td>16.2.1</td>
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<td>Jeremie</td>
<td>Best Overall Paper</td>
<td>Page 22</td>
<td>Page 94</td>
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<td>Page 96</td>
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16.2.1

Development of a Canadian Competency-Based Spine Surgery Fellowship Education Curriculum

- J. Larouche\(^1\), - S. Paquette, C. Fisher, I Domisse\(^2\), - V. Wadey, H. Hall, J. Finkelstein\(^1\), - J. Bouchard, J Hurlbert\(^5\), - R. Broad, R. Fox, D. Hedden, A. Nataraj\(^3\), - T. Carey, C. Bailey\(^8\), - M. Chapman\(^11\), - P. Moroz, D. Chow, E Wai, E. Tsai\(^7\), - S. Christie\(^12\), - K. Lundine\(^10\), - J. Paquet\(^6\), - J. Splawinski\(^9\), - B. Wheelock\(^4\), - M. Goytan\(^13\), - H. Ahn, E. Massicotte, M. Fehlings, A. Yee\(^1\)

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Objectives

A recent CSS membership survey motivated the development of a nationally-based spine surgery fellowship education curriculum. Our purpose was to develop competency-based curricula through an expert consensus method as a tool for educators and trainees.

Method

A fellowship working group of 32 spine surgeons from across the country was assembled. A modified-Delphi approach refined an initial curriculum list (108 cognitive, 84 procedural competencies). This list was generated by reviewing Canadian and U.S. accreditation standards, continuing medical education and fellowship content through national/international spine societies as well as perceived gaps in training syllabi as deemed by the authors. A consensus threshold of 70% was chosen with up to five rounds of blinded voting performed. Members were asked to ratify items into either a general comprehensive or focused/advanced curriculum.

Results

28/32 consultants (88%) responded and participated in voting rounds. 78 (72%) cognitive and 63 (75%) procedural competencies reached 70% consensus in the first round. This increased to 82 cognitive and 73 procedural items by round 4. 14/24 paediatric remained unresolved and group members ratified the addition of a separate paediatric curriculum. There were 6 cognitive and 7 procedural items that did not reach threshold after 4 rounds. All 13 remaining items were deemed important to include and were ratified to the respective curriculum based upon a final fifth round majority vote. Final curriculum documents developed include a general comprehensive curriculum (91 cognitive and 53 procedural items), a focused/advanced curriculum (22 procedural items), and a paediatrics curriculum (22 cognitive and 9 procedural items).

Conclusions

Through a consensus-building approach, the study authors have developed competency-based curricula anticipated to be of educational value to spine surgery fellowship educators and trainees. To our knowledge, this is the first nationally based effort of its kind.
17.2.1

Computer Assisted Surgery is an Effective Educational Tool for the Training of Orthopaedic Surgery Residents in Pedicle Screw Placement.

Ahmed Aoude, Hamzah Alhamzah, Maryse Fortin, Peter Jarzem, Jean Ouellet, Michael Weber

mcgill, montreal, Canada

Objectives

The accurate placement of pedicle screws in vertebral pedicles is far from straight forward and pedicle screw malposition can have significant complications. The training of orthopaedic residents in adequate pedicle screw placement is therefore very important.

Method

A total of 24 residents from the McGill Orthopaedics program participated in this study. Each resident was randomly assigned to place a screw with free hand technique (FH) and CAS technique on one of three cadavers (Cobb angles 5º, 15º and 67º), at randomly selected thoracolumbar vertebral levels. All residents were blinded to their colleagues' pedicle screw placements and were asked to fill a short questionnaire at the end of the session to evaluate CAS. Computed tomography images were obtained for each cadaver to assess pedicle screw placement accuracy and classified as follows: A) screw completely in pedicle, B) screw outside of pedicle < 2mm, C) screw outside of pedicle 2-4mm, D) screw outside pedicle > 4mm.

Results

Five screws were classified as grade A or B (safe zone) and 19 as grade C or D (unsafe zone) using FH in comparison to 15 and 9 using CAS, respectively (p = 0.008). Severe spine deformity (Cobb angle 65º) was associated with lower accuracy using FH (p=0.03). A greater number of screws were placed in the unsafe zone while using FH in the lumbar spine (p=0.004). Finally the self-reported survey showed that 65% of the residents still preferred using FH.

Conclusions

Our results suggest that CAS improves screw placement accuracy and can be successfully used as an educational training tool for orthopaedic surgery residents. However, CAS may need to be more user friendly in order to improve resident's self-perception of its use.
18.2.1

Validation of the Calgary Spine Severity Score

Godefroy Hardy-St-Pierre\textsuperscript{1}, Andrew Jack\textsuperscript{1}, Ken C. Thomas\textsuperscript{2}, Andrew Nataraj\textsuperscript{1}

\textsuperscript{1}\textit{University of Alberta, Edmonton, Canada}, \textsuperscript{2}\textit{University of Calgary, Calgary, Canada}

Objectives

The Calgary Spine Severity Score (CSSS) is a published triage score reported in 2010. It separates spine referrals into four time categories of urgency. It stratifies patients according to clinical, radiological and pathological findings. The CSSS however still requires external validation in another institution as well as an unselected sample of patients.

Method

We applied the CSSS to an unselected sample of patients from the Royal Alexandra Hospital OR between April 2014 and September 2014. Variables collected were: elective/emergent OR, re-do OR, deformity, time to OR, clinical CSSS, pathological CSSS and radiological CSSS. We compared the time to OR predicted by the CSSS in one of four categories (Routine > 6 months = CSSS 3-5, Priority < 6 months = CSSS 6-8, Urgent < 1 month = CSSS 9-11 and Emergent < 1 week = CSSS 12-15) with the actual time to OR. We used Kaplan Meier survival analysis to assess the CSSS predictive ability. Cox proportional hazards model were built and compared via ANOVA to determine if the models differed in their ability to fit the data.

Results

We had 316 patients to analyze. 289 had sufficient information. 118 were a mismatch with the actual time to OR for an accuracy of 63%. The CSSS overestimated the urgency in 68 cases and underestimated it in 50 cases. Notably, 7 cauda equina syndrome cases were classified as priority (<6 months) instead of emergent. The concordance was 0.70 and the R-square 0.33. We proposed several adjustments to the CSSS to increase its accuracy. The modified CSSS had an accuracy of 96%, overestimating 9 cases and underestimating 1 case. The concordance was 0.77 and the R-square 0.70.

Conclusions

The modified CSSS is an accurate and easy to use externally validated triage score.
19.2.2

Can triaging referrals with a simple 3-item pain questionnaire reduce wait times for consultations for patients who would benefit from lumbar spinal surgery?

Darren Roffey¹,³, Matt Coyle¹,², Stephen Kingwell¹,⁴, Eugene Wai³,⁴

¹University of Ottawa Spine Program, The Ottawa Hospital, Ottawa, Canada, ²Faculty of Medicine, University of Ottawa, Ottawa, Canada, ³Clinical Epidemiology Program, Ottawa Hospital Research Institute, Ottawa, Canada, ⁴Division of Orthopedic Surgery, The Ottawa Hospital, University of Ottawa, Ottawa, Canada

Objectives

We have developed a 3-item back-versus-leg pain questionnaire (3-Item-Q) that has previously identified optimal surgical candidates from non-specific low back pain (LBP) referrals. However, questions remain over its capacity to: a) reduce wait-times for surgical patients and; b) accurately quantify patient symptomology between referral and spinal surgery consultation.

Method

Sub-analysis of data collected via a prospective randomized controlled trial comparing two groups: (i) Control - triage via referral letter and radiology report; (ii) Study - triage via referral letter, radiology report and 3-Item-Q responses. Eligible adult lumbar spine patients were restricted to those triaged as P2 (“routine”) or P3 (“non-urgent”); P1 (“urgent”) patients were excluded. Study group patients had their wait-list position upgraded if they indicated consistent leg-dominant pain on the 3-Item-Q. Quality of life questionnaires were completed at referral and again at consultation.

Results

Study group patients had a mean wait-time of 122 ± 88 days, while Control group patients waited 131 ± 60 days. Study group patients upgraded to P1 from P2 experienced the shortest wait-times (78 ± 33 days); the largest percentage of surgical candidates was extracted from this cohort (21%). Upgraded Study group patients (i.e. P2 to P1) also had an improved quality of life at consultation, as reported by responses to the EuroQol-5D. Overall, 39% of patients from both groups worsened from referral to consultation, as per responses from numerical pain scales and the Oswestry Disability Index. Contributing factors to worsening conditions were an unhealthy BMI (≥25 kg/m²), low physical activity levels, depression/anxiety and back dominant pain.

Conclusions

This study highlights the real potential for patients to experience worsened symptoms while on the wait-list for spinal surgery consultation. By employing our 3-Item-Q and analyzing its responses, patients may experience shorter wait times and surgeons can more effectively identify surgical candidates from the abundance of non-specific LBP referrals.
20.2.2

Strategies to improve the credibility of meta-analyses in spine surgery: A systematic survey

Nathan Evaniew, Leon van der Watt, Mohit Bhandari, Michelle Ghert, Ilyas Aleem, Brian Drew, Gordon Guyatt
McMaster University, Hamilton, ON, Canada

Objectives

Meta-analyses are powerful tools that can synthesize existing research and support evidence-based care. They have become increasingly popular in spine surgery, but the rigor with which they are being conducted has not been evaluated. Our objectives were to evaluate the methodological credibility of spine surgery meta-analyses and to propose strategies to improve future research.

Method

We conducted a systematic survey of spine surgery meta-analyses published since 1990. Two reviewers independently evaluated credibility according to the Users’ Guide to the Medical Literature and completeness of reporting according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist. We used multivariable linear regression to evaluate potential associations. Inter-rater agreement was quantified using kappa and intra-class correlation (ICC) coefficients.

Results

We identified 132 eligible meta-analyses. The mean credibility score was 3 out of 7 (SD 1.4; ICC 0.86). Clinical questions were judged as sensible in 125 (95%), searches were exhaustive in 102 (77%), and risk of bias assessments were undertaken in 91 (69%). Seven (5%) meta-analyses addressed possible explanations for heterogeneity using a priori subgroup hypotheses and 24 (18%) presented results that were immediately clinically applicable. Investigators undertook duplicate assessments of eligibility, risk of bias, and data extraction in 46 (35%), and rated overall confidence in the evidence in 24 (18%). Later publication year, increasing Journal Impact Factor, increasing number of databases, inclusion of RCTs, and inclusion of non-English studies were associated with higher credibility (p<0.05). The mean score for reporting was 18 out of 27 (SD 4.4; ICC 0.94).

Conclusions

The credibility of many current spine surgery meta-analyses is limited. Researchers can improve future meta-analyses by performing exhaustive literature searches, addressing possible explanations of heterogeneity, presenting results in a clinically useful manner, reproducibly selecting and assessing primary studies, addressing confidence in the pooled effect estimates, and adhering to guidelines for complete reporting.
21.2.2

The Societal Cost of Waiting to See a Spine Surgeon for Lower Back Symptoms in Canada.

Ghazal Fazli, Jeyagobi Jeyaratnam, Nadia Nandlall, Peter Coyte, Raja Rampersaud
University of Toronto, Toronto, ON, Canada

Objectives

This study examines the societal costs associated with wait-times from the point of referral to a spinal surgeon to the point of consultation (Wait-Time One –WT1) for patients with low back pain, within a one-year time horizon.

Method

We conducted a cost analysis of 308 patients from a prospective wait-time study who were pre-screened as possible surgical candidates and wait-listed for consultation. After consultation, patients were categorized as absolutely non-surgical patients (NS, n=73) and surgical candidates (SC: those whose symptoms combined with correlative structural abnormality(ies) would have been amenable to surgical intervention at some point before or after consultation). For the purpose of this study the SC group was further divided into those who had surgery (SC-S, n=102) and those who were managed conservatively (SC-C, n=133). Overall estimated cost (direct and indirect) during a one-year period was determined based on self-reported cost-diary data on healthcare utilization, as well as all societal cost (productivity, caregiver burden, transportation, out-of-pocket patient cost). Health utility scores were determined using the SF-6D taken at baseline, surgical consultation and 1 year from referral.

Results

The overall WT1 was 6 months (1-19mths). There was no significant change in the utility scores across all three time points for all groups and thus a cost-utility comparison was not performed (mean SF-6D scores: SC-S 0.57, SC-C 0.61, NS 0.58). The total estimated societal costs (per patient) for the SC-S, SC-C and NS was $27,343, $39,385 and $31,401 respectively. Productivity loss was the major cost driver across all groups.

Conclusions

The per patient societal cost of waiting to see a spine surgeon is significant, particularly given that the majority of patients do not ultimately require surgery. Alternate models of care, wherein appropriate care is delivered at the appropriate time may significantly impact societal cost.
22.2.3

The Cost of an Adverse Event Depends on its Definition and Method of Capture

Clifford Lin¹, Christopher Witiw², Kala Sundararajan¹, Y. Raja Rampersaud¹
¹Division of Orthopaedics, University Health Network, Toronto, ON, Canada, ²Division of Neurosurgery, University Health Network, Toronto, ON, Canada

Objectives

The incidence of adverse events (AE) demonstrates wide variability due to differences in case definition and method of capture. In an era of quality initiatives to improve value and drive health-funding reform, the reliable determination of the health-services impact of AEs carries significant consequences to the healthcare system and stakeholders. The primary objective of this study was to assess how three different methods of AE reporting affect the calculation of incremental cost and length of stay (LOS).

Method

AE data was collected using: 1) Voluntary reporting (SAVES: n=1815); 2) Prospective point-of-care collection with dedicated clinical staff (orthoSAVES: n=844), and 3) Data extraction from administrative ICD-10 coding (ICD-10) for the SAVES and orthoSAVES cohorts. Microcase costing data was also obtained for all patients. Incremental cost and LOS attributable to an AE was estimated using propensity matching based on the risk of AE (1 case to 2 controls).

Results

AE rates varied widely depending on the method of capture: SAVES (17.4%); ICD-10-SAVES (25.9%); orthoSAVES (31.6%) and ICD-10-orthoSAVES (30.8%). Calculation of incremental cost (in $, 95%CI) / LOS (in days, 95% CI) was as follows: SAVES $21236 (7808-34664) / 12.0 (5.8-18.2); ICD-10-SAVES $31534 (23247-39821) / 14.6 (10.6-18.6); orthoSAVES $13506 (5449-21563) / 6.3 (3.8-8.8); ICD-10-orthoSAVES $19575 (11727-27423) / 8.6 (6.2-11). Sensitivity analysis demonstrated that varying the case definition for ICD-10 data resulted in a 29% decrease in the incidence of AEs but a 27% increase in both incremental cost and LOS.

