

The Differences of the safety margins of sacral alar-iliac screw between two entry points



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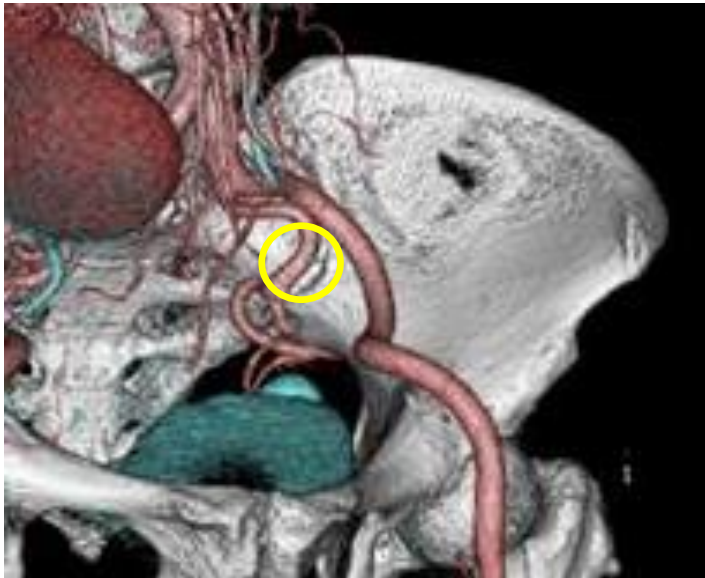
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S2 alar iliac(SAI) screw

S2 alar-iliac (SAI) screws have been common anchor recently in cases of lumbosacral fixation. The screw deviation to anterior or caudal direction has potential risk for major vessel injury,

- **Anterior Deviation**
Internal iliac artery



- **Caudal Deviation**
Superior gluteal artery



Two entry points have been reported as insertion of SAI screw. However, no study have investigated difference between the two entry point of SAI screws.

Purpose

The purpose of this study was to evaluate **safety margins of SAI screw** by two entry point and investigate **characteristics of patient required special attention** on the screw insertion, using three-dimensional (3D) analyzing software.



Materials and Methods

- Patients who were over 40 years old and taken abdominal thin-slice CT in the outpatient clinic of internal medicine
- Exclusion : 1) history of lumber or pelvic surgery
2) Patients with a lumbar or pelvic tumor or metastasis

50 pts

male 25pts / female 25 pts
mean age 63.7 ± 9.0 yrs

Pelvic Incidence(on CT): $48.3 \pm 8.7^\circ$

The obtained CT images were reconstructed using 3D analysis software (ZedView VEGA; LEXI Co., Ltd. Tokyo, Japan), which was originally designed for preoperative spinal screw simulation and allows virtual setting of screws (2.0–7.0 mm diameter) on a reconstructed plane on CT images or 3D bone images.

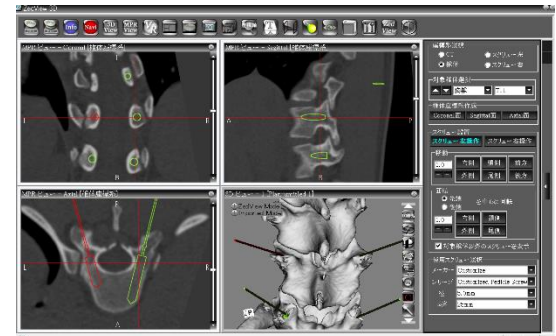


ZedView

VEGA

Visual Enhanced Guided Assistance

LEXI Co, Ltd.

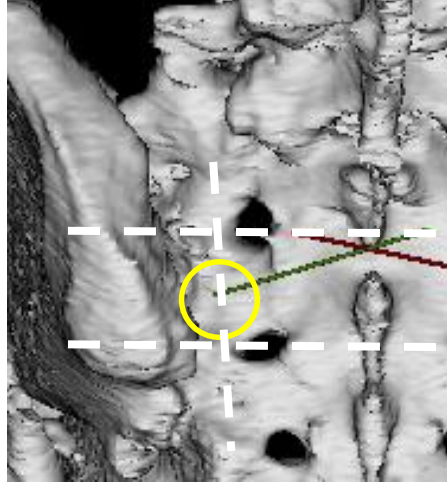


Methods (1)

