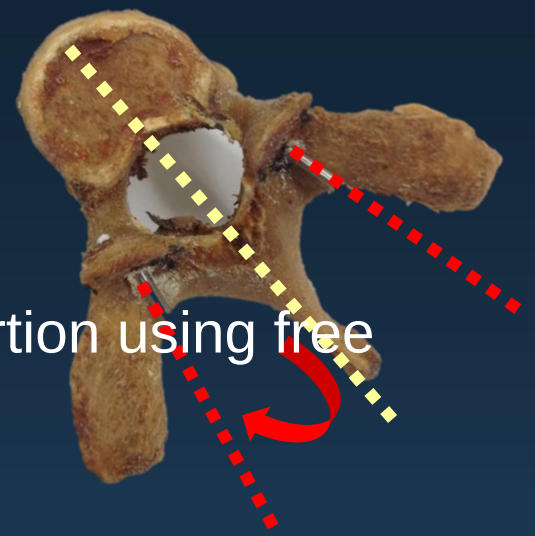
Pedicle Screw Insertion: Novel Method of 3-Dimensional Trajectory for Free-Hand Technique Using Superior Articular Process as a Landmark in Thoracic Vertebrae

[1]Tae Hoon Kim, [2]Min Seok Kang, [1]In Seok Son,
[1]Suk Ha Lee, [3]Seung Woo Suh, [4]Jin Ho Hwang

[1]Department of Orthopedic Surgery, Konkuk University School of Medicine
[2]Orthopedic Surgery, Seoul Red Cross Hospital
[3]Department of Orthopedic Surgery, Korea University, Guro Hospital
[4]Orthopedic Surgery, CM General Hospital

TH Kim

INTRODUCTION



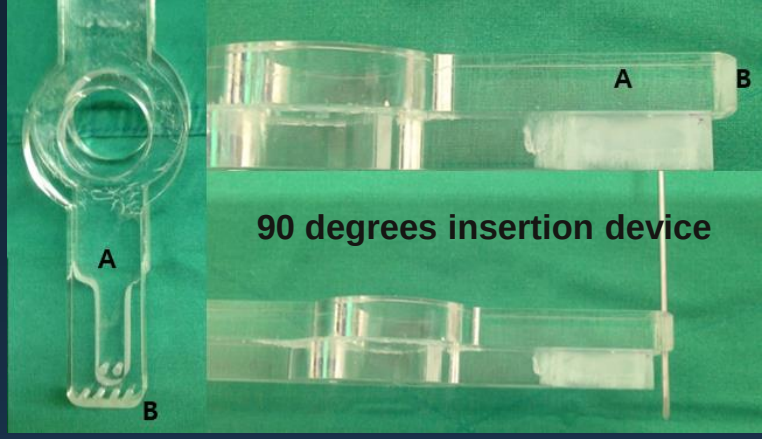
- The ideal point and trajectory of pedicle screw insertion using free hand technique has been debated considerably.

- Providing proof of the existence of constant angular relationship (trajectory) between the pedicle and a specific anatomical landmark which does not change with the thoracic levels should simplify the pedicle screw insertion.

➢ ***Purpose : To find a constant angular relationship between the superior articular process (SAP) and the axis of pedicle (90°) for thoracic pedicle screw insertion and define new safe and reliable trajectory by cadaveric study.***

TH Kim

MATERIALS AND METHODS



- **<u>220 pedicles of ten embalmed cadavers</u>**
  with negative medical history divided from T1 to T11
- Male : Female = 5 : 5, Age : avg. 33.9 (27~40) years
- To insert pins through SAP perpendicularly, a special device was engineered and three surgeons inserted pins randomly (figure).

- The length of the inserted pins **<u>(Real Chord Length=RCL)</u>** was measured and the **<u>spinal canal violation</u>** was examined grossly and confirmed with CT scan. To obtain the anatomical data of SAP, **<u>SAP width (SW), SAP tilting (ST) and Midline reference angle (MRA)</u>** were measured.
- Accurate perpendicular pins insertion was analyzed statistically using Kolmogorov-Smirnov test and one sample *t*-test.