Conclusions

Regardless of the method of capture and case definition, spine surgery AEs resulted in significant incremental cost and increased LOS. However, the gross variability in the estimated incremental cost or LOS is a cause for concern and requires further investigation. In an era of quality-based funding models, methods to ensure standardized collection protocols are paramount to enable fair and transparent AE-related funding allocation.
23.2.3

Economic evaluation of intra-operative cone beam CT based navigation for the placement of spinal pedicle screws: A patient-level cost effectiveness analysis

Nicolas Dea\textsuperscript{1}, Charles Fisher\textsuperscript{2}, Juliet Batke\textsuperscript{2}, John Street\textsuperscript{2}
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Objectives

Pedicle screws are routinely used in contemporary spinal surgery. Screw misplacement is however correlated with potential adverse events. The goal of the present study is to perform an economic evaluation looking specifically at the misplaced screws leading to reoperation secondary to neurological deficits or biomechanical concerns.

Method

A patient-level data cost-effectiveness analysis from the hospital perspective was conducted based on a single centre observational study of prospectively collected data to determine the value of a navigation system coupled with intra-operative 3D imaging (O-arm® Imaging and the StealthStation® S7 Navigation Systems, Medtronic, Louisville, CO) in adult spinal surgery. The data source was a consecutive series of patients treated with the aid of computer-assisted surgery (treatment group) compared to a matched historical cohort of patients treated with conventional methods (control group). The primary effectiveness measure studied was the number of reoperations for misplaced screws.

Results

A total of 5132 pedicle screws were inserted in 502 patients during the study period, 2682 screws in 253 patients in the treatment group and 2450 screws in 249 patients in the control group. Overall accuracy rates were 95.2% for the treatment group and 86.9% for the control group. Two patients (0.8%) required a revision surgery in the treatment group (both within the same admission) compared to 15 patients (6%) in the control group (9 within the same admission and 6 within one year during a subsequent admission). Costs of the different alternatives were assessed based on the annuitization of capital expenditures method. Using this methodology, an incremental cost effectiveness ratio of $15,961/reoperation avoided was calculated for the computer-assisted surgery group. Based on a reoperation cost of $12,618, this new technology becomes cost-saving for centres performing more than 254 instrumented spinal procedures per year.

Conclusions

Computer-assisted spinal surgery has the potential to reduce reoperation rates and thus to have serious cost-effectiveness implications. High acquisition and maintenance costs of this technology can be offset by equally high reoperation costs. Our cost-effectiveness analysis showed that for high-volume centres, this technology is economically justified.
Predictors of Inappropriate Emergency Department Utilization Following Elective Thoracolumbar Spine Surgery

Meghan Flood\textsuperscript{2}, Edward Abraham\textsuperscript{1,2}, Alana Green\textsuperscript{1,2}, Neil Manson\textsuperscript{1,2}
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Objectives

The incidence of spine surgery continues to rise, representing a significant patient population and a material percent of healthcare expenditure. While spine surgeries yield a high success rate, recent research indicates that a large number of patients visit the emergency department (ED) post-operatively. This poses a burden to the patient and the health care system alike. This study aimed to identify and predict inappropriate ED visits within six months after elective thoracolumbar spine surgery.

Method

We identified 987 consecutive patients receiving surgery from 2008-2013. Patients with previous spine surgery, malignancy, worker’s compensation or spine-related litigation (n=388) were excluded. Through regional EMR review, we identified 98 ED visits. Comprehensive chart reviews were then conducted for these visits and two fellowship-trained orthopaedic spine surgeons split patients into groups: those who engaged in an inappropriate surgery-related ED visit (n=80) and those who did not (n=519). 18 visits were determined to be appropriate and/or unrelated. These patients were included in the 519 “no inappropriate visit” group. Age, BMI, SF-36 PCS, SF-36 MCS, ODI, NRS-Back pain, NRS-Leg pain, Charleston Comorbidity Score, levels of intervention, sex, surgeon, marital status, living arrangement, education, work status, smoking, drug and alcohol use, exercise, primary pathology, primary symptom, surgery type(fusion/non-fusion), approach (open/MISS), peri-operative adverse events and family doctor status (yes/no) were measured. T-tests were performed on continuous variables and chi-squares were performed on categorical variables. A logistic regression model was then built based on these results and previous research.

Results

During the exploratory phase, BMI ($t(589)=2.487, p=0.01$) and marital status [$X^2(2,N=555)=8.24, p=0.02$] were the only two significant predictors of an inappropriate visit. The regression model was not statistically significant ($p=.54$). Upon further investigation, marital status was gender-mediated, with divorced/separated women significantly more likely to engage in an inappropriate visit than single or married/engaged/common-law women [$X^2(2,N=555)=9.48, p<0.01$], there was no effect for men ($p=.76$).

Conclusions

While there were two significant factors in this model, the $R^2$ values were very low. This, in combination with the high frequency of inappropriate ED visits, indicates that a wide range of patients would benefit from further education surrounding post-operative complications.
25.2.4


R Andrew Glennie\textsuperscript{1,2}, Tamir Ailon\textsuperscript{2}, Juliet Batke\textsuperscript{2}, Nic Dea\textsuperscript{2}, John Street\textsuperscript{0}
\textsuperscript{1}Dalhousie University, Halifax, NS, Canada, \textsuperscript{2}University Of British Columbia, Vancouver, BC, Canada

Objectives

To determine the incidence of adverse events (AE) in patients with thoracic or lumbar spine fractures treated both operatively and non-operatively and determine their impact on length of stay (LOS). Secondarily, determine the difference in incidence of AEs in both neurologically intact and compromised patients.

Method

Data on intra, pre, and postoperative AEs were prospectively collected using the SAVES data collection. Logistic regression was used to model the likelihood of experiencing at least one AE based on patient characteristics. The impact of the total number of AEs experienced by a patient and that of each of the most common AEs on LOS was determined using Poisson regression.

Results

Three hundred and ninety patients were included in final analysis. Two hundred and seventy six patients (70.8\%) were treated operatively. One hundred and forty patients (36\%) experienced neurologic deficit as a result of their initial injury. AEs occurred in operatively treated patients 56\% of the time and only 13\% of the time in the non-operative group. The presence of neurologic deficit increased the risk of AEs especially in high thoracic (T1-T6) trauma increasing the odds of having an adverse event by 12.1 (p<0.0001). The most common AEs were urinary tract infections (UTIs)(19.7\%), neuropathic pain (12.3\%) pneumonias (11.8\%), delirium (10.5\%), and ileus (6.2\%). LOS increased significantly with pneumonia (p<0.0001) and delirium (p=0.0001).

Conclusions

The presence of neurologic injury and the need for operative fixation of thoracic or lumbar injuries leads to a greater risk of adverse events. Only pneumonia and delirium consistently increase LOS.
26.2.4

Factors associated with adverse events in major elective spine, knee, and hip, in-patient orthopaedic surgery.

Dov B Millstone\textsuperscript{1,2}, Anthony V Perruccio\textsuperscript{1,3}, Elizabeth M Badley\textsuperscript{2,4}, Y Raja Rampersaud\textsuperscript{1}

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Objectives

Hip and knee replacement and spinal fusion represent an increasing burden on the healthcare system. These procedures are also associated with significant adverse event rates and related cost. The objective of this study was to identify risk factors for adverse events (AEs) in these prevalent orthopaedic surgeries based on a common clinical point-of-care adverse event capture system (Orthopaedic Surgical AdVerse Event Severity system (OrthoSAVES)).

Method

Data on in-hospital adverse events were collected over a two-year period for elective inpatient knee, hip, and spine orthopaedic procedures for degenerative musculoskeletal conditions (predominantly osteoarthritis/spinal stenosis). Multivariable logistic regression was employed to investigate the association between various factors (age, sex, surgical site, body mass index, surgical risk class, procedure time, and medical comorbidities) and the likelihood of experiencing an adverse event.

Results

The sample included 2,146 patients. The overall adverse event rate was 27%: spine 29%; knee 27%; and hip 25%. Factors independently associated with greater odds of an adverse event included increasing age (Odds Ratio=1.29, 95% CI: 1.11-1.49, per 15 year interval), male sex (OR=1.36, 95% CI: 1.11-1.68), longer procedure time (OR=1.19, 95% CI: 1.10-1.30, per 30 min increase), and undergoing revision surgery (OR=2.10, 95% CI: 1.30-3.38). Decreased odds were associated with being overweight (OR=0.73, 95% CI: 0.55-0.97) and for undergoing spine surgery (OR=0.49, 95% CI: 0.32-0.77) once procedure time was taken in account. No significant effects relating to comorbidities were found.

Conclusions

A point-of-care adverse event capture system revealed higher adverse event rates compared to estimates typically based on administrative data. We report increasing age, male sex, revision surgery, and longer procedure times as common risk factors for an adverse event in this population. The conventional perception of higher adverse event rates in spine surgery appears to be related to longer surgical procedure times.
27.2.4

Prognostic Factors for Survival in Surgical Series of Symptomatic Metastatic Epidural Spinal Cord Compression: A Prospective North American Multi-Centre Study in 142 patients

Anick Nater1,2, Michael Fehlings1,2, Lindsay Tetreault1,2, Branko Kopjar3, Charles Fisher4, Alexander Vaccaro5, Paul Arnold6, James Schuster7, Joel Finkelstein8, Laurence Rhines9, Mark Dekutoski10, Ziya Gokaslan11, John France12, Peter Rose13

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Objectives

Symptomatic MESCC afflicts up to 10% of cancer patients. Metastatic Epidural Spinal Cord Compression (MESCC) is associated with shortened survival and worsened quality of life. This study aims to identify the key survival prognostic factors in surgically treated symptomatic MESCC patients.

Method

145 MESCC patients were enrolled in a prospective North American multi-centre study and followed postoperatively for 12 months. Using univariate analyses, Kaplan-Meier methods, and log-rank tests the prognostic value of various clinical predictors were assessed. Predictors with p < 0.2 in univariate analyses were included in the final Cox proportional hazards model.

Results

The overall median survival was 7.7 months; lung and breast cancer had the shortest and longest median survival, respectively (4.5 vs. 12.1 months). Nine patients (6%), whose primary cancer were lung (3), kidney (3), melanoma (1), prostate (1), and breast (1), died within 30-days postoperatively; 46 (32%), 61 (42%), 74 (51%), and 86 (59%) died at 3, 6, 9, and 12 months, respectively. Significant predictors on the univariate analyses were: site of primary tumour, number of vertebrae involved, metastases outside the spine, bladder dysfunction, ability to walk 4 steps, ODI, EQ-5D, and ASIA scores; only spinal metastasis involving ³ 4 vertebral bodies was included in the final model (p = 0.002, HR: 25).

Conclusions

The extent of spinal metastasis, which is regarded as an indicator of the severity of patient’s metastasis burden, is an independent predictor of poor prognosis in patients with a single level symptomatic MESCC lesion. It is essential to identify factors to optimize quality of life.
28.2.5

A comparison of two prospective adverse event recording tools with institutional ICD-10 coding for detecting perioperative adverse events in patients undergoing spinal surgery

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Objectives

Recently, increasing attention has been focused toward the validity of recording perioperative adverse events (AEs) with institutional administrative databases. Prospective tools for recording events have been shown to capture more individuals experiencing AEs and more AEs per individual, however little is known about how these tools differ from one another. The aim of this investigation is to compare 2 methods of prospective perioperative AE detection.

Method

The previously validated Spine Adverse Events Severity System (SAVES) tool was used to record AEs by the surgical team via voluntary reporting at discharge for 1815 patients between August 2007 and December 2010. The orthoSAVES tool was administered by a dedicated clinical practitioner to prospectively record AEs on 844 patients between January 2011 and December 2012. In parallel, adverse events were extracted from administrative ICD-10 codes for all patients. Direct comparisons were made between ICD-10 capture and SAVES as well as orthoSAVES using McNemar’s Test. Differences with p < 0.05 were considered significant.

Results

We found that orthoSAVES captured significantly more patients with any AE (p < 0.01), deep wound infection (p = 0.01), neurological deterioration (p < 0.05), pulmonary embolism (p < 0.05), urinary retention (p < 0.05) and dural tear (p < 0.05) compared to ICD-10 codes. The SAVES tool captured significantly more urinary tract infections (p < 0.05) and post-operative pain (p < 0.01); however it captured fewer patients with any AE (p < 0.05) and dural tear (p < 0.02) than ICD-10 codes.

Conclusions

Differences exist between prospective tools and ICD-10 databases in rates of overall AE and of specific types of AE. Interestingly, there also appears to be differences between prospective capture methods. Further study is needed to determine the optimal method for recording AEs in spinal surgery.
29.2.5

Assessment of Impact of Long-Cassette Standing Radiographs on Surgical Planning for Lumbar Pathology: An International Survey of Spine Surgeons

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Objectives

Associations between global spinal alignment, patient reported disability and surgical outcomes have increasingly gained attention. Assessment of spinal alignment requires standing full cassette radiographs; however spine surgeons routinely rely on short segment imaging only when evaluating seemingly isolated lumbar pathology. This may prevent adequate surgical planning and predispose to misrecognition of associated pathology in the thoracic spine and sagittal spino-pelvic malalignment. We utilized a case-based survey questionnaire to evaluate if routine performance of long cassette radiographs results in changes to respondents' operative plans compared to standard imaging of the involved lumbar spine.

Method

A case-based survey was distributed to AOSpine members with 15 cases of lumbar spine pathology and lumbar imaging only. The same 15 cases were then re-presented with additional long-cassette radiographs. Participants selected a single operative plan from 5 choices ranging from least to most extensive. Cases included 5 "control" cases with normal global alignment and 10 'test' cases with significant sagittal and/or coronal malalignment. Mean scores were determined for each question with higher scores representing more extensive operative plans.

Results

316/712 (44%) completed the survey, including 68% with spine fellowship training and representation from more than 40 countries. For test, but not control cases, there were significantly higher surgical invasiveness scores for cases with long-cassette films (4.2) compared to those with lumbar imaging only (3.4; p=0.002). The addition of such radiographs resulted in 82.1% of respondents recommending instrumentation up to the thoracic spine, a 23.2% increase compared to the same cases presented with lumbar imaging only (p=0.008).

Conclusions

This study demonstrates the importance of maintaining a low threshold for obtaining long-cassette imaging when assessing seemingly isolated lumbar pathology. Deformity, particularly positive sagittal malalignment, may go undetected unless one maintains a high index of suspicion, and obtains long-cassette radiographs. It is recommended that spine surgeons recognize the prevalence and importance of such deformity when contemplating operative intervention.
30.2.5

Long-Term Patient Reported Outcome and Surgical Survivorship of MIS Fusion for Low Grade Spondylolisthesis

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**Objectives**

Little is known about the long-term benefits and survival of Minimally Invasive Surgical (MIS) lumbar fusions. The primary objective of this study was to measure improvements in Oswestry Disability Index (ODI) 5 years following MIS fusion for lumbar spondylolisthesis (LS) and assess the long-term survival of the procedure. The secondary objective was to measure the five-year change in Health-Related Quality of Life (HRQoL).

**Method**

A subset analysis of an ongoing prospective observational cohort study was performed. Consecutive patients undergoing MIS lumbar fusion for low-grade (Meyerding grade I-II) degenerative or isthmic LS were assessed. Procedures were performed from 2002-2008 by one academic surgeon using a single technique. ODI and Short Form 36 (SF36) scores were evaluated pre-operatively and post-operatively at 6 weeks, 3, 6, 12, 24, 36 and 60 months. Kaplan-Meier survival curves assessed procedural survival at latest follow up.

