ARE PEDICLE SCREW PERFORATION RATES INFLUENCED BY THE DISTANCE FROM THE REFERENCE FRAME IN MULTI-LEVEL REGISTRATION USING CT-BASED NAVIGATION SYSTEM IN THE SETTING OF SCOLIOSIS?

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Conflict of interest disclosure

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Introduction

- We developed a multi-level registration for pedicle screw insertion for posterior scoliosis surgery in which 3 consecutive vertebrae were registered at a single time with CT-based navigation system.

- For registration, the reference frame was set to the caudal end of 3 consecutive vertebrae, and pedicle screws were inserted into those 3 consecutive vertebrae and into the adjacent vertebrae.
Purpose

• The purpose of this study was to investigate the perforation rates of the vertebrae where the reference frame was set, of 1 and 2 vertebrae above the vertebra with the reference frame, and of the nonregistered adjacent vertebrae.
Patients and Methods

• 44 scoliosis patients who underwent pedicle screw insertion by multi-level registration from March 2006 to January 2010 were studied.
• The perforation rates of the different vertebrae involved were studied.
• Perforation was investigated by a co-presenter (H.O.) who was not involved in the surgery.
• The position of pedicle screws using postoperative axial CT was classified by Rao’s classification.

Grade 0: complete insertion
Grade 1:<2 mm perforation
Grade 2:2-4 mm perforation
Grade 3:>4 mm perforation
Results

Vertebra to which the reference frame was set
N=138

- 5/138 = 3.68%
- 24/138 = 17.7%
- 109/138 = 80.6%

Major perforation rate: 4%

1 vertebra above the vertebra with the reference frame
N=103

- 3/103 = 2.94%
- 17/103 = 16.6%
- 81/103 = 79%

5%
2 vertebrae above the vertebra with the reference frame
N=128

- 96/128 = 75%
- 21/128 = 16%
- 8/128 = 6%
- 3/128 = 2%

Major perforation rate: 8%

Vertebral adjacent to the registered vertebrae
N=30

- 21/30 = 70%
- 7/30 = 23%
- 2/30 = 7%
- 2/30 = 7%

7%
Statistics

- Grade 2 and 3 perforations were defined to be major perforations.
- Fisher’s exact test was performed among the 4 groups, and no significant difference was found ($p = 0.33$).
## Discussion 1: Position of the reference frame and level of screw insertion level

<table>
<thead>
<tr>
<th>Reporter</th>
<th>Journal</th>
<th>Type of navigation</th>
<th>Reference flame was attached to</th>
<th>Pedicle screw insertion level</th>
</tr>
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<tbody>
<tr>
<td>Scheufler KM</td>
<td>Neurosurg 2011</td>
<td>Intraoperative computed tomography (iCT)-based neuronavigation (iCT-N)</td>
<td>Mayfield or most distal spinous process within the instrumentation.</td>
<td>cervicothoracic spine</td>
</tr>
<tr>
<td>Park P</td>
<td>Surg Neurol Int 2010</td>
<td>utilizing O-arm fluoroscopy with computer-assisted navigation (StealthStation)</td>
<td>Iliac pin</td>
<td>L1-S1 pedicle screw</td>
</tr>
<tr>
<td>Best NM</td>
<td>Am J Orthop 2009</td>
<td>StealthStation</td>
<td>Iliac spine</td>
<td>Lumbar spine</td>
</tr>
</tbody>
</table>
Discussion 2: Area where accurate screw insertion is possible by multilevel registration using CT-based navigation

An accuracy of 1 mm can be guaranteed within the area of the green circle.
Conclusions

• In a single-time multilevel registration of 3 vertebrae, no significant difference was found in the major perforation rates among the 5 consecutive vertebrae.