QUALITY, SAFETY, AND VALUE OF INNOVATION IN SCOLIOSIS SURGERY: INTRAOPERATIVE SKULL FEMORAL TRACTION AND NAVIGATED SEQUENTIAL DRILLING

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Intraoperative Skull-Femoral Traction in Posterior Spinal Arthrodesis for Adolescent Idiopathic Scoliosis

The Impact on Perioperative Outcomes and Health Resource Utilization

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10-15 lbs maximum

50% Body weight (kg) - 10 lbs
Since 2013: **Navigated Sequential Drilling**

- Navigated drill guide locked at 25mm
- Regular oscillating power drill slow speed
- Drill bit 3.5mm
- Drill all pilot holes, bone wax
- Probe, tap, probe, screw
**Study Design**

- Retrospective single-center quality improvement cohort study
- Reviewed the medical records of 125 patients who underwent a single-stage PSIF for AIS

<table>
<thead>
<tr>
<th>Cohort A</th>
<th>Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort B</td>
<td>IOSFT</td>
</tr>
<tr>
<td>Cohort C</td>
<td>IOSFT &amp; NSD</td>
</tr>
</tbody>
</table>
Study Design

Outcome Measures

1° Outcomes:
- median operative time
- prevalence of cases requiring extended operating room time
- need for blood transfusion
- length of hospital stay
- total cost per case

2° Outcomes: implant density, degree of spine deformity correction, and complications
# MATERIAL & METHODS

## Table 1. Patient baseline characteristics

<table>
<thead>
<tr>
<th>Preoperative Characteristics</th>
<th>Cohort A</th>
<th>Cohort B</th>
<th>Cohort C</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Patients</td>
<td>28</td>
<td>45</td>
<td>52</td>
<td>0.885</td>
</tr>
<tr>
<td>Mean Age (yr)</td>
<td>14.7 ± 1.8</td>
<td>14.6 ± 1.8</td>
<td>14.5 ± 1.8</td>
<td>0.685</td>
</tr>
<tr>
<td>Mean Weight (Kg)</td>
<td>51.7 ± 8.5</td>
<td>52.4 ± 10.5</td>
<td>53.7 ± 11.4</td>
<td>0.999</td>
</tr>
<tr>
<td>Female (%)</td>
<td>92.9</td>
<td>91.1</td>
<td>90.4</td>
<td></td>
</tr>
<tr>
<td>Preoperative Hemoglobin (g/L)</td>
<td>137.8 ± 10.0</td>
<td>137.8 ± 8.1</td>
<td>137.1 ± 11.1</td>
<td>0.927</td>
</tr>
<tr>
<td>Lenke (%) 1/2/3/4/5/6</td>
<td>43/25/7.3.5/3.5/18</td>
<td>40/18/13/0/18/11</td>
<td>29/30/8/2/23/8</td>
<td></td>
</tr>
<tr>
<td>Major Curve Cobb Angle</td>
<td>63.6 ± 9.8</td>
<td><strong>61.9 ± 11.9</strong></td>
<td><strong>54.1 ± 13.3</strong></td>
<td><strong>0.0008</strong>&lt;sup&gt;b,c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

## Surgical Characteristic

| Levels Fused                 | 10.6 ± 1.3                | 10.7 ± 2.0                | 11.4 ± 1.6                | 0.065   |
| Implant Density              | 1.7 ± 0.2                 | 1.7 ± 0.2                 | **1.4 ± 0.2**             | < 0.0001<sup>b,c</sup> |
| High Dose Tranexamic Acid (%)| 76.0                      | 82.2                      | 92.3                      | 0.112   |
| Cobb Angle Correction (%)    | 56.6 ± 13.0               | 62.1 ± 11.2               | 66.5 ± 13.5               | **0.0043**<sup>b</sup> |

Comparison of means made by ANOVA and Tukey’s post hoc test; comparison of frequencies was done by Fisher’s exact.

- a = significant differences between baseline and traction cohort.
- b = significant differences between baseline cohort and navigated sequential drilling cohort.
- c = significant differences between intraoperative traction cohort and navigated sequential drilling cohort.

Implant density: number of hooks/screws per fused level.
Tranexamic acid, high dose 10 mg/kg/hr.
RESULTS

A. Operative time (minutes)

- Cohort A 2008-2010: 452
- Cohort B 2010-2013: 345
- Cohort C 2013-2015: 185

B. Patients requiring extended OR time (past 1545)

- Cohort A 2008-2010: 89%
- Cohort B 2010-2013: 51%
- Cohort C 2013-2015: 0%

C. Blood transfusions (%)

- Cohort A 2008-2010: 64%
- Cohort B 2010-2013: 33%
- Cohort C 2013-2015: 2%

D. Total case cost (CAD)

- Cohort A 2008-2010: $35,267
- Cohort B 2010-2013: $31,842
- Cohort C 2013-2015: $26,757
**RESULTS**

*Cost Analysis*
- Average cost per case decreased by $8,500 (24%)
  - Largely due to the shorter LOS (20%) and shorter operating time (59%)
  - Nursing costs and intangibles were slightly higher in cohort C by $85.50 ($p = 0.18$) and $416.70 per case, respectively ($p < 0.001$).
  - Total case costs were still significantly lower in cohort C once the differences in pre-operative Cobb angle and implant density were accounted for using our matched pairing sub-analyses.

*Perioperative complications*
- There were no complications directly related to IOSFT or the use of NSD.
  - No patient required revision surgery due to inaccurate pedicle screw placement.
**Limitations**
- Retrospective design
- One of the surgeons in our study was in his first five years of practice

**Conclusion**
- In combination, IOSFT and NSD, significantly improved quality, safety and value-of-care for scoliosis patients at our institution.
  - These surgical strategies were performed without increased perioperative complications, while reducing cost per case by 24%.
- If reproducible, these strategies could have significant implications for health resource utilization.