**Results**

Fifty-nine patients were identified with completed 5-year follow up. The mean age at surgery was 53 years with 56% female. Baseline ODI scores (42.48%) continued to improve until 1-year post-operative (17.64%) and were maintained to 5 years (18.25%).

Kaplan-Meier survival curves for all fusions identified an 88% survival at 4000 days. There was no difference in survival between isthmic versus degenerative etiologies.

All SF36 Norm Based Score (NBS) domains improved with surgery. The SF36 sub-components most responsive to change were Role Physical (RP) and Bodily Pain (BP). Patients with isthmic spondylolisthesis had statistically higher scores for RP-NBS and BP-NBS than degenerative spondylolisthesis at intermediate and long-term follow up.

**Conclusions**

This paper presents the largest long-term cohort of MIS lumbar fusions for low-grade spondylolisthesis. Patient reported outcomes were significant and maintained to at least 5 years. Overall procedure survival was high at long-term follow up. Isthmic spondylolisthesis had greater improvement in SF36 subcomponents (RP and BP) than degenerative spondylolisthesis.
## PODIUM PRESENTATIONS

### SATURDAY

**FEBRUARY 28th, 2015**

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31.3.1

The Effect of Prolonged Post-Operative Antibiotic Administration on the Rate of Infection in Patients Undergoing Posterior Spine Surgery Requiring a Hemovac Drain

Darryl Collings\textsuperscript{1,2}, Lori Nutt\textsuperscript{1,2}, Jennifer Urquhart\textsuperscript{1,2}, Linda Kuska\textsuperscript{1,2}, Fawaz Siddiqi\textsuperscript{1,2}, Kevin Gurr\textsuperscript{1,2}, Chris Bailey\textsuperscript{1,2}

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Objectives

Postoperative prophylactic antibiotics for 24 hours following an elective procedure are routinely given to most orthopaedic surgery patients as the standard of care. However, a spinal wound drain is often maintained for 48 hours following surgery to prevent compressive hematoma formation. It is hypothesized that maintaining the prophylactic antibiotics for 24 hours after drain removal may decrease infection rates. The purpose of this study is to compare the rate of deep infection in patients receiving prophylactic antibiotics for 24 or 72 hours, and to provide more advanced practice guidelines on the management of wound infections in post-operative spine surgery.

Method

All patients undergoing elective posterior spine surgery were screened. 500 patients met the inclusion criteria, with 450 patients computer randomized to either 24 or 72 hours of antibiotics. A stratified block randomization design was utilized to ensure equal numbers of patients with diabetes in each group. For this interim analysis Chi Square tests were used to compare the rate of superficial and deep infection between the two groups. Secondary outcomes, such as length of stay, were compared using simple two-tailed t-tests.

Results

There were 17 superficial infections in the 24 hour group, compared with 5 in the 72 hour group ($p = 0.008$). There were 7 deep infections in the 24 hour group, compared to 8 in the 72 hour group ($p = 0.801$). The most commonly isolated organism was staphylococcus aureus. The mean length of stay was $4.0 \pm 2.4$ days in the 24 hour group and $4.3 \pm 1.7$ days in the 72 hour group ($p = 0.162$).

Conclusions

These preliminary results would suggest that a prolonged course of postoperative antibiotics may decrease the rate of superficial infection, but is not associated with a statistically significant difference in the rate of deep infection requiring irrigation and debridement.
32.3.1

Preliminary Results of a Phase 1 Trial on the use of Photodynamic Therapy in Vertebral Metastases

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\textsuperscript{1}Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada, \textsuperscript{2}University of California San Francisco, San Francisco, California, USA, \textsuperscript{3}University Health Network / Princess Margaret Hospital, Toronto, Ontario, Canada, \textsuperscript{4}McMaster University, Hamilton, Ontario, Canada

Objectives

The spine is a common site of cancer spread. Complications include pathologic fracture and spinal cord compression. Vertebroplasty (VP) and Balloon Kyphoplasty (KP) are minimally-invasive stabilization procedures. Photodynamic therapy (PDT) is a tumour-ablative modality that may complement mechanical stability afforded by VP/KP. This first-in-human study evaluates PDT safety when applied in conjunction with VP/KP.

Method

Following institutional ethics and Health Canada approval, symptomatic patients eligible for VP/KP in treating pathologic fracture or at-risk lesions were recruited. Exclusion criteria included spinal canal compromise and/or neurologic impairment. PDT is a 2-step binary therapy of systemic drug (photosensitizer) followed by intra-vertebral activating light administration: Visudyne\textsuperscript{®}(6mg/m\textsuperscript{2}), 15 minute drug-light interval, 690nm diode-laser light (150mW/cm\textsuperscript{2} interstitial diffusing optical fibre), for escalating total light doses (50, 100, 150 and 200J/cm\textsuperscript{2} delivered over 5.5-22.5 minutes). Light was applied through the VP/KP bone trochar prior to cementation. Six patients were treated as light-only (no drug) controls, followed by PDT (drug+light) with 6 patients planned for each light-dose increment. Drug/light safety, neurologic safety, generic (SF-36) and disease-specific outcomes (VAS, EORTC-QLQ-BM22) were recorded through 6 weeks.

Results

To date, 15 patients have been treated (including 2 patients in drug+100J/cm\textsuperscript{2} cohort). Neurologic examination immediately following treatment was normal in all patients. There have been no adverse drug, light, or neurologic events attributed to PDT. In general, patients experienced improvement in pain and functional scores by 6 weeks. Two patients (50J/cm\textsuperscript{2}, drug group) developed further fracture despite VP/KP, resulting in lumbar radiculopathy by 5-6 weeks. Review by an independent data safety monitoring board determined that these 2 events were the result of cancer progression with failure of VP/KP mechanical support. Both patients were treated medically.

Conclusions

To date, vertebral PDT using the drug & light regimen appears safe from a pharmaceutical and neurologic perspective. Ongoing study to determine safe dose range and subsequent efficacy studies will be required in clinical translation.
33.3.1

The Minimal Clinically Important Difference of the modified Japanese Orthopaedic Association Scale in Patients with Degenerative Cervical Myelopathy undergoing Surgical Intervention

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1University of Toronto, Toronto, Ontario, Canada, 2Toronto Western Hospital, Toronto, Ontario, Canada, 3University of Ontario Institute of Technology, Toronto, Ontario, Canada

Objectives

The modified Japanese Orthopaedic Association (mJOA) score is the most frequently used tool to assess functional status in patients with cervical spondylotic myelopathy (CSM). By defining the minimal clinically important difference (MCID) for this scale, clinicians can evaluate the impact of treatment interventions for CSM and better interpret results from previous therapeutic research studies. This study therefore aims to define the MCID of the mJOA in patients with CSM. Furthermore, a secondary objective is to define a cut-off point between an “optimal” and “suboptimal” surgical outcome.

Method

Three different methods were used to determine the MCID of the mJOA: 1) distribution-based, 2) anchor-based and 3) professional opinion. The first two were accomplished using data on 757 surgical CSM patients enrolled in either the prospective CSM-North America or International study. Distribution-based methods were used to estimate the MCID by computing the half standard deviation. In addition, using anchor-based methods, the change in mJOA (1-year vs baseline) was compared between patients who achieved the MCID on the Neck Disability Index (NDI) and SF-36 Physical Component Score (PCS) and those who did not. The difference between the two groups was computed and taken to be the MCID. These results were confirmed by a survey distributed to members of AOSpine International that asked professionals to define the MCID of the mJOA. To determine an appropriate cut-off, the final mJOA at 1-year was compared between patients who achieved the MCID on the mJOA and those who did not.

Results

In the combined CSM-North America and International dataset, the average baseline mJOA of the total sample (n=757) was 12.62±2.81 and the mJOA at 1-year follow up (n=627) was 15.23±2.65. The half standard deviation of the baseline mJOA was 1.40. The difference in ∆mJOA between patients who achieved the MCID on other scales was 1.50 with respect to the NDI and 1.33 based off the SF-36 PCS. The survey of 416 spine professionals confirmed these estimates as the mean response was 1.65±0.66. From these three methods, we can approximate the MCID of the mJOA to be 1.5. In the group of patients who improved by 1.5 or more points on the mJOA, the final score at 1-year was 16.02±2.10. Therefore, patients who reach a score of 16 on the mJOA likely demonstrated clinically significant gains, deeming this an appropriate cut-off point between “optimal” and “suboptimal” surgical outcomes.

Conclusions

The MCID of the mJOA is 1.5. This knowledge will enable clinicians to identify meaningful functional improvements following surgical intervention in CSM patients.
34.3.1

Patient and Surgeon Radiation Exposure during Spinal Instrumentation using Intraoperative CT-Based Navigation

John Street, Daniel Mendelsohn, Jason Strelzow, Juliet Batke, Marcel Dvorak, Charles Fisher, Combined NeuroSurgical and Orthopedic Spine Program, Vancouver General Hospital Departments of Orthopedics and Neurosurgery, University of British Columbia, Vancouver, Canada

Objectives

Imaging modalities available to visualize spinal anatomy include plain x-rays, fluoroscopy and intraoperative CT scanning. All emit ionizing radiation exposing the surgical team and patient to radiation. The radiation emitted to the patient and the surgeon, when performing surgeries using intraoperative CT-based spine navigation were compared.

Method

An ambispective review of surgical cases using intraoperative CT navigation over one year was performed. The number of intraoperative x-rays, fluoro and CT dosages were recorded and standardized to effective doses. Fluoroscopy doses included scout images, guiding interbody devices and spine alignment verification. A literature review was performed to determine historical radiation exposure values for fluoroscopy-guided spine instrumentation.

Results

Seventy-three surgical cases involving an average of 5.44 levels of instrumentation were reviewed. Thoracic and lumbar spine instrumentations had the highest radiation emission from all modalities (CT, X-ray, fluoroscopy) compared to cervical cases (TL: 6.40 mSv vs. C: 2.33 mSv). Major deformity and degenerative cases involved more radiation exposure than trauma or oncology cases (6.68 mSv vs. 4.18 mSv). On average, the patient was exposed to 8.7 times more radiation compared to the surgical team. Total radiation exposure to the patient was 1.85 times the values reported in the literature for thoracolumbar fusions performed with fluoroscopy. In comparison, radiation exposure to the surgeon was reduced by 89% compared to conventional fluoroscopically facilitated open thoracolumbar fusions. The average total radiation exposure to the patient was 5.69 mSv, a value less than a single routine lumbar CT scan (7.5 mSv).

Conclusions

Intraoperative CT navigation increases the radiation exposure to the patient and reduces the radiation exposure to the surgeon. Intraoperative CT navigation improves the accuracy of spine instrumentation with acceptable patient radiation exposure, and reduced surgical team exposure. Surgeons should be aware of the radiation exposure implications to both the patient and the surgical team when using intraoperative CT navigation.
35.3.2

Are Post-operative Pelvic Parameters and Sagittal Balance Predictive of Further Lumbar Surgery in Patients with Spinal Stenosis?

Joel Phillips\textsuperscript{1,2}, Jennifer Urquhart\textsuperscript{1,2}, Corinne Tallon\textsuperscript{1,2}, Kevin Gurr\textsuperscript{1,2}, Fawaz Siddiqi\textsuperscript{1,2}, Stewart Bailey\textsuperscript{1,2}, Chris Bailey\textsuperscript{1,2}
\textsuperscript{1}London Health Sciences Centre, London, Ontario, Canada, \textsuperscript{2}Western University, London, Ontario, Canada

Objectives

Surgical treatment of spinal stenosis has been reported to have an early success rate of up to 85%. Despite this, recurrent surgical rates remain substantial in this population. Sagittal balance, pelvic incidence, pelvic tilt, sacral slope and lumbar lordosis (LL) are all measurements that could play a role in predicting success or failure of surgically treated lumbar spinal stenosis. This study examined whether postoperative pelvic parameters as well as sagittal balance were predictive of the need for further lumbar surgery in the spinal stenosis patient population.

Method

A retrospective review of 212 patients with surgically managed spinal stenosis at our institution between February 1 2006 and June 1 2010 was performed. Post-operative upright radiographs were examined and measurements of pelvic parameters, lumbar lordosis and sagittal alignment were made. Modes of failure included instability or recurrent neural element compression at the operative level, adjacent-level, or non-adjacent lumbar level. Secondary surgery for a wound infection was not included.

Results

199 patients were included with an average follow-up of 5.0±1.5 years. 14% of patients failed surgical treatment and required revision surgery. The majority of patient's index procedure was a decompression and fusion (83% vs. 17% decompression only). The second surgery rate was similar for those who underwent fusion versus decompression only (\(p=0.406\)). The most common reasons for further surgery were adjacent level instability (30%) and/or adjacent level compression (54%). Sagittal vertical axis did not differ between patients who required further surgery and those who did not (66.9±34.4° vs. 59.3±40.5°, \(p=0.547\)). However, LL differed significantly between the two groups (41.9±13.7° vs. 49.3±15.7°, \(p=0.022\), respectively).

Conclusions

The results show that only decreased LL was associated with a second surgery. Other measurements of sagittal alignment as well as pelvic parameters did not predict need for revision. Postoperative measurement of LL may provide the highest yield in predicting future surgery in spinal stenosis.
36.3.2

Post-Operative Ambulation in Patients Undergoing Total Hip Arthroplasty, Total Knee Arthroplasty and Elective Lumbar Spine Surgery to Treat Arthritic Pathologies

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¹Canada East Spine Centre, Horizon Health Network, Saint John, NB, Canada, ²Dalhousie University of Medicine, Saint John, NB, Canada

Objectives
Degenerative osteoarthritis of the knee, hip and spine are an increasing concern as our population ages. Total knee arthroplasty (TKA) is generally considered the “goal standard” benchmark for orthopaedic surgery recovery. The purpose of this study was to compare post-surgical walking performance and ambulatory capacity in patients undergoing lumbar fusion for lumbar spinal stenosis (LF) to those undergoing total hip arthroplasty (THA) and TKA.

Method
This is a single-center prospective observational cohort study on patients who underwent THA (n=32), TKA (n=33) or 1-2 level LF (n=29) from May 2013-August 2014.

An Orthocare Innovations StepWatch Activity Monitor was attached to each patient’s ankle after incision closure. This measured patient ambulation for the duration of their post-surgical hospitalization.

Pre-operative measures included age, sex, BMI, comorbidities, SF-36 PCS and MCS scores, and the Tampa Scale for Kinesiophobia.

Ambulation measures included steps for each day, total steps, average steps, max steps per day, intensity for each day, average intensity and max intensity. Intensity is a measure of the number of steps per minute during activity.

Results
Knee patients had significantly higher BMI than hip patients (p<.05), there was significantly lower mental health functioning in LF patients than hip patients (p<.01); and the LF group contained significantly more female patients than the THA and TKA groups (p<.05). There were no other significant differences in baseline variables.

The only significant group difference in activity was that knee patients (M=6.57) displayed significantly higher average intensity than lumbar patients (M=5.17, p<.05); hip patients were not significantly different from either (M=5.94). There were no other group differences in ambulation. However, both age (p<.05) and kinesiophobia were significantly correlated with post-operative activity (p<.05).