Setting of ideal SAI screw from 2 entry points

Entry point [A]

the midline between the S1 and S2 forsal foramen meet the lateral sacral crest

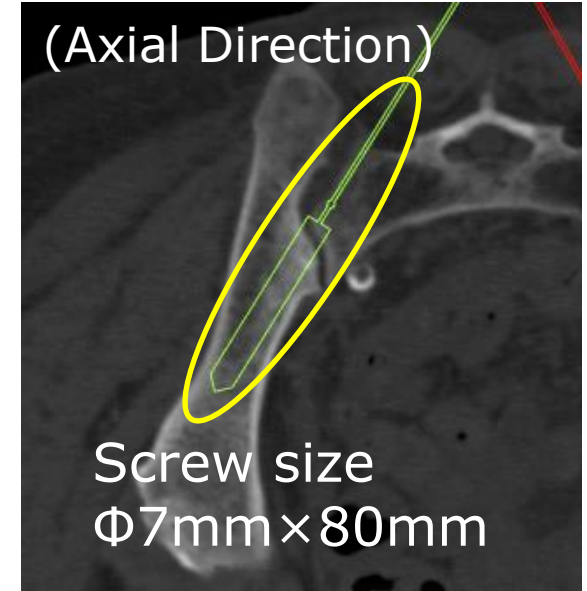
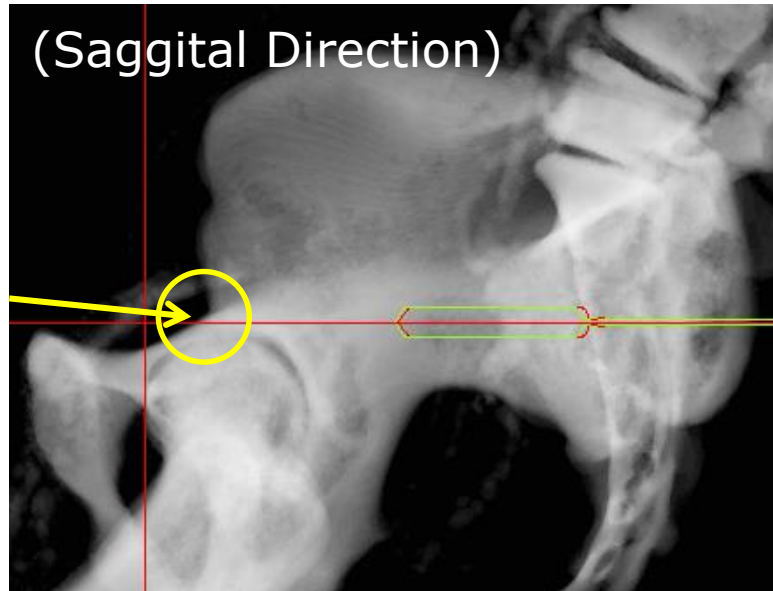


Entry point [B]

1 mm inferior and 1 mm lateral to the S1 dorsal foramen.



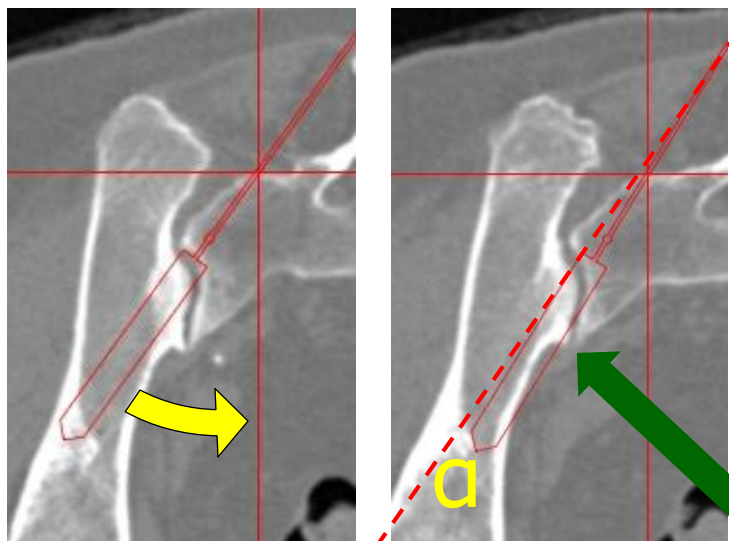
targeted the notch at the border of the anterior inferior iliac spine and the acetabulum



Methods (2)