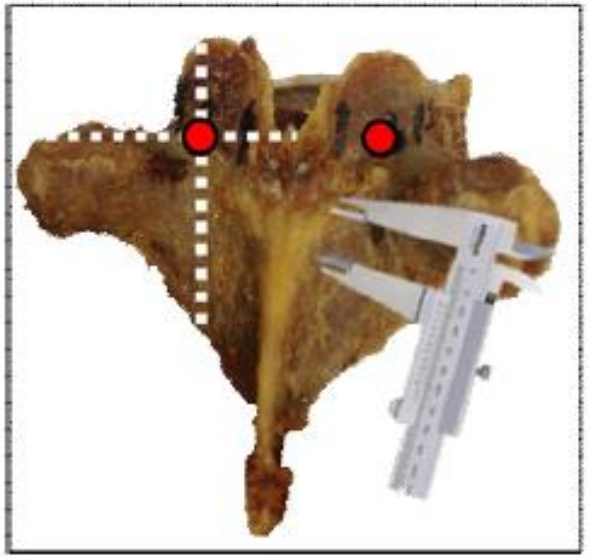
PROCEDURES of PIN INSERTION by 90 Degrees Insertion Device

I. Entry point

Vernier calliper

T1,2,3 : 60%

T4~11 : 30%

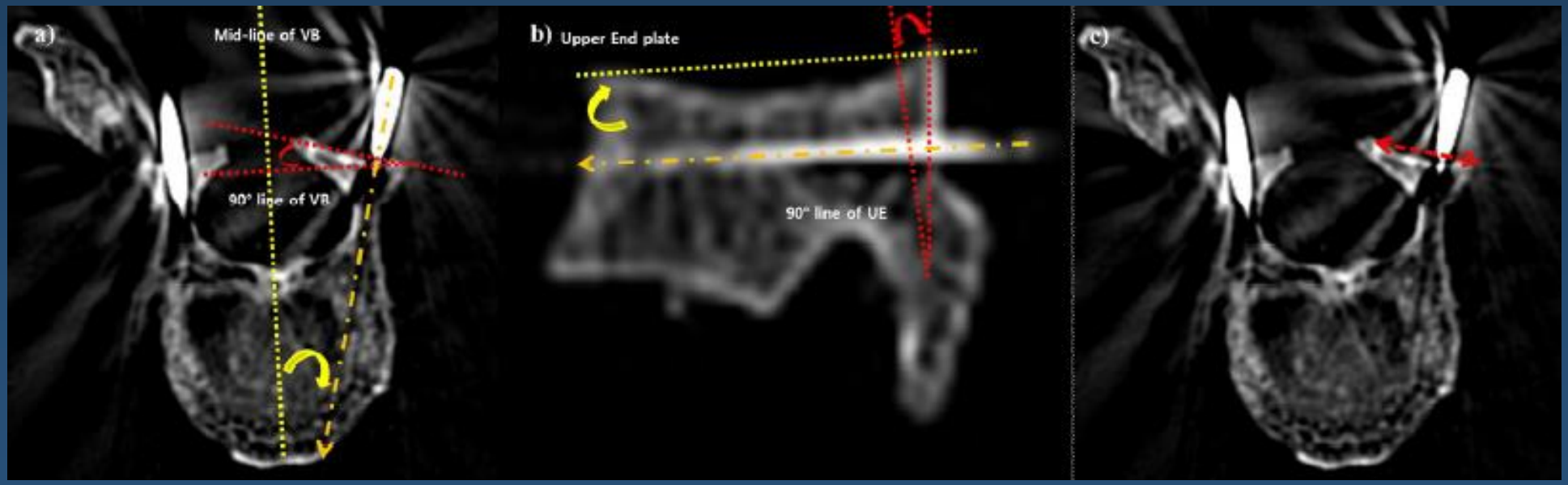


II Put device on vertebra

III 2 mm pin insertion

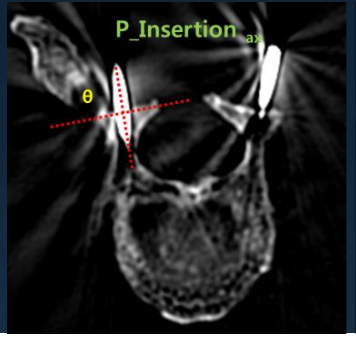
The Definition of “SAP Tilting (ST), Midline Reference Angle (MRA), and SAP width (SW)”

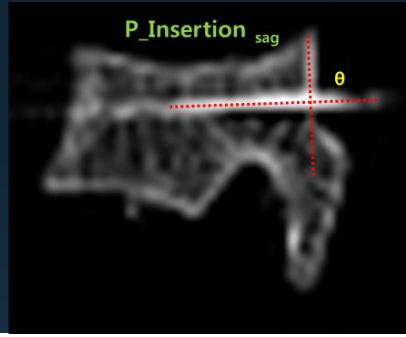
- **SAP Tilting Ax** (in axial CT image): defined as the angle (red curved arrow) between the perpendicular line to the bisector of the vertebral body and the horizontal line of the SAP.
- **Mid Ref Ang Ax** (in axial CT image)**:** defined as the angle (yellow curved arrow) created by the perpendicular line (Orange dot arrow) to the SAP and bisector of each vertebral body.
- **SAP Tilting Sag** (in sagittal CT image)**:** defined as the angle (red curved arrow) created between the horizontal line to the end-plate and the horizontal line of SAP.
- **Mid Ref Ang Sag** (in sagittal CT image)**:** defined as the angle (yellow curved arrow) created between the horizontal line to the end-plate and the horizontal line of SAP
- **SAP width** (in axial CT image): defined as the longest length of SAP.