Conclusions
This study supports previous findings that post-operative recovery in spine patients is similar to that of hip and knee patients. It is interesting that a measure of kinesiophobia (fear of re-injury with movement/exercise) is the only significantly correlated variable other than age in this analysis. This may indicate the importance of educating patients about the importance and safety of post-operative ambulation during their recovery.
37.3.2

Pain on the Brain: Is the SF-36 Mental Component Summary enough?

Erin Bigney¹, Neil A. Manson¹,², Alana J. Green¹, Edward P. Abraham¹,²
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Objectives
Patient pain coping is gaining increasing attention in spine surgery research. However, most databases still do not include psychological measures beyond the SF-36 Mental Component Summary (MCS). This study aimed to correlate MCS scores with thoracolumbar spine surgery outcomes to determine the strength of this relationship. We believe this offers a preliminary indication as to whether the MCS is sufficient for measuring psychological factors that contribute to spine patient outcomes.

Method
Design: Ambispective cohort analysis of 462 consecutive patients from a prospective spine surgery outcomes database. Minimum follow up: 1-year. Exclusions: Previous spinal fusion, spine-related litigation or malignancy.

Primary Measures: Pre vs. post-operative change in SF-36 physical component summary (PCS), Oswestry Disability Index (ODI), Back and Leg pain Numerical Rating Scales (NRS-B;NRS-L), patient satisfaction.

Secondary Measures: Demographics (age, gender, BMI, primary diagnosis, primary symptom), length of hospital stay, adverse events (peri-operative, post-operative, post-discharge, re-operation).

Analysis: Pre-operative MCS values were linearly regressed against each continuous dependent variable. Categorical variables were analyzed using chi-square tests by dividing pre-operative MCS scores by quartiles.

Results
Average pre-operative MCS score: 43.48 (SD=11.91,range:11-70). MCS was a significant predictor of SF-36 PCS change (b=0.22,t(445)=4.82,p<0.001;R²=0.05,F(1,445)=23.21,p<0.001). And ODI change (b=0.15,t(460)=3.23,p=0.001;R²=0.22,F(1,460)=10.45,p=0.001).

MCS scores also predicted patient satisfaction (b=0.17,t(448)=3.62,p<0.001;R²=0.03, F(1,448)=13.11, p<0.001). However, pre-op MCS scores did not significantly predictor change in NRS-B or NRS-L, length of hospitalization or BMI. There were no differences in gender or adverse events by MCS quartiles. Interestingly, MCS scores did predict age at surgery (b=0.22,t(459)=4.83,p<0.001;R²=0.03,F(1,459)=23.36,p<0.001).

Conclusions
While MCS scores are correlated with many outcome measures, the correlations are not as strong as those yielded by other measures of pain coping and social support in the past. Regression slopes are weak and percent variance accounted for is negligible. Future research should compare the MCS to other common psychological measures. This may highlight the importance of integrating different psychological measures into large-scale spine surgery databases.
38.3.2
Accurate and Safe Cervical Osteotomy for Kyphotic Deformity in Ankylosing Spondylitis

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Objectives

The purpose of this paper is to describe a safer and more accurate technique for the surgical correction of cervicothoracic kyphotic deformity in association with ankylosing spondylitis.

Method

The traditional surgery for the correction of deformity in the cervical spine has been with the patient sitting and awake with local anaesthesia. The osteotomy is performed then the surgeon manually manipulates the head and neck into position before fixing the spine with a halo and internal fixation. The principle risks are over/under-correction and paralysis from spinal cord damage.

The modification in techniques discussed in this paper are the following: 1) awake intubation and general anaesthesia throughout the procedure 2) intraoperative spinal cord monitoring, 3) gradual multiplanar correction using distraction external fixator (Ilizarov distraction bars from circular fixators, Orthofix external fixator or special design turnbuckle fixator) attached to the halo. 4) internal fixation of the spine.

Results

27 patients have undergone gradual multiplanar correction. Follow up is 1 to 5 years. The chin brow angles have improved from 42.5 degrees pre-op (range 32-55) to 8.1 degrees post-op (range 0-20). 5 patients with coronal tilt the correction was from 17.4 degrees pre-op (range 7-35) to 4.4 degrees post-op (range 0-12). Four patients had complications, 2 of which were transient and minor. All patients were very satisfied with the procedure and the results.

Conclusions

The basic osteotomy technique remains unchanged but since the correction is assisted with the distraction devices more precise alignment of the spine can be obtained while maintaining its stability. At no time during the procedure is the head not stabilized by the halo. Use of the external devices permits a variation of distraction moment and direction. Having the procedure done under general anaesthesia has improved acceptance by the patients. Excellent multiplanar correction of cervical deformity in ankylosing spondylitis can be accomplished safely and accurately with the described technique. It is safe and well accepted by the patients.
39.3.3

Adjacent segment pathology in the lumbar spine: progressive disease or a consequence of iatrogenic fusion?

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Objectives

Clinical adjacent segment pathology (CASP) following surgery in the lumbar spine has a literature-reported range between 5.2 and 18.5%. However, it is unclear whether CASP occurs due to increased mechanical stress created by a fusion segment, or whether it represents a progression of lumbar degenerative change in patients predisposed to spondylosis. We aimed to address this question by comparing prevalence of CASP in traumatic and spondylotic patient cohorts.

Method

We performed a retrospective cohort study comparing the prevalence of adjacent segment surgery for CASP in patients who underwent lumbar spine fusion for trauma versus for degenerative disease in a single centre from 2002-2008. Outcome measures were the incidence of subsequent surgery for CASP and radiological evidence of CASP. Several clinical factors were also compared between groups.

Results

There were significant baseline differences in mean age (trauma, 38.6 years versus spondylotic, 49.7 years, p<0.01, t-test), gender (trauma, 78% males versus spondylotic, 50% males, p<0.01, Fisher’s test), median follow-up (trauma, 8 years versus spondylotic, 6 years, p<0.01, Wilcoxon test), and median number of levels fused (trauma, 3 versus spondylotic, 1, p<0.01, Wilcoxon test).

Univariate analysis revealed a significant difference in the proportion of patients developing CASP between groups (trauma, 0/40 versus spondylotic, 15/100, p<0.01, Fisher’s test). Stratified analysis controlling for gender and age still revealed a significant difference in CASP among groups (p<0.05, Fisher’s test). Logistic regression analysis could not be performed since there were no cases of CASP in the trauma cohort. Due to a longer follow-up in the trauma group (biasing towards CASP development), it was not adjusted for.

Conclusions

We found a higher rate of repeat surgery for CASP in patients with degenerative lumbar disease. This finding suggests that the cause of CASP is patient factors predisposing to progressive degenerative disease and not mechanical factors induced by surgical intervention.
The Association of Cervical Spine Alignment with Neurological Recovery in a Prospective Cohort of Surgical Myelopathy Patients: Analysis of a Series of 124 Cases

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Objectives

There is evidence that both cervical sagittal alignment and spinal cord MRI hyper-intensity correlate with disease severity in CSM patients. The impact of spinal alignment on neurological recovery in a surgical series of patients has not been thoroughly investigated. The goal of this study was to evaluate the impact of sagittal alignment and magnetic resonance imaging (MRI) abnormalities on neurological recovery in a prospective surgical series of myelopathy patients.

Method

An ambispective analysis of prospectively collected data was performed of surgical patients with CSM at a single tertiary-care neurosurgical centre. Demographic data and clinical pre-operative and post-operative measures of neurological disability (mJOA, Nurick, NDI scores) were collected and analyzed for dependency on cervical spine imaging parameters including alignment (kyphotic vs. lordotic) and spinal cord signal abnormality (quantitative hyper-intensity). Multiple logistic regression analysis was utilized at the 0.05 level of significance with correction for multiple comparisons.

Results

Among 124 CSM patients, kyphotic alignment was seen in 34% of patients. Surgical intervention was more frequently anterior or combined anterior/posterior among this group than those with preserved lordosis. The majority of patients exhibited postoperative neurological improvement for myelopathy severity, however the extent of this improvement was dichotomous based on pre-operative sagittal alignment. Improvement was noted to a greater extent among patients with pre-operative lordosis (DmJOA of 3.1) than among patients with pre-operative kyphosis (DmJOA of 1.4, p = 0.02). Surgical correction of spinal malalignment did not provide for heightened neurological recovery, although whether it protects against symptomatic adjacent segment disease is unclear.

Conclusions

The majority of CSM patients showed post-operative neurological improvement. Patients with pre-operative lordotic alignment exhibited greater improvement than those with pre-operative kyphotic alignment. Neither correction of the spinal alignment nor choice of surgical approach in this series specifically affected the extent of neurological recovery.
41.3.3

Use of Neuropathic Pain Questionnaires in Predicting the Development of Failed Back Surgery Syndrome following Lumbar Discectomy for Radiculopathy

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Objectives

Failed back surgery syndrome (FBSS) describes neuropathic pain that occurs when extremity symptoms in lumbar disease persist despite structurally corrective spinal surgery. It is unclear whether specific pre-operative pain characteristics predict which patients are prone to this post-operative persistence of their disabling symptoms.

Method

This prospective study analyzed surgical patients with painful radiculopathy secondary to lumbar degenerative disease. Clinical parameters included general demographic information, pre-operative and post-operative clinical examination, self-reported pain and disability scores, and neuropathic pain scoring. The neuropathic pain screening tests used in this study were the Douleur Neuropathique 4 (DN4) and Leeds Assessment of Neuropathic Symptoms and Signs (LANSS), with correlation tested for ordinal score and screen positivity. Multiple logistic regression analysis was used to define predictors of post-operative symptomatology.

Results

Among 250 surgical radiculopathy patients, 12% were classified with FBSS with only modest relief of leg pain. The condition was highly associated with abnormal pre-operative screens for neuropathic pain, but not gender, smoking status, or pre-operative pain severity (multiple logistic regression, a=0.05). Good correlation was seen between the two screening tests used in this study for both absolute ordinal score (Spearman's r=0.84, p<0.001) and thresholding for determining the patient as having neuropathic pain features (Spearman’s r=0.48, p<0.001).

Conclusions

While FBSS was more common among younger and female patients, it occurred with low overall frequency in this population. Higher neuropathic pain screening scores correlated strongly with likelihood of significant post-operative leg pain. Further work is required to develop more accurate prognostication tools for radiculopathy patients undergoing structural spinal surgery.
42.3.3

Quality of Life and Neurological Outcomes after Surgical Decompression in Patients with Cervical Ossification of the Posterior Longitudinal Ligament: Prospective, Multicenter AOSpine International Study on 479 Patients

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Objectives

Degenerative cervical myelopathy (DCM) is an all-encompassing umbrella term that includes cervical spondylotic myelopathy (CSM), ossification of the posterior longitudinal ligament (OPLL) and other degenerative changes to the cervical spine. It is unclear whether surgery is equally effective and safe in patients with OPLL as it is in other forms of DCM. If outcomes are comparable between disease causations, there will be further justification to unify the terminology in this field and adopt the term “DCM”. It is therefore the aim of this study to compare the impact of surgical decompression on functional status and quality of life outcomes between patients with OPLL and those with other forms of DCM.

Method

A total of 479 patients with symptomatic DCM undergoing surgery were prospectively enrolled in the CSM-International study at 16 global sites (6 in Asia Pacific, 5 in Europe, 3 in South America and 2 in North America). Patients’ functional and neurological statuses were quantified using the modified Japanese Orthopaedic Assessment scale (mJOA) and the Nurick score and patients’ Quality of Life (QOL) was assessed using self-reported outcome measures such as the Neck Disability Index (NDI), and the Short-Form 36 (SF-36) Health Survey. Functional status and QOL were compared between baseline and 1-year post-operative in patients with OPLL and those with other forms of DCM.

Results

Of 479 patients, 135 (28.2%) exhibited imaging evidence of OPLL while 344 (71.8%) displayed other forms of degenerative changes. There were no significant differences in demographics, surgical approach, or most baseline severity scores between patients with OPLL and those with other forms of DCM. Patients with OPLL achieved similar functional outcomes at 1-year following surgery when compared to patients with other forms of DCM. With respect to QOL scores, the NDI and most of the subscales of the SF-36 were not different between the two groups. However, the SF-36 Role Limitation Physical subscale (p=0.009) and the SF-36 Social Functioning subscale (p=0.01) were significantly lower in OPLL patients. Finally, there were more peri-operative complications in the OPLL group, but more than half of these were superficial infections.

Conclusions

Surgical decompression for the treatment of cervical OPLL results in significant improvements in QOL and neurological status comparable to gains seen in other forms of DCM. The majority of perioperative complications in OPLL were transient and without long-term functional consequences. These results provide another basis for unifying nomenclature and using the standard term “DCM.”
Minimally invasive decompression in focal lumbar spinal stenosis with or without stable spondylolisthesis - Comparative outcomes and re-operation rates at a minimum of 2 years.

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Objectives

The objective of the study was to assess surgical & patient reported outcomes following decompression alone in selected patients with degenerative lumbar spondylolisthesis (DLS) compared to those with no DLS.

Method

A single surgeon consecutive series of patients undergoing surgery for lumbar spinal stenosis with a minimum of 2 year follow up were assessed as part of an ongoing prospective observational study. Primary outcome measures were Oswestry Disability Index (ODI) scores & re-operation rates. Decompression alone was chosen for patients with neurogenic claudication/radiculopathy no or tolerable mechanical back pain and no dynamic instability (<5mm of motion). All patients underwent bilateral decompression via a unilateral minimally invasive approach.

Results

157 LSS patients had surgery from Jan.2007 to Jun.2011, 62 with DLS & 95 without DLS. The cohorts were comparable for age (p=0.51) & pre-operative ODI (p=0.74). The DLS cohort had greater proportion of women (p=0.02).

There was significant ODI improvement in both cohorts (DLS mean baseline ODI improved from 40 to 23 at 2 years [p < 0.01] & in noDLS from 39 to 26 [p < 0.01]). The change in ODI was comparable in the two cohorts (p=0.18). VAS leg & back scores similarly improved between cohorts (p=0.50 & 0.22, respectively). Satisfaction was also similar in the 2 groups (88% of DLS patients rated their post-surgical satisfaction scores as favourable whilst for noDLS patients this was 82% [p=0.56].

In the DLS cohort, the reoperation rate was 11.3% at a mean follow-up of 3.06 years (2-4 years). For those without DLS the reoperation rate was 11.6% at a mean follow-up of 4.49 years (2-6 years).

Conclusions

Using the aforementioned selection criteria DLS patients undergoing decompression alone have excellent intermediate term results comparable to LSS patients without DLS. For highly selected DLS patients, successful outcomes without a fusion are achievable.
44.3.4

Impact of Non-operative care utilization on post thoracolumbar spine surgery outcomes: a national perspective using the CSORN registry

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Objectives

A standard justification for scheduling elective spine surgery for degenerative pathology is that non-operative care options have been exhausted. There are no standardized definitions of either non-operative or exhausted. Our objective was to assess the impact of non-operative care in the 6 months preceding spine surgery on post-surgical outcomes, across Canada.

