

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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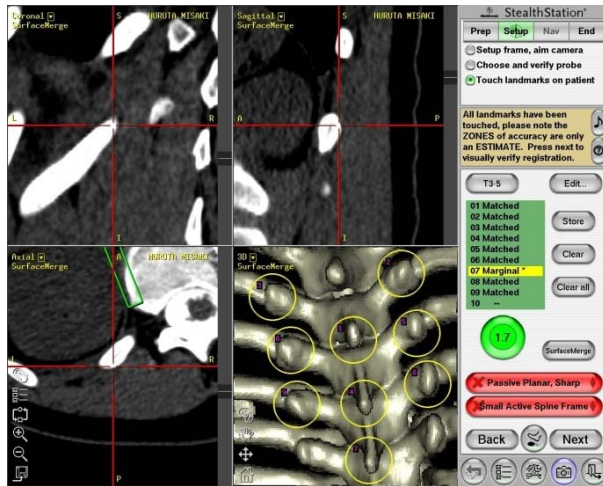
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Conflict of interest disclosure

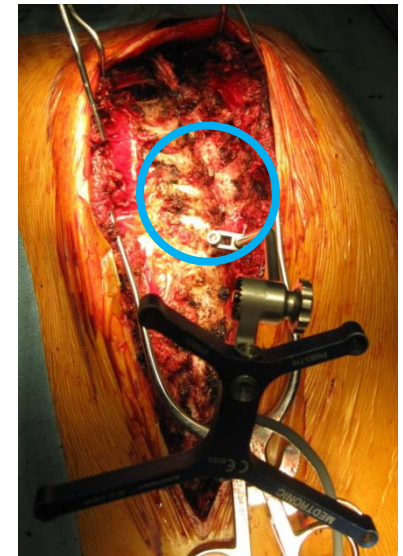
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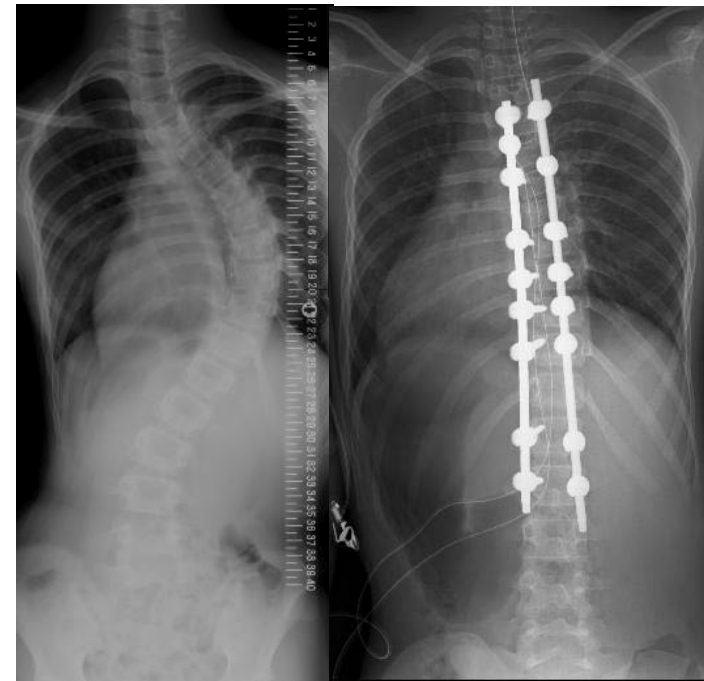
Introduction



- 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.