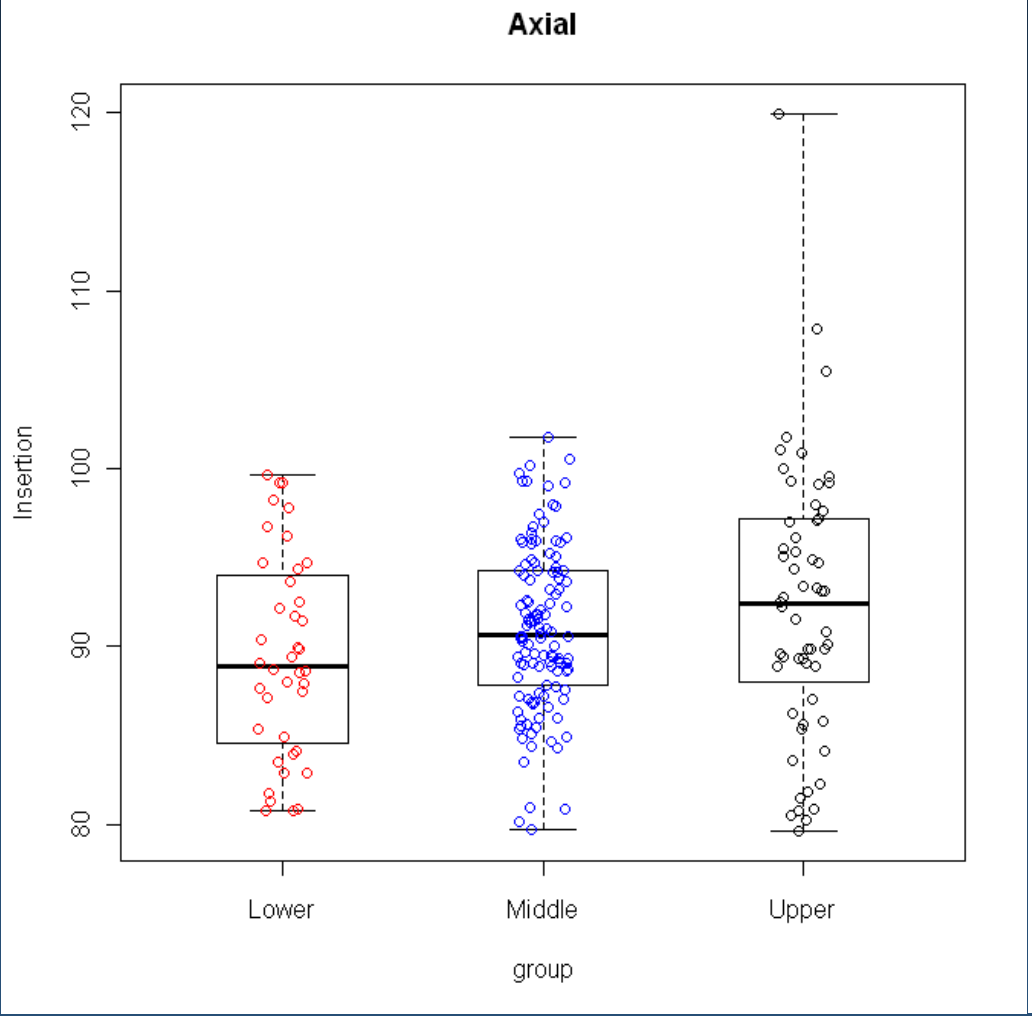


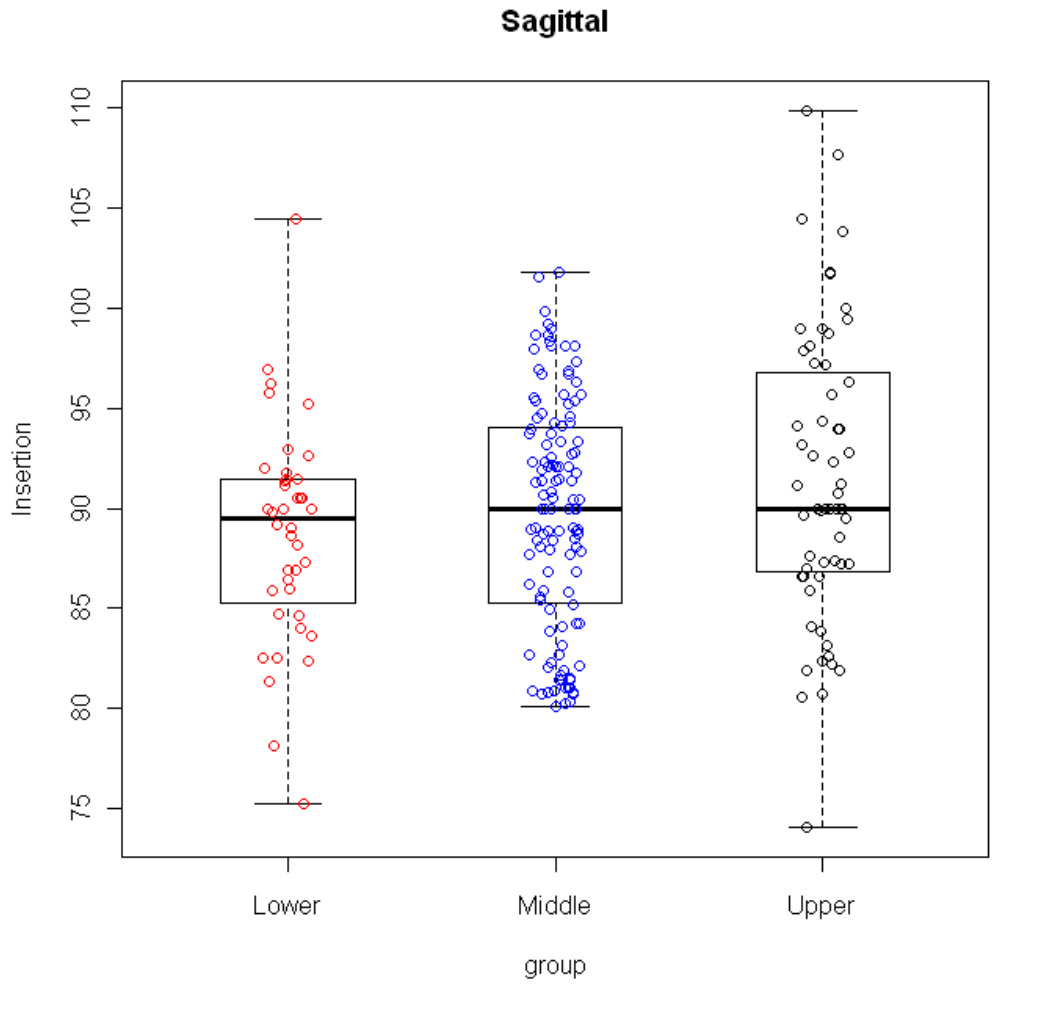
Insertion Angle 90° ?