Method

Participants (n=456) had degenerative spinal pathology or deformity of the thoracolumbar region, with no evidence of trauma, infection, or neoplasm. They consented to the Canadian Spine Outcomes and Research Network (CSORN), then proceeded to spine surgery between January 2012 and August 2014. Outcomes assessed were change in pain, disability and VAS-EuroQuol for health-related quality of life.

Results

Prior to surgery, non-operative treatment was not routinely provided; 51% (n=233) attended no therapy, 34% (n=156) attended some, while only 15% (n=67) had >30 visits within 6 months.

Those attending non-operative therapy 1-30 times within six months pre-surgery had a statistically significant improvement in health-related quality of life score from baseline (M=52.3, SD=22.5) to follow up (M=70.5, SD=17.5) compared to those who did not attend any pre-surgical care (baseline: M=51.7, SD=20.4; follow up M=64.9, SD=20.7, F(2,372)=3.44, p=0.033).

For Oswestry score, there was a trend approaching statistical significance toward improvement for those attending non-operative therapy >30 times (baseline: M=52.9, SD=16.4; follow-up: M=33.5, SD=20.2) compared to those who did not attend any pre-surgical care (baseline: M=51.1, SD=16.0; follow up M=38.5, SD=19.0, F(2,317)=2.855, p=0.059). No other significant differences were found.

Conclusions

Failure of non-operative care does not appear be a common prerequisite for elective thoracolumbar surgery. Pre-surgical non-operative care was underutilized; approximately half the patients did not attend any therapy at all. Pre-surgical non-operative intervention improved postsurgical health-related quality of life, with an additional trend toward decreasing disability.

Only after consistent referral to structured and exhaustive non-operative therapy can the role of non-operative treatment in complimenting surgical outcomes be validly determined.
Pre-Surgical Imaging, Testing and Injection Utilization in Elective Thoracolumbar Spine Surgery Candidates: A Nationwide Analysis from the CSORN Database

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Objectives

The objective was to assess the utilization of imaging, tests and injections in spine surgery candidates in the six months prior to surgical booking.

Method

We conducted a retrospective analysis of prospectively collected data from the Canadian Spine Outcomes and Research Network (CSORN). Twelve spine surgery sites across Canada contributed patient data for possible spine surgery cases between October 2008 and September 2014. Patients (n=527) had degenerative spinal pathology or deformity of the thoracolumbar region.

Frequencies were tabulated to estimate some of the imaging, testing and spinal injection utilization by spine surgery candidates prior to surgeon consultation.

Results

Patients reported 836 counts of one use, 274 counts of 2 uses, 126 of 3 and 236 counts of >3 uses. This equals a conservative estimate (if >3=4) of 1471 imaging, tests and/or injections.

EMG/nerve conduction tests and bone scans were utilized the least. MRI had the highest prevalence of use, followed by x-rays.

There was no statistically significant difference in the frequency of x-ray utilization in those with deformity, fracture or spondylolisthesis compared to those with infection, tumour, disc herniation, degenerative disc disease or stenosis.

There was a significant difference in pain ratings by imaging frequency. Those with no x-ray had significantly higher leg pain ratings than those with >3 x-rays (p<0.05). Patients with no CT imaging had the highest leg pain ratings; patients with >3 CT scans had the lowest leg pain ratings (p<0.05). Those with one MRI had significantly higher leg pain ratings than those with >3 x-rays (p<0.05).

Conclusions

There is an inverse relationship between the amount of pain and the frequency of the imaging test. Despite numerous guidelines and published reports that suggest the limited value of x-raying patients with uncomplicated back pain, this imaging technique remains a popular choice. Patients requiring spine surgery demonstrate a high utilization of health care resources, including diagnostic imaging, on their pathway to the surgeon. Defining a Canadian strategy to manage and optimize the care and resource utilization for these patients is required.
46.3.5

A Clinical Prediction Rule for Clinical Outcomes in Patients Undergoing Surgery for Degenerative Cervical Myelopathy: Analysis of an International AOSpine Prospective Multicentre Dataset of 743 Subjects

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Objectives

Cervical spondylotic myelopathy (CSM) is a degenerative spine disease that is often treated surgically. International differences in patient demographics and disease presentation, along with biases in surgical practice, may contribute to regional differences in patient prognosis. This study aims to determine the most important global clinical predictors of surgical outcome in patients undergoing surgery for CSM, based on data from two multi-centre prospective studies.

Method

Seven-hundred and forty-three surgical CSM patients participated in either the CSM-North America or CSM-International study. The model was developed to distinguish between patients with mild myelopathy at 1-year postoperatively (mJOA≥16) and those with substantial residual neurological impairment (mJOA<16). Univariate analyses were performed to evaluate the relationship between outcome and various clinical predictors. Multivariate logistic regression was used to formulate the final prediction model.

Results

Univariate analyses demonstrated that the odds of achieving a score ≥16 decreased with the presence of certain symptoms, including impaired gait; the presence of certain signs such as lower limb spasticity; positive smoking status; a higher co-morbidity score; more severe preoperative myelopathy; and older age. The final prediction model included age (OR=0.97,p=0.0017), duration of symptoms (OR=0.88,p=0.049), smoking status (OR=0.51,p=0.0018), impairment of gait (OR=1.94,p=0.0168), broad-based unstable gait (OR=1.75,p=0.0133), baseline severity (OR=1.23,p<0.0001) and co-morbidity score (OR=0.84,p=0.0030).

Conclusions

Patients are more likely to achieve a score ≥16 if they are younger; have a shorter duration of symptoms; are less severe preoperatively; do not smoke; and do not have comorbidities or evidence of gait dysfunction.
A Comparison of Health Related Quality of Life Outcomes in Spinal Cord Injury Patients Residing in Rural and Urban Areas

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Objectives

1. Describe the differences in HRQOL outcomes in those patients residing in rural versus urban areas after spinal cord injury at 1 and 5 years.
2. Determine whether patients originally residing in a rural area able to maintain their place of residence after SCI.
3. Describe some potential interventions early in acute hospital and rehabilitation phases of stay that may help patients maintain their place of residence.

Method

Patients admitted to Vancouver General Hospital or GF Strong Rehabilitation Centre with a traumatic SCI from 2004-2012 were identified using the Vancouver Rick Hansen SCI registry (RHSCIR). Health Related Quality of Life (HRQOL) was determined with SF-36 physical and mental scores. Functional and health outcomes were determined using the Functional Independence Measures (FIM), Craig Hospital Inventory of Environmental Factors short form (CHIEF-SF) and the Spinal cord injury health questionnaire (SCI-HQ).

Results

867 RHSCIR participants were identified. Prior to injury, 41.7% of participants lived in a rural setting. Of the rural participants with 5 year follow-up data, only 44.8% were able to maintain their rural place of residence. Admission demographic data comparing the urban and rural groups was similar except for age at injury which was greater for urban participants (p<0.001). Urban patients had a significantly higher incidence of depression at 1 year on SCI-HQ (p=0.01). There was no significant difference in SF-36, FIM, CHIEF-SF and SCI-HQ scores for each group at 1 and 5 years.

Conclusions

A significant proportion of rural patients move to larger urban centres after SCI at 1 year. HRQOL outcomes were similar between urban and rural patients at 1 and 5 years.
48.3.5

Minimally invasive versus open discectomy: A systematic review and meta-analysis

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Objectives

Minimally invasive (MIS) surgical techniques may accelerate recovery and reduce pain, but they also require technical expertise and involve increased risks. This meta-analysis was performed to determine the effects of MIS techniques on function, pain, complications, and reoperations for cervical and lumbar discectomies.

Method

MEDLINE, EMBASE, and The Cochrane Library were systematically searched up to January 12, 2014. Two reviewers assessed eligibility and risk of bias. Functional outcomes were pooled using Standardized Mean Differences (SMDs) and complications were pooled dichotomously. Minimal Important Differences were incorporated to aid interpretation. Quality of evidence was summarized using the Grading of Recommendations Assessment, Development, and Evaluation approach.

Results

Ten trials reported on lumbar discectomies (n=1159) and four reported on cervical discectomies (n=431). MIS techniques did not improve function (cervical SMD 0.11, 95% CI -0.09 to 0.31; lumbar SMD 0.04, 95% CI -0.11 to 0.20), or reduce pain (cervical SMD -0.21, 95% CI -0.52 to 0.10; lumbar SMD 0.08, 95% CI -0.16 to 0.32). Evidence suggested overall higher rates of nerve root injuries (Relative Risk [RR] 1.62, 95% CI 0.45 to 5.84), incidental durotomies (RR 1.56, 95% CI 0.80 to 3.05), and reoperations (RR 1.48, 95% CI 0.97 to 2.26) with MIS techniques. Infections trended towards being more common with open procedures (RR 0.24, 95% CI 0.04 to 1.38). Evidence overall was low to moderate quality

Conclusions

Current evidence does not support the routine use of MIS cervical and lumbar discectomies. Further high quality trials are warranted given the lack of high quality evidence.
### POSTERS FOR PRESENTATION

<table>
<thead>
<tr>
<th>ABSTRACT #</th>
<th>PROGRAM CODE</th>
<th>POSTER #</th>
<th>PRESENTER LAST NAME</th>
<th>PRESENTER FIRST NAME</th>
<th>PRESENTATION DAYS</th>
<th>Part I ABSTRACTS PAGE</th>
<th>Part II CONFLICT OF INTEREST DISCLOSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>49.1.1</td>
<td>1</td>
<td>Morris</td>
<td>Susan</td>
<td>THURSDAY &amp; SATURDAY</td>
<td>Page 57</td>
<td>Page 123</td>
</tr>
<tr>
<td>2</td>
<td>50.1.2</td>
<td>2</td>
<td>Spurway</td>
<td>Alan</td>
<td>THURSDAY &amp; SATURDAY</td>
<td>Page 58</td>
<td>Page 124</td>
</tr>
<tr>
<td>72</td>
<td>51.1.3</td>
<td>3</td>
<td>Bateman</td>
<td>Anthony</td>
<td>THURSDAY &amp; SATURDAY</td>
<td>Page 59</td>
<td>Page 125</td>
</tr>
<tr>
<td>88</td>
<td>52.1.4</td>
<td>4</td>
<td>Abduljabbar</td>
<td>Fahad</td>
<td>THURSDAY &amp; SATURDAY</td>
<td>Page 60</td>
<td>Page 126</td>
</tr>
<tr>
<td>30</td>
<td>53.1.5</td>
<td>5</td>
<td>Shamji</td>
<td>Mohammed</td>
<td>THURSDAY &amp; SATURDAY</td>
<td>Page 61</td>
<td>Page 116</td>
</tr>
<tr>
<td>77</td>
<td>54.1.6</td>
<td>6</td>
<td>McLachlin</td>
<td>Stewart</td>
<td>THURSDAY &amp; SATURDAY</td>
<td>Page 62</td>
<td>Page 127</td>
</tr>
<tr>
<td>48</td>
<td>55.2.7</td>
<td>7</td>
<td>Manson</td>
<td>Neil</td>
<td>FRIDAY &amp; SATURDAY</td>
<td>Page 63</td>
<td>Page 85</td>
</tr>
<tr>
<td>84</td>
<td>56.2.8</td>
<td>8</td>
<td>Palkovsky</td>
<td>Rachelle</td>
<td>FRIDAY &amp; SATURDAY</td>
<td>Page 64</td>
<td>Page 128</td>
</tr>
<tr>
<td>92</td>
<td>57.2.9</td>
<td>9</td>
<td>Ailon</td>
<td>Tamir</td>
<td>FRIDAY &amp; SATURDAY</td>
<td>Page 65</td>
<td>Page 129</td>
</tr>
<tr>
<td>61</td>
<td>58.2.10</td>
<td>10</td>
<td>Tetreault</td>
<td>Lindsay</td>
<td>FRIDAY &amp; SATURDAY</td>
<td>Page 66</td>
<td>Page 130</td>
</tr>
<tr>
<td>70</td>
<td>59.2.11</td>
<td>11</td>
<td>Johnson</td>
<td>Michael</td>
<td>FRIDAY &amp; SATURDAY</td>
<td>Page 67</td>
<td>Page 131</td>
</tr>
<tr>
<td>40</td>
<td>60.2.12</td>
<td>12</td>
<td>Street</td>
<td>John</td>
<td>FRIDAY &amp; SATURDAY</td>
<td>Page 68</td>
<td>Page 111</td>
</tr>
<tr>
<td>89</td>
<td>61.1.13</td>
<td>13</td>
<td>Street</td>
<td>John</td>
<td>THURSDAY &amp; SATURDAY</td>
<td>Page 69</td>
<td>Page 111</td>
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<tr>
<td>66</td>
<td>63.1.15</td>
<td>15</td>
<td>Nouri</td>
<td>Aria</td>
<td>THURSDAY &amp; SATURDAY</td>
<td>Page 71</td>
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<td>Page 74</td>
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**SPECIAL POSTERS**

**REGULAR POSTERS**
49.1.1

Validity of Transcranial Motor Evoked Potentials as Early Indicators of Neural Compromise in Rat Model of Spinal Cord Compression

Susan Morris\textsuperscript{1,2}, Jason Howard\textsuperscript{3}, Douglas Rasmusson\textsuperscript{2}, Ron El-Hawary\textsuperscript{1,2}
\textsuperscript{1}IWK Health Centre, Halifax, Nova Scotia, Canada, \textsuperscript{2}Dalhousie University, Halifax, Nova Scotia, Canada, \textsuperscript{3}Sidra Medical and Research Center, Doha, Qatar

Objectives

To determine the temporal threshold at which complete (100\%) loss of intraoperative transcranial motor evoked potentials (TcMEPs) will result in significant post-operative functional deficits.

Method

24 adult male Wistar rats were divided into three experimental groups according to the length of time that 100\% TcMEP signal loss was maintained; all animals had pre-operative functional testing. Following surgical placement of a balloon catheter in the thoracic sub-laminar space, TcMEPs were recorded while the spinal cord was compressed by balloon inflation. The recordings were terminated after maintaining a 100\% TcMEP loss for different time periods (0, 5 or 15 minutes). Functional behavioural testing was repeated after 24 hours.

Results

Only the group wherein the catheter was left inflated for 5 or 15 minutes after a complete (100\%) loss of TcMEP amplitude showed a significant deterioration in functional testing as compared to pre-operative baseline values. Functional testing remained normal for the control group and for the group in which termination of spinal cord compression occurred immediately after a decrease of TcMEP amplitude to 100\%. There was a strong correlation between TcMEP amplitude recovery post intervention and functional ability at 24 hours post-surgery.

Conclusions

If 100\% loss of TcMEP signals is immediately recognized and reversed by rapid removal of the compressive force on the spinal cord, normal post-operative function was observed in this rat model. However, delaying intervention for even 5 minutes can result in significant post-operative functional deficits.
50.1.2

Validation of True Spine Length Radiographic Measurements

Alan Spurway\textsuperscript{1,2}, Waleed Kishta\textsuperscript{1}, Chukwudi Chukwunyerenwa\textsuperscript{1}, Ron El-Hawary\textsuperscript{1,2}
\textsuperscript{1}IWK Health Centre, Halifax, Nova Scotia, Canada, \textsuperscript{2}Dalhousie University, Halifax, Nova Scotia, Canada

Objectives

A diminishing returns effect for vertical growth of coronal T1-S1 height has been suggested during treatment for Early Onset Scoliosis (EOS). It has been theorized that the increased length from treatment surgeries translates into increased thoracic kyphosis. Out of the plane growth is not captured with the standard coronal height measurement. A new technique utilizing custom software has been produced to measure the sagittal plane True Spine Length (TSL).