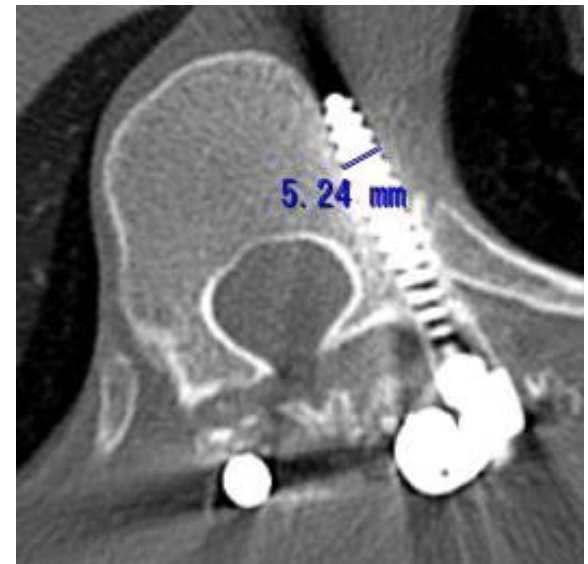
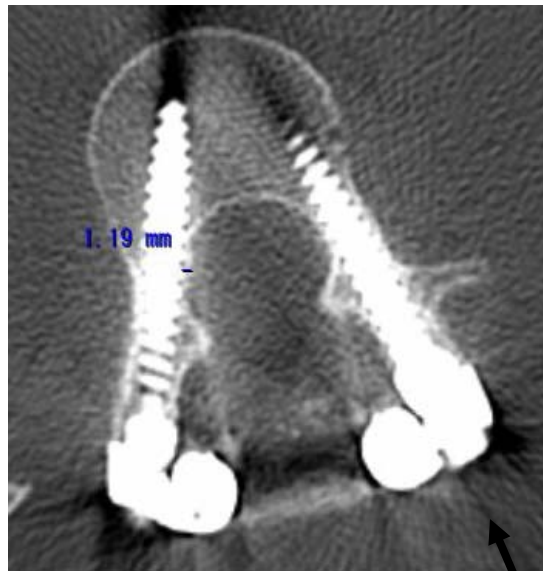
Rao classification Rao G et al. Spine 2003