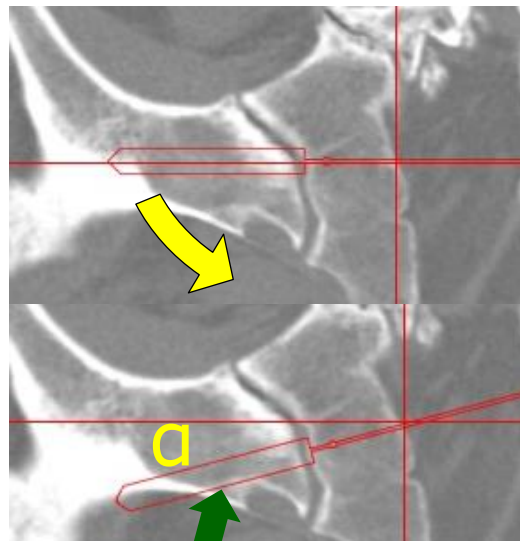
Setting of deviated SAI screws on anterior or caudal direction

● Anterior Deviation



Rotation from Entry Point of the Ideal Screw

● Caudal Deviation



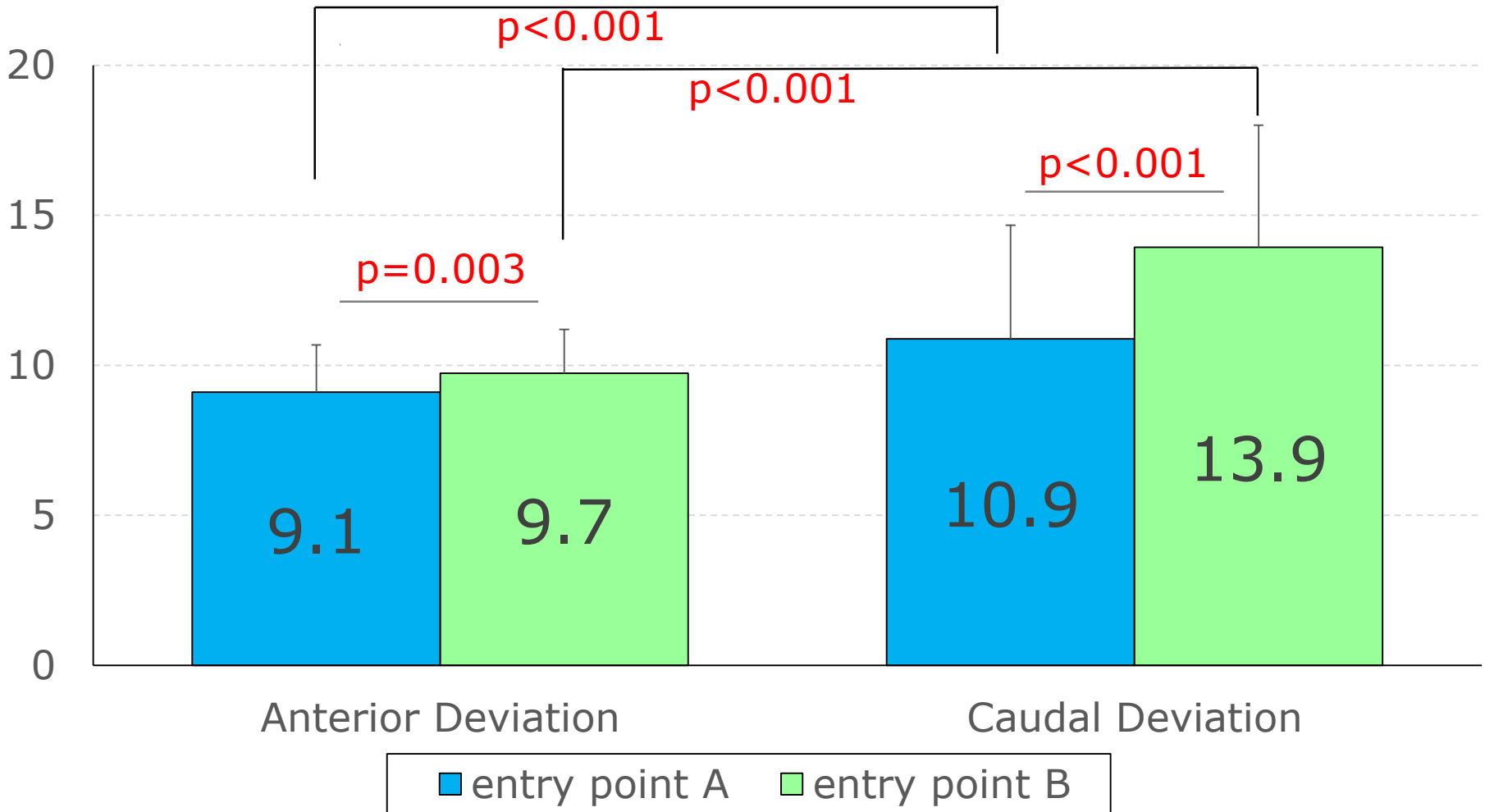
Deviated half thread of screw

● (a):
Safety Margin of the Screw

Analysis

The differences of safety margin were evaluated in terms of direction, laterality, sex, and entry point. Moreover, the cases with small safety margin were investigated in the point of the view of location of L5 vertebral body.