Method

Accuracy and Inter-Rater Reliability (IRR) in super-optimal conditions was tested using phantom models. Six kyphotic curve configurations were created. The T1-T12 TSL and geometric chord distances were measured physically and electronically. Four reviewers used the software to measure the TSL, height and chord lengths of the thoracic sections on 23 consecutive pre-operative EOS patient PA and lateral radiographs. The reviewers then measured the PA height, sagittal height and chord, Cobb and kyphosis angles of the same patients using commercial software. To assess intra-rater reliability, measures were repeated two weeks or more after initial collection.

Results

The IRR for the phantom models was excellent with an average Inter Class Coefficient (ICC) of 0.999 (0.994 to 1.000) and an average absolute error of 0.27mm (0.00 to 0.55). Clinical testing showed excellent IRR for the PA view with an average ICC of 0.980 (0.959 to 0.991). The IRR for sagittal views had an average of 0.818 (0.604 to 0.923). Errors between reviewers ranged from an average 9.44mm PA to 19.33mm sagittal.

Conclusions

TSLs are accurate and consistent measurements during super-optimal and optimal conditions. The crowded thoracic anatomy on lateral images causes measurement IRR decreases in both the custom and commercial software. Higher quality lateral images will increase usability and accuracy of the software. Sagittal TSL and chord lengths are reliable measures that can add information to the assessment of growth during EOS treatment.
51.1.3

Closure of the intervertebral disc annulus fibrosis using a novel suture application device – in vivo porcine and ex-vivo biomechanical evaluation

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¹University of Toronto, Toronto, Ontario, Canada, ²Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada, ³University of Waterloo, Waterloo, Ontario, Canada, ⁴Anchor Orthopedics XT Inc, Mississauga, Ontario, Canada

Objectives

Defects in the annulus fibrosis (AF) remain a challenge in the surgical treatment of lumbar disc herniations with persistent defects allowing potential re-herniation of nucleus pulposus (NP) tissue. We performed an in vivo feasibility study of a minimally invasive kerrison-shaped suture device designed to achieve closure of AF defects in the intervertebral disc. A cervical porcine model was chosen to simulate human lumbar discs.

Method

Three pigs (53-57 kg) were anaesthetised and underwent a ventral surgical approach to the cervical spine (C2/3 – C5/6). The AF of two discs was incised with a scalpel in a vertical fashion and a simulated partial NP discectomy performed. The resultant defect was closed at one randomly selected level using the AnchorKnot™ device to apply a 2-0 non-absorbable UHMWPE suture with a Dines knot and 4 half hitches. This was the optimal configuration based on preliminary ex vivo biomechanical tests. The pigs were then observed for four weeks before euthanasia. The excised cervical spine underwent 7T MRI followed by histological H&E evaluation.

Results

A Dines knot with four half hitches resulted in no knot slippage after motion segments were subjected to 4000 cycles of flexion and extension with 1500N of axial load.

Clinically, the neurological examination in treated pigs was normal following surgery. Histological and MRI assessment confirmed sustained defect closure at four weeks. There was no significant reaction to the suture material and no nucleus pulposus extrusion at any of the sutured levels.

Conclusions

Our in vivo porcine study demonstrates that it is technically feasible to perform a suture repair of an AF defect using this novel device with sustained defect closure through four weeks. This technique may reduce the incidence of early disc re-herniation following discectomy through closure of the AF defect, although further study is required to assess this potential application.

52.1.4
Vertebroplasty Versus Kyphoplasty in Osteoporotic Vertebral Compression Fracture Model; What is Safer?

Fahad Abduljabbar1,2, Abdulaziz Al-Jurayyan1, Saad Alqahtani1, Zeeshan Sardar1, Rajeet Singh Saluja1, Jean Ouellet1, Michael Weber1, Thomas Steffen1, Lorne Beckman1, Peter Jarzem1
1McGill University Health Centre, Montreal/Qc, Canada, 2King Abdulaziz University, Jeddah, Saudi Arabia

Objectives

Kyphoplasty and Vertebroplasty are widely used techniques to alleviate pain in fractures secondary to osteoporosis. However, cement leakage towards vital structures like the spinal cord can be a major source of morbidity and even mortality. We define safe cement injection as the volume of cement injected into a vertebra before cement leakage occurs. Our objective is to compare the amount of cement that can be safely injected into an osteoporotic vertebra with simulated compression fracture using either vertebroplasty or balloon kyphoplasty techniques.

Method

Forty artificial vertebral analogues made of polyurethane with osteoporotic cancellous matrix representing the L3 vertebrae were used for this study that were divided into 4 groups of 10 vertebrae each. The 4 groups tested were: Low viscosity cement injected using vertebroplasty, High viscosity cement injected using vertebroplasty, Low viscosity cement injected using balloon kyphoplasty, and High viscosity cement injected using balloon kyphoplasty. The procedures were carried out under fluoroscopic guidance. Injection was stopped when the cement started protruding from the created vascular channel in the osteoporotic vertebral fracture model. The main outcome measured was the volume of cement injected safely into a vertebra before leakage through the posterior vascular channel.

Results

The highest volume of cement injected was in the vertebroplasty group using high viscosity cement, which was almost twice the injected volume in the other 3 groups. One-way ANOVA comparing the 4 groups showed a statistically significant difference (P < 0.005).

Conclusions

High viscosity cement injected using vertebroplasty delivers more cement volume before cement leakage and fills the vertebral body more uniformly when compared to balloon kyphoplasty in osteoporotic vertebrae with compression fractures.
Brain Derived Neurotrophic Factor Promotes Intraneural Macrophage Migration and Allodynia in Experimental Disc-Herniation Neuropathy

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¹Toronto Western Hospital, Toronto, Canada, ²University of Toronto, Toronto, Canada, ³SickKids Research Institute, Toronto, Canada

Objectives

Disc-herniation induced radiculopathy arises from both mechanical compression and biochemical inflammation of apposed neural elements. This study demonstrated the need for intraneural macrophage migration after placement heterotopic disc tissue to generate the painful neuropathy phenotype.

Method

C57BL/6 mice underwent a surgical procedure with mid-thigh exposure of the sciatic nerve. Control animals underwent exposure only, whereas experimental animals underwent placement of littermate tail nucleus pulposus. Animals were evaluated throughout one week for mechanical allodynia by Von Frey testing, thermal hyperalgesia by heat withdrawal latency, cold allodynia by acetone testing, and gait stability by RotaRod testing. At sacrifice, immunohistochemistry was performed to identify perineural and intraneural macrophage and lymphocyte presence. Necessity of an inflammatory response in developing the positive findings was tested by inducing macrophage apoptosis using bisphosphonate liposomes and by limiting macrophage migration using a tamoxifen-induced CreER BDNF knockout system as well as local anti-BDNF therapy.

Results

Mice exposed to heterotopic NP stimulation demonstrated substantial mechanical allodynia, thermal hyperalgesia, and cold allodynia compared to controls. Intraneural macrophage infiltration was observed in this group, alongside associated auto-reactive lymphocytes at the disc-nerve interface. Elimination of macrophages blocked both macrophage infiltration and the painful phenotype. Selective deletion of macrophage BDNF activity or perineural delivery of BDNF antagonists blocked both macrophage infiltration and the painful phenotype. Taken together, these suggest an important role for BDNF-mediated macrophage migration in the development of experimental radiculopathy, beyond simply macrophage-mediated inflammation.

Conclusions

Non-compressive disc herniation leads to altered behaviour in this animal disease model, with demonstrated need for intraneural macrophage migration. Strategies to decrease perineural inflammation or maintain integrity of the blood nerve barrier may be effective in treating painful disc-herniation radiculopathy.
54.1.6

Development and Evaluation of an Open-Source 3D Virtual Simulator with Integrated Motion-Tracking as a Teaching Tool for Pedicle Screw Insertion

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Sunnybrook Research Institute, Toronto, Ontario, Canada

Objectives

Simulation is an effective adjunct to the traditional surgical curriculum, though access to these technologies is often limited and costly. The objectives of this work were to develop a freely accessible virtual pedicle screw simulator and to improve the clinical authenticity of the simulator through integration of low-cost motion tracking.

Method

The open-source medical imaging and visualization software, 3D Slicer, was used as the development platform for the virtual simulation. 3D Slicer contains many features for quickly rendering and transforming 3D models of the bony spine anatomy from patient-specific CT scans. A step-wise pedicle screw insertion workflow module was developed which emulated typical pre-operative planning steps. This included taking anatomic measurements, identifying insertion landmarks, and choosing appropriate screw sizes. Virtual monitoring of the surgeon's simulated tool was assessed with a low-cost motion tracking sensor in real-time (~$80, LeapMotion, San Francisco). This allowed a screw surrogate (i.e. pencil) to be tracked as the surgeon defined the virtual screw's insertion point and trajectory on a 3D spine model. The final step graded screw insertion based on bone density contact and cortical breaches.

Results

Using a combination of existing and custom-written 3D Slicer modules, a robust and accessible virtual simulator was created. Initial surgeon feedback of the virtual simulator with integrated motion tracking was positive, with no noticeable lag and high accuracy between the real-world and virtual environments. The software yields high fidelity 3D visualization of the complex geometry and the tracking enabled coordination of motion to small changes in both translational and angular positioning.

Conclusions

Free software and low cost tracking can facilitate widespread adoption of simulation technology for pedicle screw insertion (and other implants). Future work will evaluate the benefit of this simulation platform with use over the course of resident spine rotations to improve planning and surgical competency and in quantitatively evaluating performance.
Pre-Operative “Amber Flag” Psychological Measure Scores and Patient Expectations: A Nation-Wide Analysis from the CSORN Database

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1Canada East Spine Centre, Horizon Health Network, Saint John, NB, Canada, 2Dalhousie University of Medicine, Saint John, NB, Canada, 3Canadian Spine Outcomes and Research Network, Canada, Canada

Objectives

Previous research has revealed a disconnect between patient and surgeon expectations for post-operative outcomes. There is a consensus among most Canadian spine surgeons that the primary objective of elective thoracolumbar surgery is to correct radicular symptoms – a reduction in back pain is desired but supplementary. Nonetheless, many patients still perceive back pain to be the primary indication for surgery. Patient expectations have been shown to have a strong impact on recovery. The purpose of this study was to determine whether there is a correlation between “amber flag” scores on pre-operative psychological measures and patient expectations.

Method

This was a retrospective analysis of prospectively collected Canadian Spine Outcomes and Research Network (CSORN) data (n=568). Twelve spine surgery sites across Canada contributed data for possible spine surgery cases between October 2008 and September 2014.

Two patient types were investigated: those without amber flags (MCS12 >42 and PHQ9 <15 and EQ5D-AD=none or moderate, n=424) and those with amber flags (MCS12=42+ or PHQ9=15+ or EQ5D-AD=extreme, n=144).

Prior to surgery, patients are asked to choose the single most important change that they expect to occur as a result of their operation; there are seven choices.

Results

A Spearman’s Rho analysis showed a weak correlation between patient expectations and psychological amber flags. Those without amber flags listed a reduction in leg pain as their number one reason significantly most often (37.3%) and those with amber flags listed a reduction in back pain significantly most often (41.7%) (rs[568] = .13, p < .013); however, the effect size was very small. Pain was significantly more important than function to both groups (p<0.05).

Conclusions

Surgeons should be especially careful to address patient expectations with patients who demonstrate psychiatric symptoms on pre-operative questionnaires. Further investigations are needed to assess patient expectations and amber flags vs. post-operative outcomes. Databases should also consider employing more sensitive pain perception scales pre-operatively. These might be more sensitive in identifying patients at risk of poor surgical outcomes due to misaligned expectations.
Assessment of Frailty in Elderly Spinal Surgery Patients

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¹University of California San Francisco, San Francisco, CA, USA, ²University of Calgary, Calgary, Alberta, Canada

Objectives

The primary objective of this initial study was to determine the incidence of frail elderly patients referred to a sub-specialty clinic electing surgical treatment of spinal disorders. The secondary objective was to determine the utility of the Frailty Index for predicting surgical outcomes in the elderly patient with spinal pathology.

Method

For this prospective cohort study, 65 presenting patients aged 65 years or older, who were scheduled to undergo elective spine surgery, were consented and enrolled.

The methods used for this study were consistent with those already established for determining frailty in elderly patients. Patients were required to complete the Godin-Shephard Leisure-Time Physical Activity Questionnaire, ambulate along a 15 foot walking course while wearing a dual access accelerometer, and have grip strength measured using a dynamometer. Exhaustion and unintentional weight loss (>10lbs) were self-reported. The final score (0 to 5) was calculated according to patients’ respective sex and BMI using the validated Frailty Index scoring system. Post-operative follow up for enrolled patients was conducted through the collection of the EQ5D, SF36, and Visual Analog Scale validated outcome questionnaires during post-operative follow up examinations.

Results

Of the 64 patients enrolled, 4 (12.5%) qualified as Frail, 27 (42.29%) qualified as Pre-Frail and 33 (51.56%) were Non-Frail. Sub-group analysis revealed 13.11% of patients reported unintentional weight loss, 49.18% reported routine exhaustion and 37.70% reported diminished activity levels. Walking speed in the bottom 20th percentile was observed in 9.84% of the patients. Dynamometer data demonstrated 45.31% of all patients scored in the bottom 20th percentile for grip strength.

Conclusions

Assessment of the Frailty Index in a clinical setting proved simple and undisruptive. The patient sample of this study suggests that a significant proportion of presenting elderly spinal surgical patients qualify as Frail, and an even larger proportion present as Pre-Frail, indicating the need for pre-surgical evaluation of this patient group. Classifying patients as Non-Frail, Pre-Frail or Frail may prove to be of significant value in the evaluation of elderly spinal surgical candidates and for prognostication of surgical outcomes.
57.2.9

Predicting Adverse Events and Their Impact on Hospital Length of Stay in a Prospective Spine AdVerse Events Severity (SAVES) Database

Tamir Ailon1,2,3, Peter Wagner1, Hanbing Zhou1, Natalie Egge1, Maribeth Harrigan1, Anthony Lapinsky1, Patrick Connoly1, John Street2, Christian DiPaola3

1UMass Memorial Healthcare, University of Massachusetts Medical School, Worcester, MA, USA, 2Vancouver General Hospital, University of British Columbia, Vancouver, BC, Canada, 3University of Virginia Medical Centre, University of Virginia, Charlottesville, VA, USA

Objectives

Adverse event (AE) reporting in spine surgery has historically been retrospective, utilizing administrative data. Prospective recording using the Spine AdVerse Events Severity System identifies a higher rate of postoperative complications. Our objective was to determine the incidence, severity, risk factors and effect on hospital length of stay (LOS) for AEs in spine surgery.