* Kolmogorov-Smirnov test : data distribution
* One sample t-test



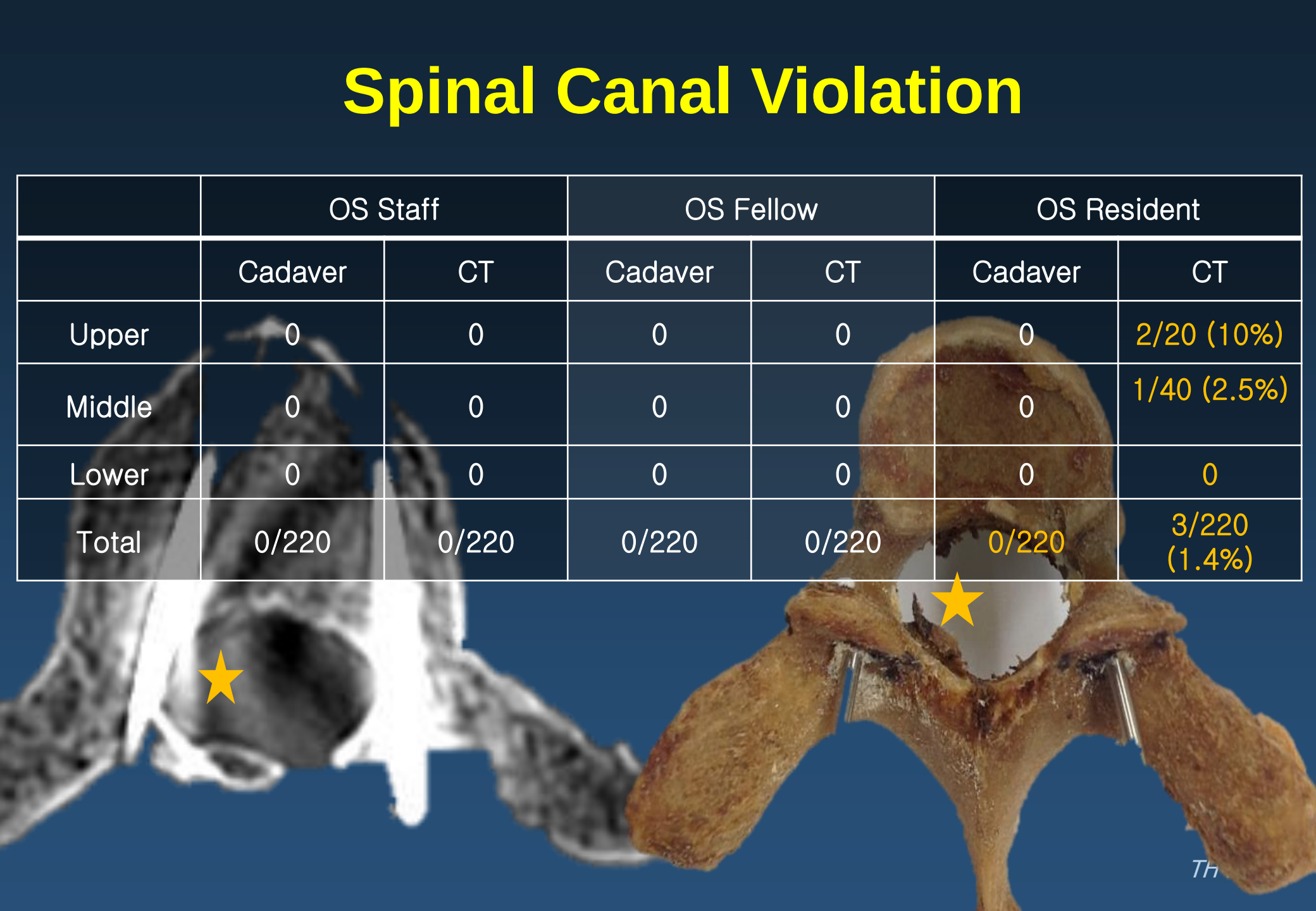




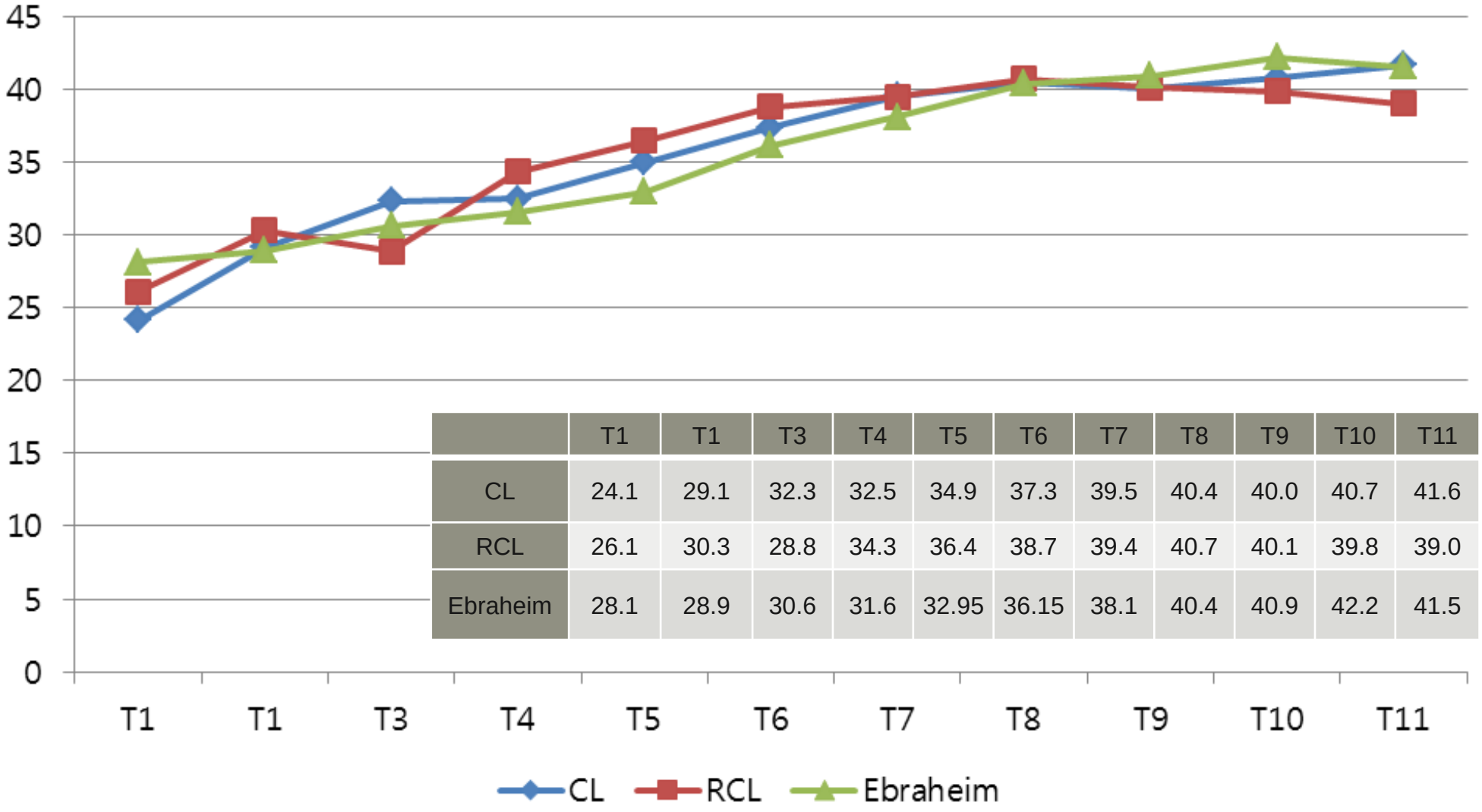


Spinal Canal Violation

	OS Staff		OS Fellow		OS Resident	
	Cadaver	CT	Cadaver	CT	Cadaver	CT
Upper	0	0	0	0	0	2/20 (10%)
Middle	0	0	0	0	0	1/40 (2.5%)
Lower	0	0	0	0	0	0
Total	0/220	0/220	0/220	0/220	0/220	3/220 (1.4%)