Results (1) Differences of safety margin of the SAI screw between directions, and between entry points



The safety margins of S2AI screws were smaller in the anterior direction than in caudal direction and by entry point A than by B.

Results (2) Differences of safety margin of the SAI screw in terms of laterality and sex

laterality	Entry point	Right	Left	p
Anterior deviation	A	9.3±1.4°	8.9±1.7°	0.207
	B	9.7±1.4°	9.7±1.5°	0.847
Caudal deviation	A	11.1±4.0°	10.7±3.6°	0.728
	B	14.3±4.4°	13.6±3.7°	0.357
Sex		male	female	p
Anterior deviation	A	9.3±1.6°	8.9±1.6°	0.102
	B	10.2±1.4°	9.3±1.4°	0.072
Caudal deviation	A	10.3±3.7°	11.4±3.8°	0.124
	B	13.6±4.2°	14.3±3.9°	0.287

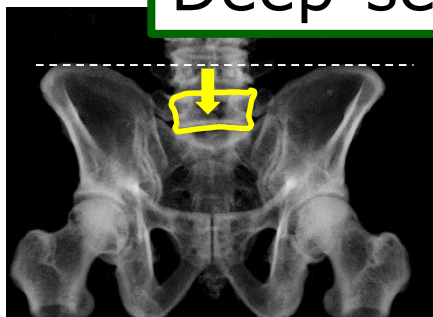
There were no differences in laterality and sex among screws with the exception of a negligible sex difference in anterior deviation at entry point B



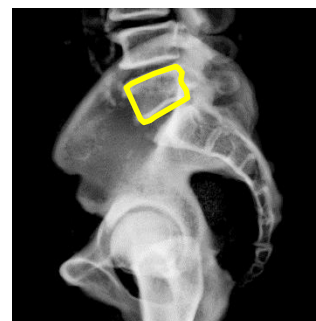
Results (3)

Cases with small safety margin; Focusing **Deep-seated L5**

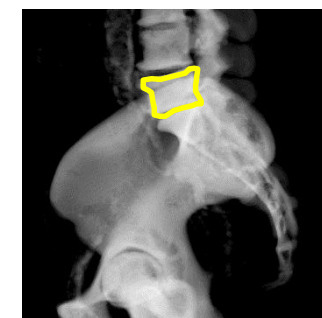
Deep-seated L5



the superior endplate of L5 existed below the intercrestal line (Jacoby's line)