Grade 0: complete insertion

Grade 1: <2 mm perforation

Grade 2: 2-4 mm perforation

Grade 3: >4 mm perforation



↑
Grade 0

↑
Grade 1

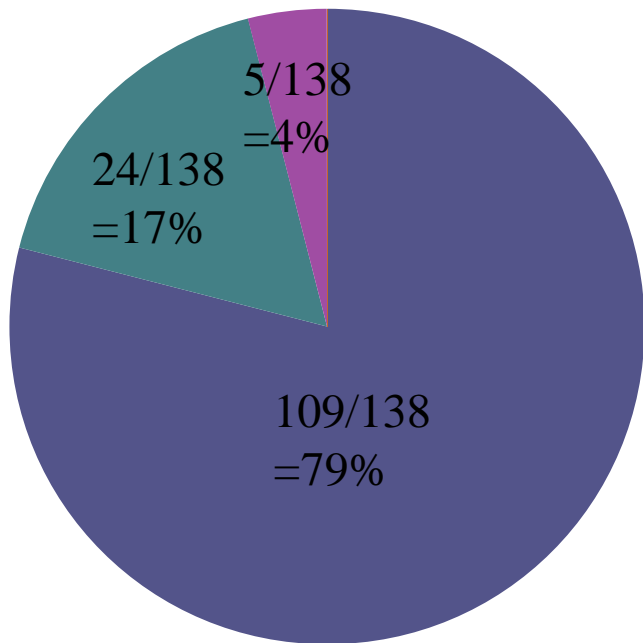
Grade 2

Grade 3

Results

Vertebra to which the reference frame was set

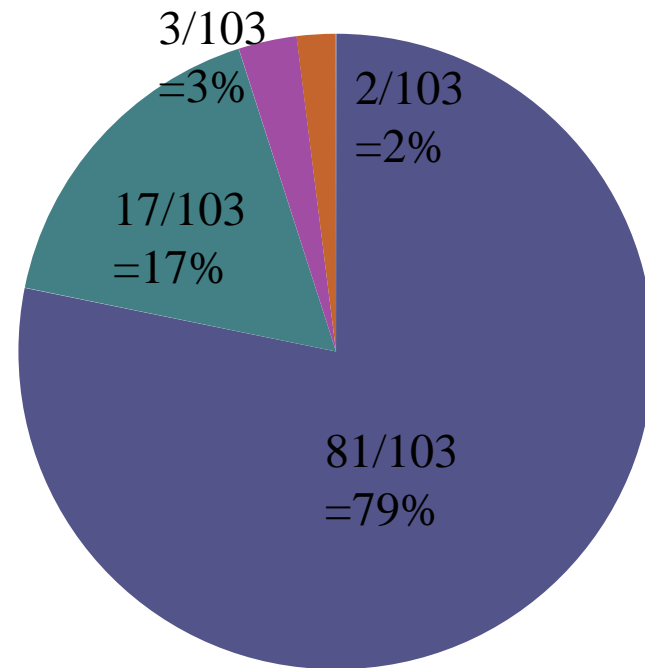
N=138



Major perforation rate: 4%

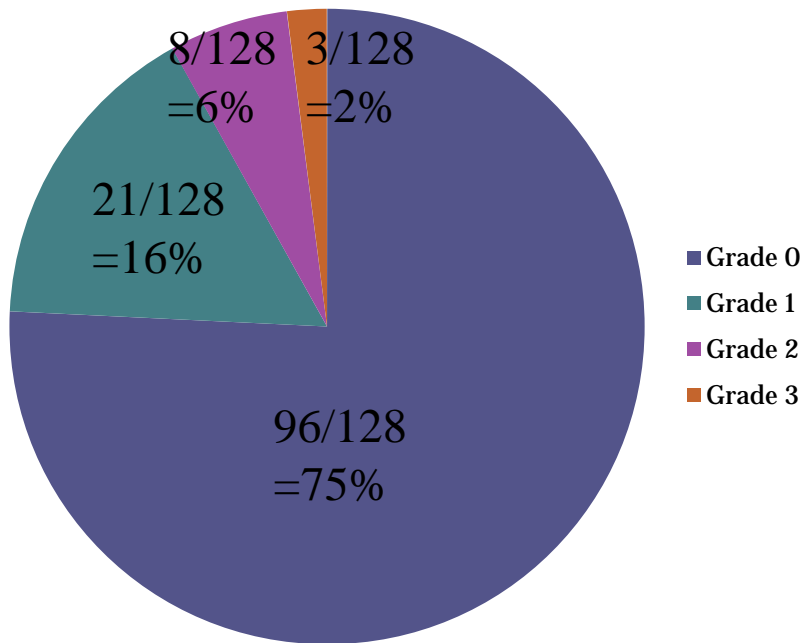
1 vertebra above the vertebra with the reference frame