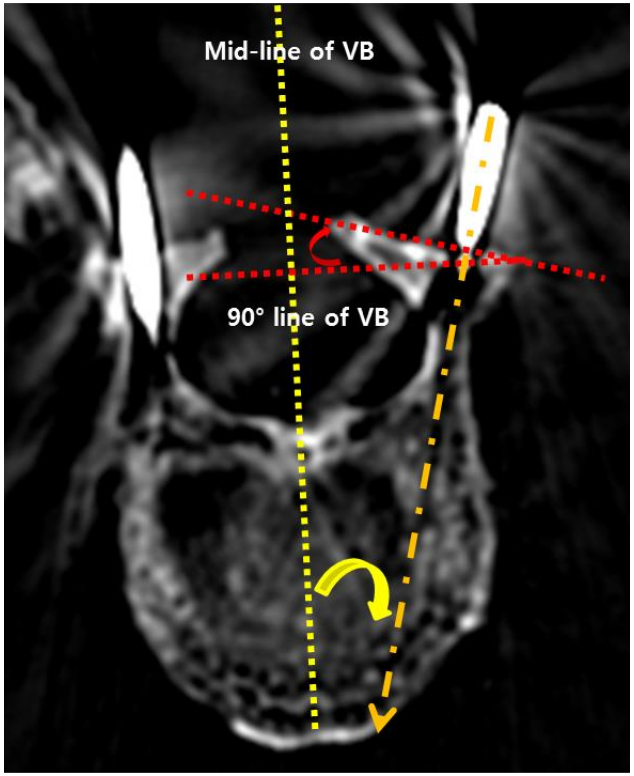


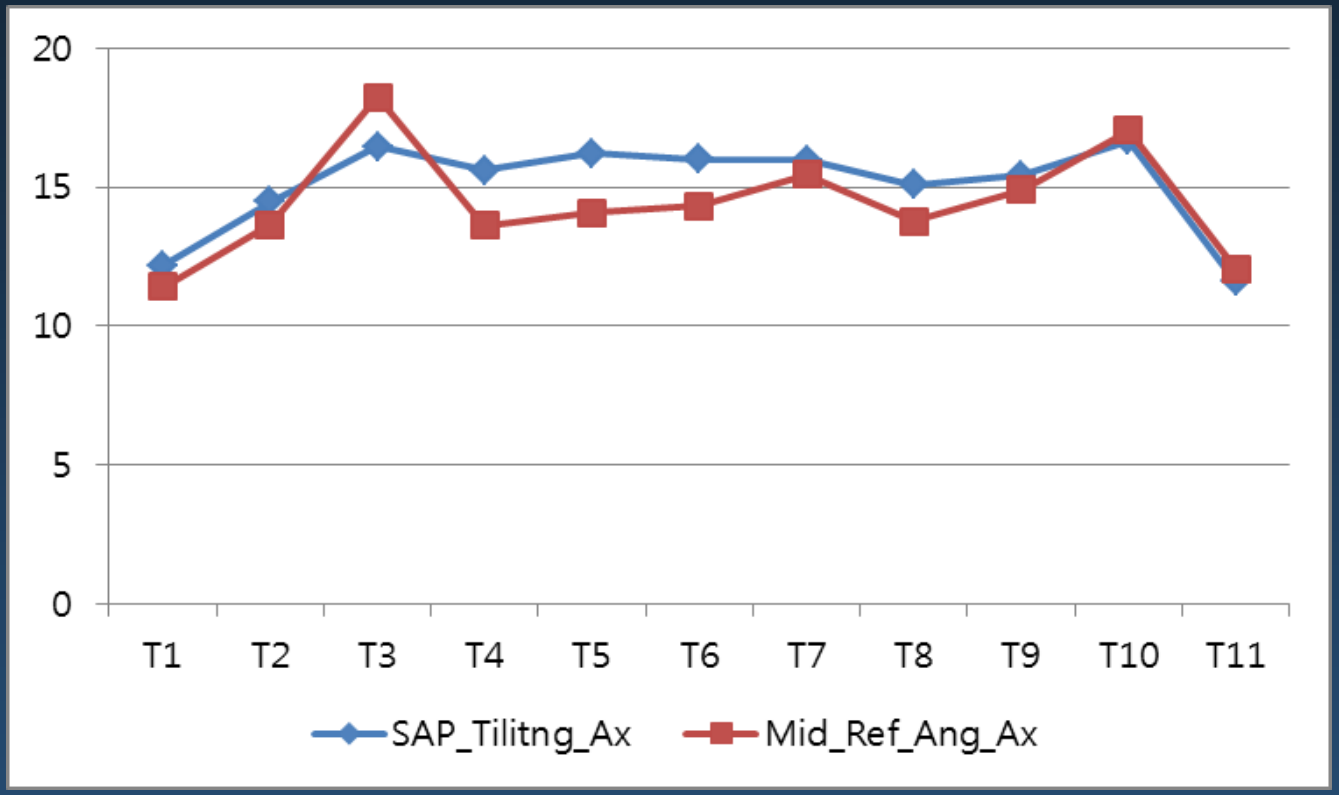
Chord Length vs. RCL vs. Ebraheim



	T1	T1	T3	T4	T5	T6	T7	T8	T9	T10	T11
CL	24.1	29.1	32.3	32.5	34.9	37.3	39.5	40.4	40.0	40.7	41.6
RCL	26.1	30.3	28.8	34.3	36.4	38.7	39.4	40.7	40.1	39.8	39.0
Ebraheim	28.1	28.9	30.6	31.6	32.95	36.15	38.1	40.4	40.9	42.2	41.5