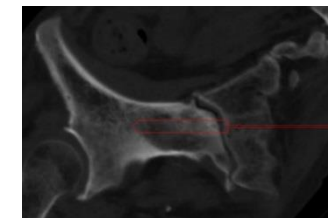
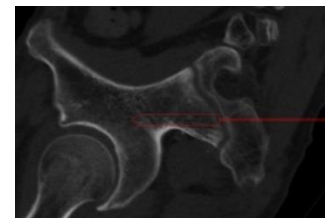
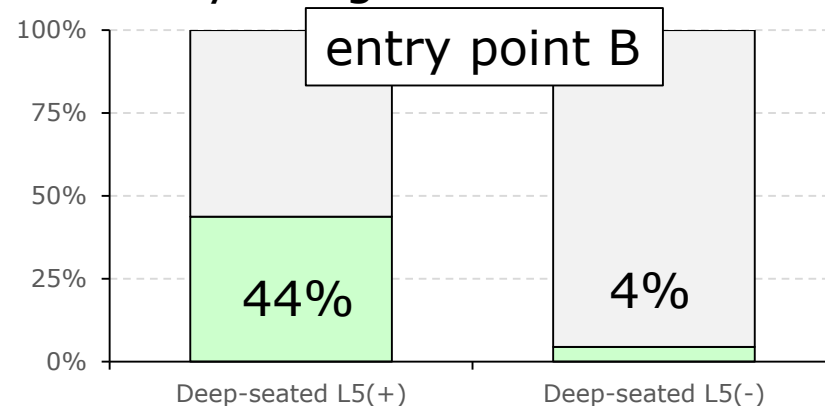
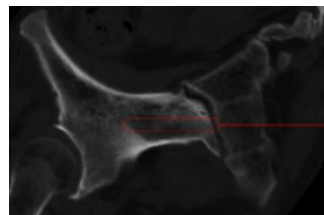
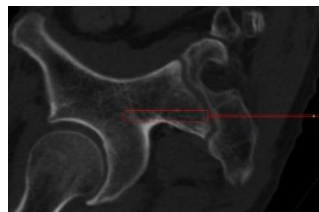
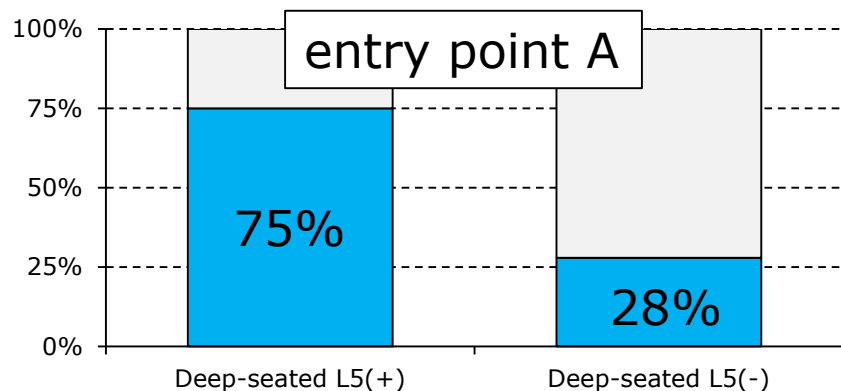


Deep-seated L5 (+)
N=16



Deep-seated L5 (-)
N=34

Rate of cases with a caudal safety margin $<10^\circ$

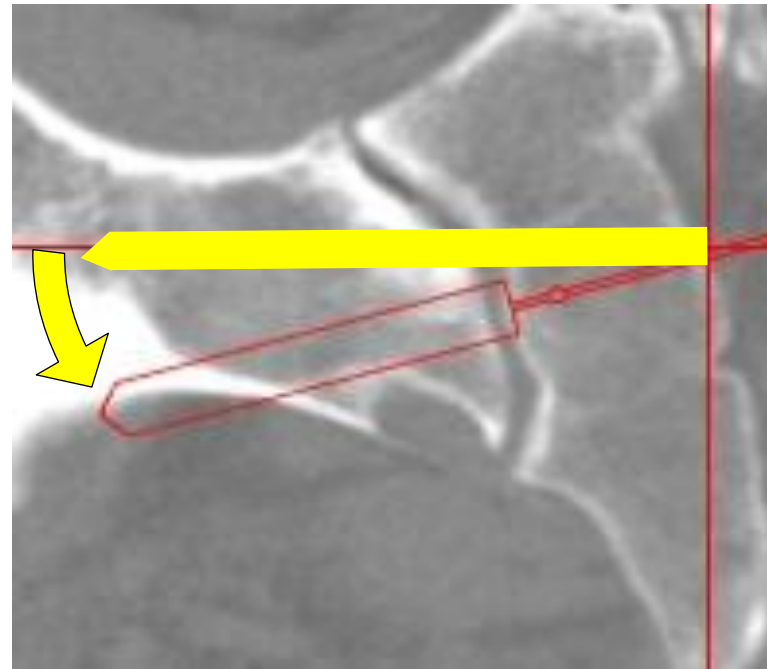
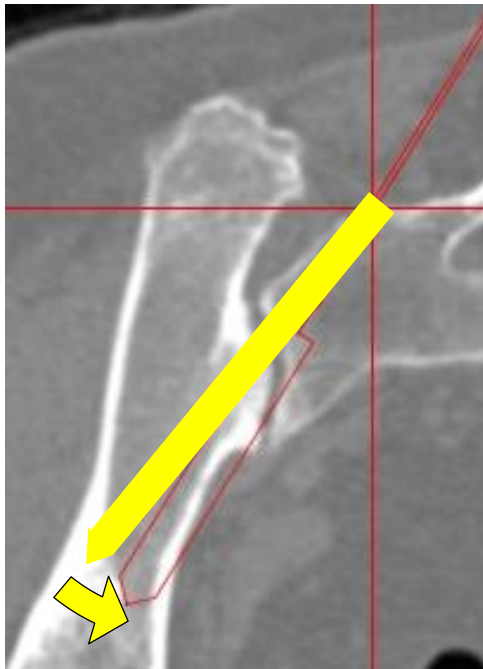


A caudal safety margin of $<10^\circ$ from entry point A was observed in 75% of cases with a deep-seated L5 (+), which was significantly higher than 27.9% for cases with deep-seated L5 (-) ($p < 0.001$).