Method

AEs for spine patients were prospectively collected for 18 months and linked with retrospective data from operative reports. Patient and surgical characteristics were correlated with incidence and severity of AEs to identify important risk factors and impact on hospital LOS.

Results

At least one AE occurred in 75% of patients, with an average of 1.2 AEs per patient. The most common AEs were pain control (31%), urinary retention (9.7%), and wound infection (6.3%). For patients experiencing at least one AE, 30% had no effect on LOS, 48% increased 1-2 days, 15% increased 3-7 days, and 7% greater than 8 days. Our system captured 25.4% more adverse events than hospital administrative data. Univariate analysis revealed patient age, emergent surgery, diagnostic and surgical categories, and spine region to be predictors of both AEs and LOS. Instrumentation was predictive of increased LOS but not AEs. Logistic regression model of AE likelihood demonstrated emergent surgery, Charlson Comorbidity Index and extent of surgery to be independent predictors with odds ratios of 8.0, 1.1, and 3.7 respectively. Poisson regression modelling of hospital LOS demonstrated a strong influence of surgical invasiveness with a risk of 2.1 for circumferential fusion. Surgery for trauma, infection and deformity has the largest impact on LOS as compared to degenerative disease.

Conclusions

Spine surgery is associated with a high incidence of adverse events, which often prolong hospital length of stay. Better characterization of adverse events and their predictors could lead to improved management strategies that reduce patient morbidity and mortality.
58.2.10

Clinical and Surgical Predictors of Perioperative Complications in patients with degenerative cervical myelopathy: Results from the multicenter, prospective AOSpine International study on 479 patients

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1University of Toronto, Toronto, Ontario, Canada, 2Toronto Western Hospital, Toronto, Ontario, Canada, 3University of Washington, Seattle, Washington, USA, 4Tan Tock Seng Hospital, Singapore, Singapore, 5University of Ontario Institute of Technology, Toronto, Ontario, Canada

Objectives

Surgery for the treatment of cervical spondylotic myelopathy (CSM) is not without associated morbidity and is typically accompanied by complication rates between 11 and 38%. By identifying important clinical and surgical predictors of complication development, clinicians can recognize their high-risk patients and institute appropriate prevention plans. This study aims to identify important clinical and surgical predictors of perioperative complications in patients with CSM.

Method

Four-hundred and seventy-nine surgical CSM were enrolled in the prospective CSM-International study at sixteen global sites. A panel of physicians reviewed all adverse events and classified each one as related or unrelated to surgery. Univariate analyses were performed to determine demographic and surgical differences between patients who suffered a perioperative complication and those who did not. A complication clinical prediction rule was developed using multiple logistic regression.

Results

Eighty patients experienced 92 perioperative complications (16.7%). Univariately, the major clinical risk factors were OPLL (p=0.022), the number of comorbidities (p=0.020), diabetes (p=0.004), and co-existing gastrointestinal disorders (p=0.045). Patients undergoing a 2-stage surgery and those with a longer operative duration were also at a greater risk of perioperative complications. A final model consisted of diabetes (OR=2.35,p=0.039), age (OR=1.02,0.25), operative duration (OR=1.03, p=0.17), two stage surgery (OR=20.37, p=0.012), OPLL (OR=1.82, p=0.064), gastrointestinal co-morbidities (OR=2.53, p=0.020) and BMI (OR=1.06, p=0.10).

Conclusions

Patients are at a higher risk of perioperative complications if they are older; have OPLL, a higher BMI, diabetes or gastrointestinal disorders; and if they undergo a two-stage surgery and a long operation.
Longitudinal analysis of the incidence of adverse events in tertiary spine referral centres: A national perspective from the Canadian Spine Outcomes and Research Network (CSORN) Registry

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¹University of Manitoba, Winnipeg, Canada, ²Canadian Spine Outcomes and Research Network, everytown, Canada, ³Vancouver Coastal Health, Vancouver, Canada

Objectives
Published reports of adverse events (AE) typically explore a single occasion at a single institution, which is characterized by large variances in reported incidences. Our objective was to use a multi-centre national database to record AE incidence at points along the recovery spectrum in an attempt to better understand an often reported tenfold difference in AE incidence.

Method
This was a retrospective examination of prospectively consented patients to the CSORN Registry. Data obtained between October 2008 and September, 2014 in 12 Hospital sites across Canada were used to determine longitudinal AE incidence rates across four time points: intra-operative, peri-operative and post discharge (<=12, >12 weeks). Poisson regression for count data was used for statistical analysis.

Results
Of the 1733 documented spine surgeries, AEs occurrence was: intra-operative=128 (incidence=7.4%), peri-operative=253 (incidence=14.6%), discharge to 12 weeks post-op=75 (incidence=4.3%), post 12 weeks=31 (incidence=1.8%).

Surgeons are directly involved in AE documentation personally or as part of rounds at all CSORN sites except two (one site uses a resident and the other has indirect surgeon involvement via chart abstraction by a research coordinator). AE incidence over time by principal pathology:

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<th>Pathology</th>
<th>n</th>
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<th>Peri-operative</th>
<th>&lt;=12 weeks</th>
<th>&gt;12 weeks</th>
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<tr>
<td>disc herniation</td>
<td>210</td>
<td>13 (6.2%)</td>
<td>13 (6.2%)</td>
<td>5 (2.4%)</td>
<td>5 (2.4%)</td>
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<tr>
<td>spondylolisthesis</td>
<td>203</td>
<td>15 (7.4%)</td>
<td>47 (23.2%)</td>
<td>19 (9.4%)</td>
<td>1 (0.5%)</td>
</tr>
<tr>
<td>stenosis</td>
<td>450</td>
<td>38 (8.4%)</td>
<td>74 (16.4%)</td>
<td>28 (6.2%)</td>
<td>8 (1.8%)</td>
</tr>
<tr>
<td>deformity</td>
<td>55</td>
<td>8 (14.5%)</td>
<td>20 (36.4%)</td>
<td>3 (5.5%)</td>
<td>2 (3.6%)</td>
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<tr>
<td>fracture</td>
<td>37</td>
<td>3 (8.1%)</td>
<td>4 (10.8%)</td>
<td>2 (5.4%)</td>
<td>0</td>
</tr>
<tr>
<td>infection</td>
<td>12</td>
<td>3 (25%)</td>
<td>1 (8.3%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>tumour</td>
<td>12</td>
<td>1 (8.1%)</td>
<td>1 (8.3%)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Conclusions
Longitudinal collection of AEs revealed that the peri-operative period had the highest rate of AEs, especially with surgery for spondylolisthesis. Deformity surgery represents the highest incidence of complications across the four time intervals. Methods of AE recording were similar between sites.
60.2.12

The Use of Validated Clinical Outcome Measures in Spinal Surgery: An Analysis of Recent Annual Meeting Abstracts

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\textsuperscript{1}University of Limerick, Limerick, Ireland, \textsuperscript{2}University Hospital Limerick, Limerick, Ireland, \textsuperscript{3}University of British Columbia, Vancouver, Canada, \textsuperscript{4}Blusson Spinal Cord Center, Vancouver, Canada

Objectives

To analyze the use of clinical outcome measures in abstracts accepted to the CSS and NASS annual meetings from 2010 to 2013 inclusively.

Method

Abstracts accepted to CSS and NASS annual meetings from 2010 to 2013 were read. The frequency of abstracts containing clinical outcome measures and the frequency of validated versus non-validated outcome measures were analyzed. A literature search was performed using the NASS Evidence-Based Clinical Guidelines for Multidisciplinary Spine Care, Cochrane Library Database, PubMed, and Google Scholar. The concepts contained in the items of the ten most commonly used outcome measures were selected and linked to the most specific International Classification of Functioning, Disability and Health (ICF) categories.

Results

A total of 1663 abstracts were analyzed. Of the abstracts accepted to CSS and NASS, 71% and 53% contained validated outcome measures respectively. The ten most commonly used outcome measures were the ODI, VAS, SF36, NDI, SRS, SF12, EQ5D, mJOA, AIS, and RMDQ. The NASS Evidence-Based Guidelines for Multidisciplinary Spine Care provided limited validity recommendations covering three spinal conditions. The Cochrane Library Database published reviews for disc arthroplasty, degenerative disease, vertebral and burst fractures, spinal fusion, back pain, and cervical spondylotic myelopathy. All of the concepts for each outcome measure were linkable to the ICF.

Conclusions

According to the present study, all of the ten most commonly used outcome measures in abstracts to CSS and NASS from 2010 to 2013 were validated in the field of spinal surgery. There is still a need for a universal database to determine which outcome measures would be most useful for a given spinal condition or surgical approach. The ten most commonly used outcome measures were linked to the ICF. This provides evidence that recently, researchers and clinicians in spinal surgery have identified the importance of utilizing validated HRQOL outcome measures as their health predictors.
The Efficacy & Accuracy of Cone Beam CT (O-Arm®) Navigation (StealthStation®) on screw position in Primary cases of Adult Major Deformity surgery

John Street¹, Jason Strelzow¹, Danny Mendelsohn¹, Nicolas Dea², Marcel Dvorak¹, Charles Fisher¹

¹University of British Columbia, Vancouver, Canada, ²University de Sherbrooke, Sherbrooke, Quebec, Canada

Objectives

Intra-operative CT and navigation systems may provide an opportunity to improve precision and accuracy of pedicle screw placement. Adult spinal deformity provides unique anatomical challenges potentially amenable to spinal navigation. Our study examines the efficacy and safety of intra-operative cone beam CT navigation for pedicle screw placement in complex spinal deformity cases.

Methods

We identified patients treated at our institution with spinal fusion for the primary diagnosis of major adult deformity between January 2008 and December 2012 in whom O-arm® and StealthStation® navigation was used (NAV). A historic control cohort (NonNAV) was matched based on age, number of levels, curve type and size, and previous fusion. The number and timing of screw malposition, the need for revision screw placement was recorded along with direction and anatomic level of misplaced screws. All patients had a minimum of 1 year follow-up. Quantitative statistical analysis compared screw placement between cohorts.

Results

Fifty-six patients met inclusion criteria in each cohort. The mean number of screws placed in each group was not significantly different (p=0.75). Thirty-eight (34%) patients in the NonNAV group had misplaced screws compared to 21 (19%) in the NAV group (p=0.002). The need for intra-operative screw revision favoured navigation (p<0.03). The number of adverse events and length of stay were not significantly different. The mean number of post-operative CT scans was significantly fewer in the NAV group (p=0.004) while mean OR time was statistically different between groups (492 mins in NAV Group vs. 408 mins, p=0.002).

Conclusions

Our results demonstrate that intra-operative CT-guided navigation provides an equally safe, and more accurate tool for pedicle screw placement than traditional techniques in adult spinal deformity surgery. There were more intra-operative screws adjusted and fewer post-operative screws revised with navigation.

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Objectives

The objectives of this study were: 1) to compare the effect of early and late surgical decompression on neurological recovery in complete traumatic SCI 2) to assess if surgical timing differently impacts on cervical or thoracolumbar SCI.

Method

A prospective cohort study was performed in a single Level 1 trauma centre specialized in SCI care. All consecutive cases of traumatic SCI referred between 2010 and 2013 were screened for eligibility. Neurological status was assessed systematically using the ASIA grading system at first arrival to the trauma centre and the neurological recovery was assessed at rehabilitation discharge. Patients operated within 24h of the trauma were compared with patients operated later than 24h after the trauma. Potential confounders were recorded such as the age, Injury Severity Score (ISS), smoking, body mass index (BMI), the Glasgow Coma Scale (GCS) and duration of follow-up.

Results

Fifty-three complete SCI were included in the study with 33 thoracic SCI and 20 cervical SCI. The 38 patients operated <24h were generally younger than the 15 patients operated ≥24h although no other potential confounder were statistically different. Overall 28% (15/53) of complete SCI had some neurological recovery with 34% (13/38) of patients operated <24h and 13%(2/15) of patients operated ≥24h (p=0.182). Sixty-four percent (9/14) of cervical complete SCI operated <24h had some neurological recovery whereas none of the 6 complete cervical SCI operated ≥24h improved (p=0.008).

Conclusions

This study suggests that surgical decompression earlier than 24h in complete SCI may promote improvement in neurological status, especially at the cervical level.
The Role of MRI in Predicting Surgical Outcome in Patients with Degenerative Cervical Myelopathy

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Objectives

Cervical Spondylotic Myelopathy (CSM) is the commonest cause of spinal cord impairment in the elderly population worldwide. While MRI is the primary imaging modality for confirming the diagnosis, its role in predicting surgical outcome remains unclear. Using prospective and multicenter study data it is the purpose of the present study to assess the role of MRI in predicting the surgical outcome of patients treated for CSM.

Method

Two hundred and seventy-eight patients with \( \geq 1 \) clinical signs of myelopathy were enrolled and underwent decompression surgery. Complete baseline clinical and MRI data were available for 102 patients. MRI parameters measured included presence/absence of signal change on T1 and T2, T2 signal quantitative factors, and anatomical measurements. A dichotomized post-operative mJOA score at 6-months was used to characterize patients with mild myelopathy (\( \geq 16 \)) and those with substantial residual neurological impairment (\(< 16 \)). Univariate analysis assessed the relationship between baseline parameters and outcome. Multivariate logistic regression was conducted following a conceptual division of variables into three groups: T1 signal analysis, T2 signal analysis and anatomical measurements.

Results

Baseline mJOA (\( p<0.001; \) OR=1.644, CI:1.326-2.037), maximum canal compromise (MCC) (\( p=0.0322; \) OR=0.965, CI:0.934-0.997), T2 hyper-intensity ROI area (\( p=0.0422; \) OR=0.67, CI:0.456-0.986) and sagittal extent (\( p=0.026; \) OR=0.673, CI:0.475-0.954) were significantly associated with outcome univariately. The final model was comprised of T1 hypo-intensity (\( p=0.029; \) OR=0.242; CI:0.068-0.866), MCC (\( p=0.005; \) OR=0.940; CI:0.90-0.982) and baseline mJOA (\( p<0.001; \) OR=1.743; CI:1.353-2.245), yielding an area under the receiver operating characteristic curve (AUC) of 0.845.

Conclusions

Baseline mJOA is a strong predictor of post-surgical outcome in CSM at 6-months. However, a model inclusive of MCC and T1 hypo-intensity assessment provides superior predictive capacity. This suggests that MRI analysis has a distinct and significant role in predicting surgical outcome. It is therefore recommended that a thorough MRI analysis be conducted in all CSM patients considered for surgical treatment.
64.1.16

Post surgical patients can have similar functional improvements and return to work rates following rehabilitation as those treated non-surgically.

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Objectives

The purpose of this study was to compare the clinical outcomes of two distinct groups of low back pain (LBP) patients commencing rehabilitation: 1) those with a history of spine surgery (n=1097), and 2) those without surgical intervention (n=2092).

Method

This prospective study of LBP cases was a collaborative effort of spine care rehabilitation clinics in New Zealand and Canada. Patient enrolment occurred between January 2008 and October 2012. All patients had mechanical LBP as determined by the Saskatchewan Spine Pathway triage methodology.

Results

There were 929 cases from New Zealand and 2260 from Canada.