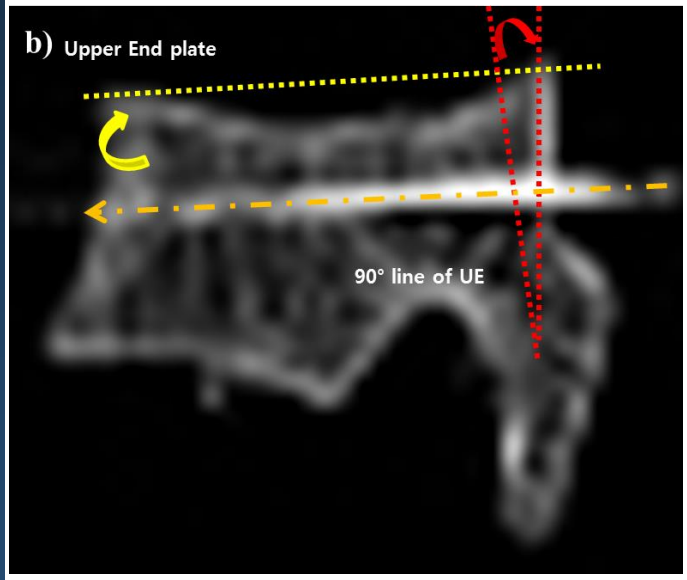
SAP Tilting Ax vs. Mid Ref Ang Ax

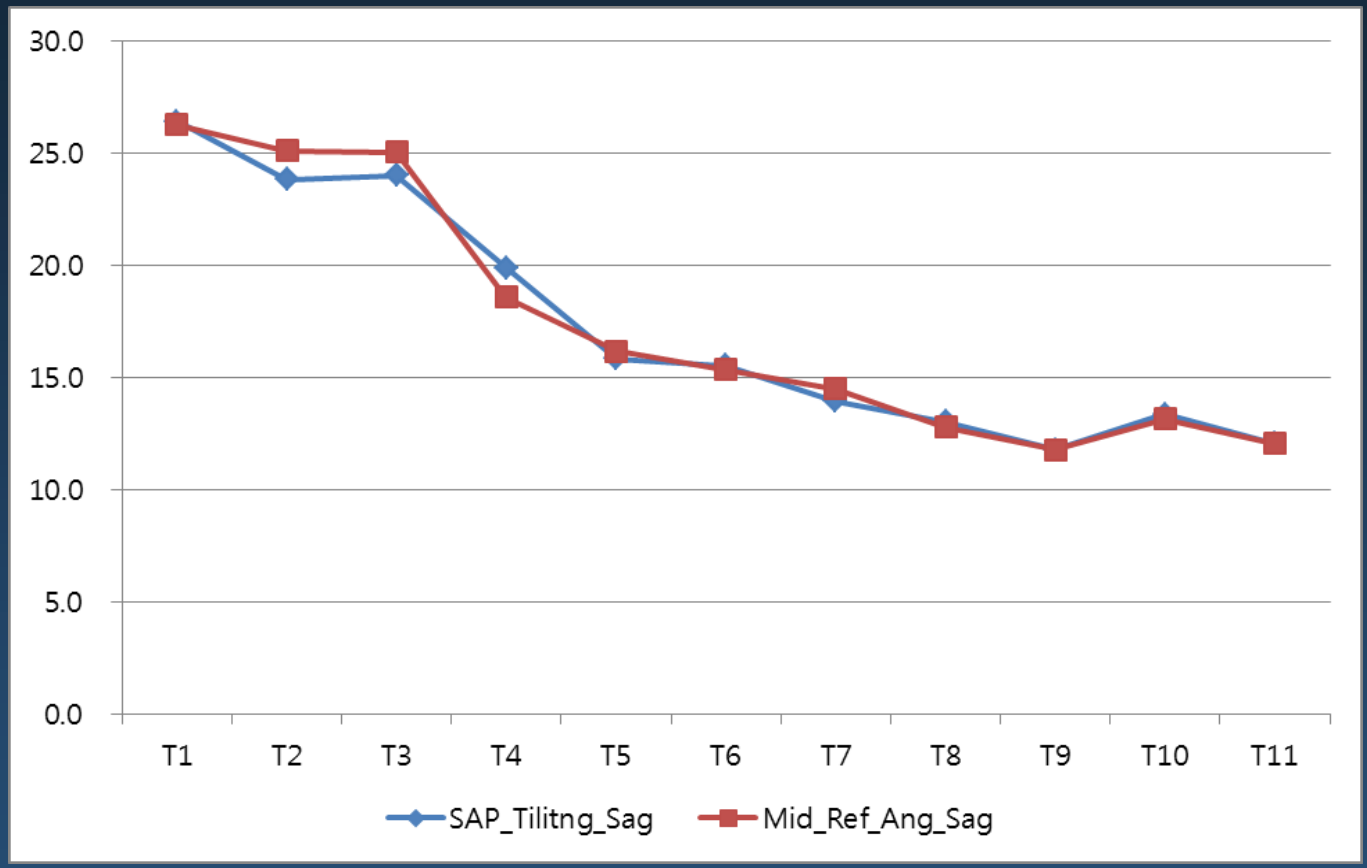




	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	평균
SAP Tilitng Ax	12.1	14.4	16.4	15.6	16.2	16	15.9	15	15.4	16.6	11.6	**15.1**
Mid Ref Ang Ax	11.4	13.65	18.2	13.6	14	14.3	15.4	13.7	14.9	17	12	**14.4**

SAP Tilting Sag vs. Mid Ref Ang Sag



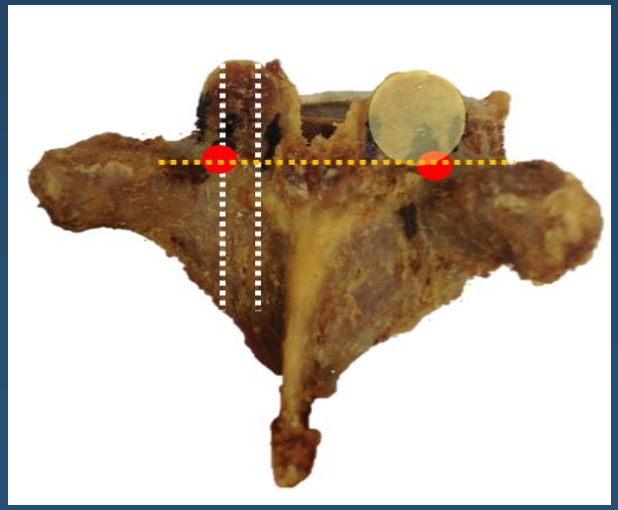


	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	평균
SAP Tilitng Sag	26.4	23.8	24	19.8	15.8	15.5	13.9	13	11.7	13.3	12.0	**17.2**
Mid Ref Ang Sag	26.2	25.1	25.0	18.5	16.1	15.3	14.4	12.7	11.7	13.1	12.0	**17.3**

CONCLUSION

- Through the cadaveric study, it is proved that there was ***a constant angular relationship between SAP and the axis of pedicle*** in thoracic spine. Moreover, we have confirmed that there were ***no spinal canal violations when pins were inserted at 90 degrees to SAP***.

- Therefore, ***SAP perpendicular trajectory is a highly useful reference point and a novel method for inserting pedicle screw*** in thoracic vertebrae in free-hand technique.



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My disclosure is in the EUROSPINE Program Book.

None of the authors has any potential conflict of interest