Conclusion (1)

Safety margin for SAI screws

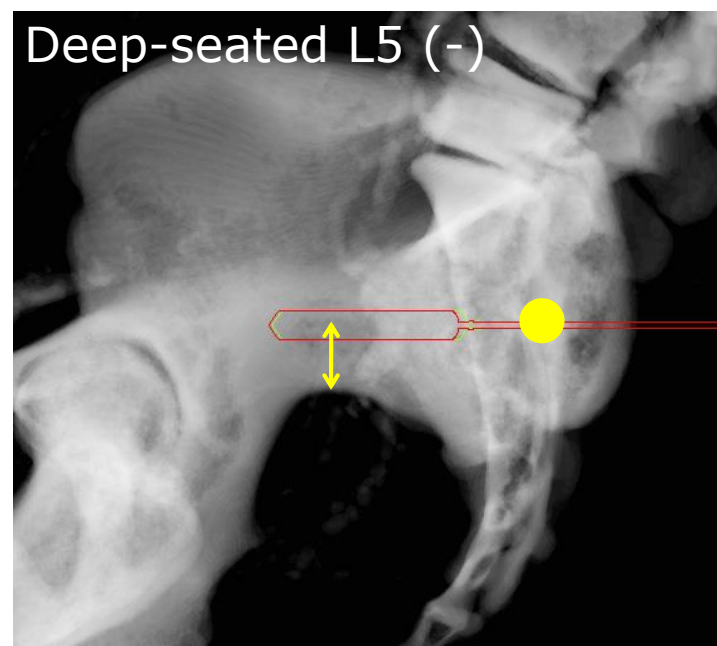
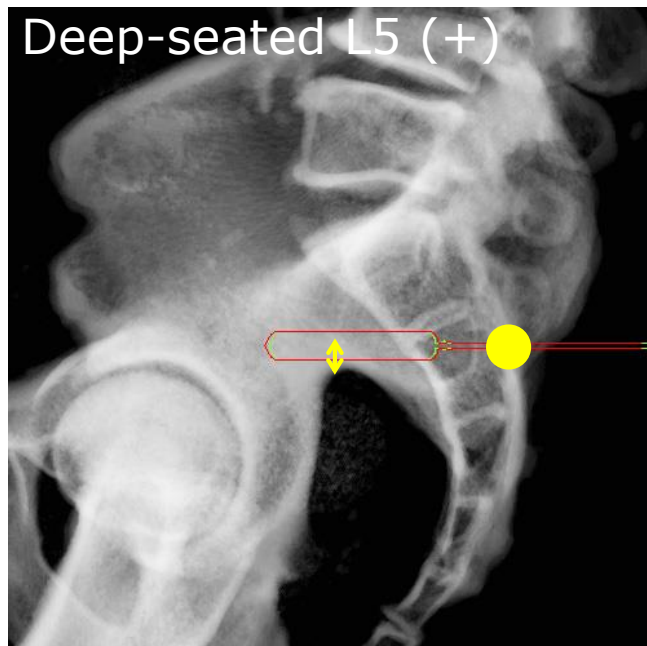
- This study indicated the safety margins of SAI screws were smaller in anterior direction than in caudal direction. **Therefore, Surgeon should take care of anterior direction at the screw insertion.**
- **In terms of the safety margin between entry points, entry point A had small safety margin than B, however, the difference was negligible small.**



Conclusion (2)

Cases required special attention for caudal deviation.

- Patients with deep-seated L5 have smaller safety margin in caudal direction than those without deep-seated L5.
- This phenomenon could explain the relative locational relationship between the screw and pelvis. Since the sacrum with deep-seated L5 is located more caudally against the pelvis than those without deep-seated L5, S2AI screws deep-seated at L5 pass more caudally in the ilium than those without deep-seated L5 and closer to the greater sciatic notch.
- Patients with deep-seated L5 should be avoid from entry point A, and screw should be targeted more cranial than usual.



Conflict of Interest

All authors have declared no funding or conflict of interest in this study.