At assessment, the post-surgical group had lower pain levels (mean = 5.24 vs 5.57 (p<0.001)), but poorer baseline function (p<0.001), and were more likely to be off work (p<0.001) than the non-surgical group.

At the conclusion of rehabilitation, the post-surgical group had significantly less functional improvement (p<0.001) but this difference was no longer significant at 3-month follow up. The post-surgical group had significantly less reduction in pain (p<0.001) at discharge and follow up (p<0.001). Return to work rates at follow up were not significantly different between groups (post-surgery=60.1% vs non-surgical=64.9%, p<0.001)

Conclusions

Initially, post-surgical patients had less pain but showed less reduction in pain over time and had poorer baseline function; both groups achieved similar functional improvements and return to work rates.
65.1.17

Intra-operative Cone Beam CT (O-Arm®) and Stereotactic Navigation (StealthStation®) System in Complex Adult Spine Surgery - Early Experience and Learning Curve

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Objectives

There is limited data evaluating the clinical learning curve for surgeons and its relationship to patient outcomes when using intra-operative navigation and imaging systems. We examined the clinical learning curve and patient outcomes of using O-Arm® and StealthStation® for 6 fellowship trained Spine Surgeons at our institution, a single quaternary referral centre, from 2009-2013.

Method

This ambispective study examined 231 surgical cases where O-arm® and StealthStation® were used to facilitate pedicle instrumentation. The learning curve was determined by examining total operative time and blood loss, operative time and blood loss per surgical level, and the incidence of surgery related adverse events (AEs) by year. AEs were prospectively collected using the Spine adverse events severity system (SAVES).

Results

At our institution, all spine surgeons were using O-arm® and StealthStation® by the beginning of 2009. 231 patients had screws placed using the O-arm® and StealthStation® between 1January2009 and 31December2012. There number of screws placed increased significantly from 430 screws placed in 27 cases in 2009 to 758 screws in 75 cases in 2012, p<0.05. The average estimated blood loss (EBL) decreased from 1229 mLs in 2009 to 907 mLs in 2012, p<0.05. The EBL per case per number of levels instrumented decreased from 5.72 mLs in 2008 to 2.39 mLs in 2012, p<0.05. Mean operating time decreased from 407 to 378 mins from 2009 to 2012, p<0.05. The number of misplaced screws per case decreased from 0.78 to 0.54 from 2009 to 2012, p<0.05. There were no significant differences in incidences of dural tear, surgical site infection or other surgical AEs over the study period.

Conclusions

Our results demonstrate that there is a learning curve to the use of intra-operative CT based navigation, as measured by OR time, intra-operative blood loss and screw malposition. There were no significant differences in surgical AEs during this learning period.
A pilot randomized controlled trial of iodine-impregnated plastic adhesive drape usage in spine surgery and the effect on wound bacterial load

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Objectives

Little evidence exists supporting the use of plastic adhesive drapes (PAD) to prevent surgical site infection, despite their widespread utilization for decades. Through a double-blinded, randomized controlled trial, we investigated the effect of PADs on bacterial colony-forming-units (CFU) during elective spinal surgery with a novel, inexpensive, low-risk methodology to investigate the microbiological effects.

Method

Over three months, 15 blinded elective spine patients were randomly assigned to PAD (3M Ioban2) versus no PAD usage. A blinded observer collected surface specimens using flocked swabs (Copan eSwab) on wounds immediately post-operation (POD-0) and on post-operation day 3 (POD-3) using a standardized technique. Specimens were plated for bacterial CFUs on both blood and chocolate blood agar in triplicate in serial dilutions. CFUs were manually counted. Median CFU/cm of wound swabbed and % positive cultures were calculated, and statistical significance was assessed with the Mann-Whitney U test and Fisher’s Exact test, respectively.

Results

There were no significant differences between groups in baseline characteristics. POD-0, blood agar, median CFU/cm: no PAD=0 (range 0-7.69) vs PAD=0.04 (range 0-4.18) ($P>0.2$); % positive cultures: no PAD=42.9% vs. PAD=50% ($P=1.00$). POD-0, chocolate blood agar, median CFU/cm: no PAD=0.06 (range 0-7.51) vs PAD=0.09 (range 0-4.8) ($P>0.2$); % positive cultures: no PAD=57.1% vs. PAD=62.5% ($P=1.00$). POD-3, blood agar, median CFU/cm: no PAD=0.08 (range 0-1.87) vs PAD=0.22 (range 0-4.53) ($P>0.2$); % positive cultures: no PAD=57.1% vs. PAD=50% ($P=1.00$). POD-3, chocolate blood agar, median CFU/cm: no PAD=0.04 (range 0-2.22) vs PAD=0.04 (range 0-4.56) ($P>0.2$); % positive cultures: no PAD=71.4% vs. PAD=75% ($P=1.00$).

Conclusions

Our study demonstrated similar bacterial contamination whether a PAD was used or not. With the numbers available, we did not detect a significant difference between groups. As this is a pilot study, we acknowledge that it is underpowered, but do note that this methodology is feasible for ongoing study.
Dynesis™ long term outcome study

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Objectives

Dynesis™ (Zimmer) is a dynamic stabilization spinal instrumentation system. It endeavours to provide spinal stability without fusion with the goal of preventing adjacent segment disease (ASD). Dynesis™ was introduced in 1993 and is mostly used in Europe. There is no published data for long term follow-up at 5 years or more.

Method

We retrospectively reviewed prospectively collected data on patients undergoing surgery with implantation of the Dynesis™ system from 2006-2009. We analyzed data regarding 18 variables: neurological deficit, claudication, multilevel degeneration, prior ASD, OR segments, associated procedure, age, sex, medical & psychiatric comorbidities, prior spine OR, smoking, BMI > 35, revision OR, scoliosis, spondylolisthesis, early complications and hospital stay. We analysed 2 primary endpoints: solid fusion on x-ray and clinical ASD both at 5 years. Secondary endpoints were time to fusion, time to ASD and reoperation. We conducted a multivariate analysis via the random forest method. Mann-Whitney U test and Fisher exact test were used to qualify relationship between variables.

Results

There were 52 patients. Three died of unrelated causes during follow-up. Fifteen had ASD (29%) at a mean 45 months. Nine had a solid fusion (17%), two of which also had ASD. Mean time to fusion was 65 months. The multivariate analysis revealed 3 variables significantly associated with ASD: prior ASD (OR = 11.3 p= 0.005), neurological deficit (OR = 8.5 p=0.018) and multilevel degeneration (OR = 0.18 p=0.026). No variable was associated with fusion.

Conclusions

Dynesis™ is associated with a much higher rate of ASD then previously reported in short term follow-up studies despite maintaining a low fusion rate. This may relate to the use of Dynesis™ in highly selected patients deemed to be at the highest risk for ASD. The natural history of ASD seems to overcome the treatment at 5 years.
Maverick™ Total Disc Replacement in a real-world patient population: A prospective, multicentre, observational study

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Objectives

Controlled trials have shown that total disc replacement (TDR) can provide pain and disability relief to patients with degenerative disc disease; however, whether these outcomes can also be achieved for patients treated in normal surgical practice has not been well documented.

Method

This prospective, international study observed changes in disability and back pain in 134 patients who were implanted with Maverick™ TDR within the framework of routine clinical practice and followed for 2 years post-surgery. Primary and secondary outcomes were the differences from baseline to 6 months post-surgery in the means of the Oswestry Disability Index and the change in back pain intensity assessed on a 10-cm visual analogue scale, respectively. Mean patient age at surgery was 43 years, but ranged up to 65 years.

Results

Respectively one hundred twenty-three patients had an implant at one level, 10 patients at two levels, and one patient at three levels. Statistically significant improvements in mean disability (−25.4) and low back pain intensity (−4.0) scores were observed at 6 months postoperatively (P < 0.0001 for both). During the study, 56 patients (42%) experienced a complication or adverse event.

Conclusions

This is the first international observational study to report outcomes of TDR in real-world clinical settings. We showed statistically significant improvements in disability and pain scores at 6 months following Maverick™ TDR, which were maintained for 2 years alongside an acceptable rate of peri-operative complications. The safety and tolerability shown in this observational study were comparable to those from controlled trials.
Pedicle Screw Malposition in Revision Spinal Surgery: Efficacy of Intra-operative CT based Navigation

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Objectives

Revision surgery poses unique technical challenges for pedicle screw instrumentation. Use of intra-operative 3D imaging with navigation has been underreported in spine revision surgery. The aim of this study was to examine pedicle screw malposition rates and patient outcomes in revision surgeries comparing O-arm® and StealthStation® navigated cases to traditional freehand techniques.

Method

This ambispective study compared two matched cohorts of patients undergoing revision thoracolumbar surgery. The study group comprised 56 consecutive patients who underwent O-arm® and StealthStation® navigation assisted pedicle screw instrumentation (NAV) between January 1, 2008 and December 31, 2012. The control group comprised 34 historical matched cases with surgery between January 1, 2006 and December 31, 2008, using traditional (freehand or with fluoroscopy), non-navigated techniques (nonNAV). Cases were matched on age, gender, surgical location, number of surgical levels and primary diagnosis.

Results

A significant difference existed in the number of misplaced screws between NAV and nonNAV groups (31 vs. 54, P<0.001). Mean number of misplaced screws per case was 0.57 (SD=0.92) with navigation and 1.86 (SD=2.49) without (P=0.01). No difference existed in the number of screws revised intra-operatively (10 vs. 7, P= 0.54). One NAV patient and two nonNAV patients required early post-operative screw revision during the same admission (P=0.33). No screws in the NAV group required revision during subsequent admissions. No difference was observed in grade of screw malposition (P=0.11), anatomical location of malposition (P=0.26), duration of surgery (P=0.11), incidence of intra-operative dural tear (P=1.00), wound infection (P=1.00), or length of stay (P=0.78). A significant difference in intra-operative massive (>2L in 3 hours) blood loss existed; 3.3% of NAV cases compared to 7.8% of nonNAV cases.

Conclusions

This early analysis of revision surgery demonstrates an increased accuracy of pedicle screw placement utilizing O-arm® and StealthStation®, without an increase in OR time. Clinical outcomes between NAV and nonNAV cases were similar.
70.2.22


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Objectives

To study how the systematic use of intraoperative skull-femoral traction (IOSFT) in posterior arthrodesis for Adolescent Idiopathic Scoliosis (AIS) impacts perioperative outcomes and health resource utilization.

Method

Retrospective, single-centre cohort study. Seventy-three consecutive patients with AIS who underwent single stage posterior spinal arthrodesis from 2008 to 2012 at a tertiary children’s hospital were identified. Forty-five patients were operated with IOSFT (traction group) and twenty-eight patients were operated without IOSFT (non-traction group). Outcome measures included operative time, calculated blood loss, blood transfusion requirement, traction related complications and cost comparisons.

Results

Operative time was 375.6 min for the traction group (p=0.0001) and 447.6 min for the non-traction group. Calculated blood loss was significantly less in the traction group (p=0.027). Thirty-three percent of patients in the traction group required blood transfusion, as compared to 64% of patients in the non-traction group (p=0.01, absolute risk reduction of 31%). There was no significant difference in curve magnitude correction (p=0.49). There were no significant complications with the use of traction. There was a significant reduction in cost per surgical procedure in the traction group (p=0.0003).

Conclusions

The systematic use of IOSFT in posterior arthrodesis for AIS contributed to significant reductions in operative time, calculated blood loss, and blood transfusion requirement, thus resulting in lower perioperative costs and improved health resource utilization. There were no significant complications or added morbidities associated with the use of IOSFT thus supporting the use of IOSFT as an adjunct to posterior arthrodesis in AIS. Improved health resource utilization resulted in improved access to surgical care for children. Further research is required to investigate the generalizability of our findings and to study the effect of IOSFT on patient based outcomes.
The Effect of Growth Friendly Surgery on Coronal and Sagittal Plane Spine Growth in Idiopathic Scoliosis

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Objectives

To evaluate the effect of lengthening procedures on coronal, sagittal, and true spine length in children with idiopathic scoliosis.

Method

Retrospective, multi-centre, review of 18 patients with minimum 5 yr follow-up after growth friendly surgery. Radiographs were analyzed at implantation and at each lengthening procedure. Primary outcomes were changes in coronal, sagittal, and true (along the sagittal arc of vertebrae) T1-T12 length per lengthening.

Results

With minimum 5 year follow up, 18 patients with a mean age of 4.1 years were treated with rib-based(n=9) or spine-based(n=9) distraction. Three groups were compared: First lengthening (L1), 2nd through 5th lengthening (L2-L5), and 6th through 10th lengthening (L6-L10). Cobb angle stayed constant (45.0°, 44.7°, 48.6°), maximum kyphosis increased (32.1°, 45.3°, 47.5°)*, coronal thoracic height increased (16.4cm, 17.6cm, 17.8cm), true thoracic length increased (18.4cm, 19.5cm, 20.8cm)*, change in coronal T1-T12/lengthening decreased (5.7mm, 4.0mm, 1.7mm), change in sagittal T1-T12/lengthening decreased (4.0mm, 3.3mm, 3.1mm), and change in true T1-T12 / lengthening remained constant (2.8mm, 4.4mm, 4.4mm).(*p<0.05).

Conclusions

Although there is the appearance of a law of diminishing returns when measured in the coronal plane, these changes were not as apparent when measured in the sagittal plane and were nullified with measurement of true spine length. These findings support the hypothesis that, when measured in the plane of distraction, a law of diminishing returns may not be apparent.
A Qualitative Web-Based Expert Opinion Analysis on the Adoption of Intra-Operative CT and Navigation Systems in Spine Surgery

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Objectives

Intra-operative computed tomography (IoCT) and navigation systems have numerous potential uses in instrumented spine surgery and may decrease patient morbidity, leading to cost-effectiveness implications. Despite this, its adoption is not ubiquitous. The goal of this study is to identify facilitators and barriers to the adoption of this technology by spine surgeons.

Method

A web-based survey was designed to explore spine surgeons’ impressions of IoCT and navigation systems. The survey was distributed to surgeon members of the Canadian, New Zealand, and Australian Spine Societies. Participants were stratified into user and non-user groups, with a slight variability in questions to both groups based on applicability.

Results

53 surgeons completed the survey. The main differences between users (24) and non-users (29) of this technology were their baseline expectations, the size of their spine practice group, and the proportion of spine surgery in their practice. The main reasons for adopting this technology were its clinical safety, accuracy and technical utility in complex cases (15/24 respondents). Non-users mostly identified the prohibitive cost and lack of availability in their institution as the primary deterrent to adopting it (21/25 respondents), as well as the limited need and benefit associated to its use (6/26 respondents). Evidence gaps identified were cost-benefit analysis (8/19 respondents) and clinical outcomes studies (6/19 respondents). Both users and non-users identified the top advantages as being more accurate and safer screw placement, and top disadvantages as its cost and increased radiation exposure to the patient. Recommendations for training requirements and device improvements were made by surgeons and reported.

Conclusions

Spine surgeons recognize the improved screw placement accuracy and safety of IoCT and navigation systems. Their cost is the biggest deterrent to their widespread adoption. Cost-benefit analysis and outcome studies related to their use are warranted. Suggestions for improvements in this technology and training for its use are discussed.
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