N=103



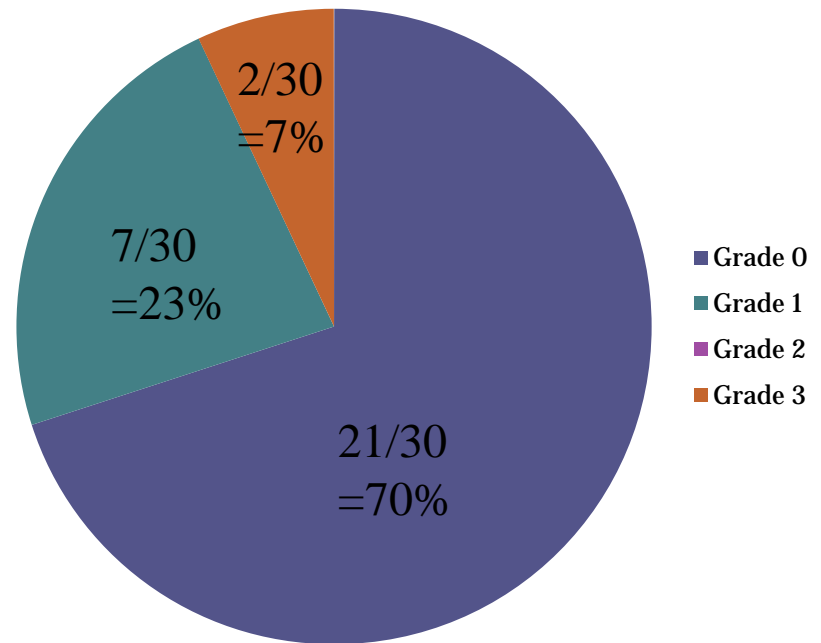
5%

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



Major perforation rate: 8%

Vertebrae adjacent to
the registered vertebrae
N=30



7%

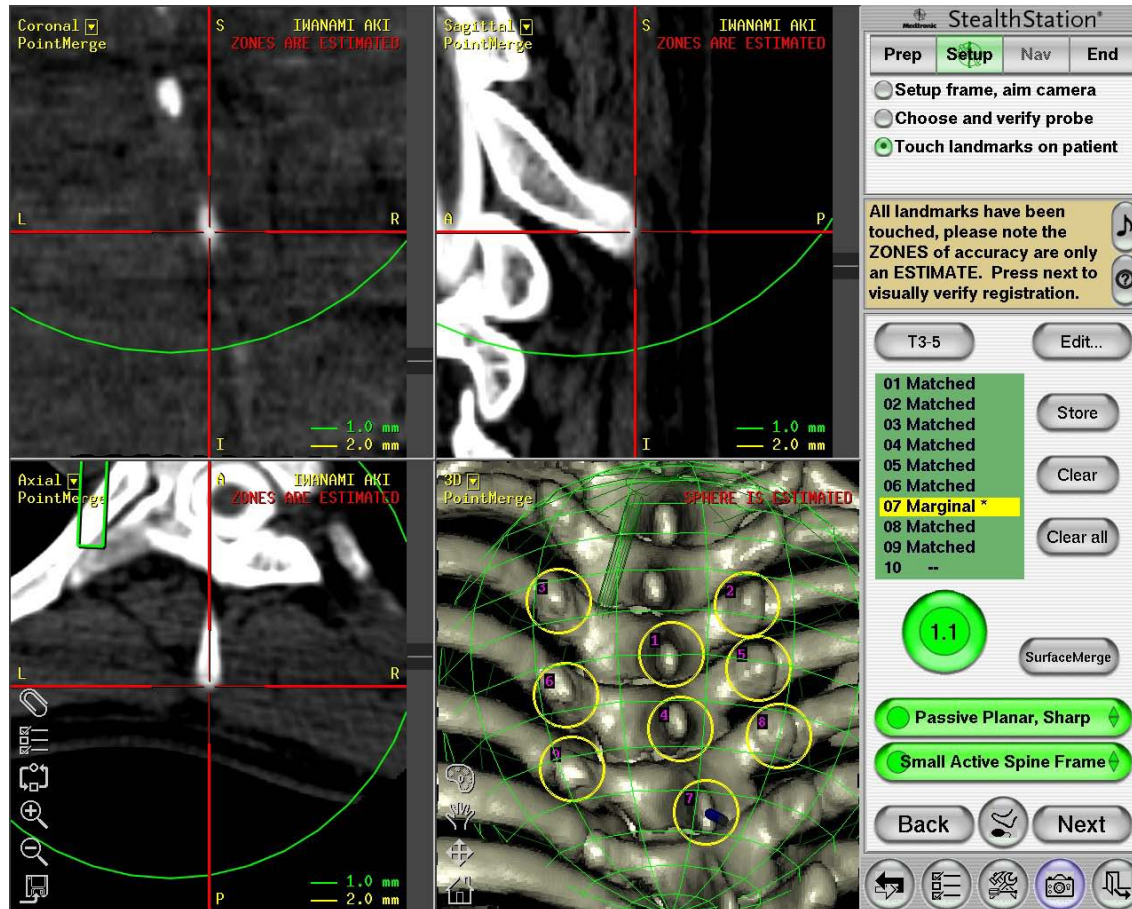
Statistics

- 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

| Reporter | Journal | Type of navigation | Reference frame was attached to | Pedicle screw insertion level |
|--------------|----------------------|---|---|-------------------------------|
| Scheufler KM | Neurosurg 2011 | Intraoperative computed tomography (iCT)-based neuronavigation (iCT-N) | Mayfield or most distal spinous process within the instrumentation. | cervicothoracic spine |
| Park P | Surg Neurol Int 2010 | utilizing O-arm fluoroscopy with computer-assisted navigation (StealthStation) | Iliac pin | L1-S1 pedicle screw |
| Best NM | Am J Orthop 2009 | StealthStation | Iliac spine | Lumbar spine |

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.