

c - (c-arm fluoroscopy)



Thoracic Pedicle Screw Insertion in Scoliosis Using Posteroanterior C-arm rotation Method

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– Abstract –

Study Design: A prospective study of the accuracy of thoracic pedicle screws inserted in scoliotic patients.

Objectives: To evaluate and present a practical, safe and accurate method for thoracic pedicle screw insertion in the surgical treatment of scoliosis using the posteroanterior c-arm fluoroscopy rotating method.

Summary of Literature Review: Previous studies have emphasized the clinical importance, yet difficulty, of accurate thoracic pedicle screw insertion in scoliotic patients. Three-dimensional alterations in the pedicle orientation of scoliotic patients makes the accurate insertion challenging. No reports exist on the accuracy and benefits of posteroanterior c-arm fluoroscopy, which is rotated to allow visualization from en face, in real patients.

Materials and Methods: A total of 350 thoracic pedicle screws were inserted in 29 patients, including 24 with idiopathic scoliosis, using the posteroanterior (PA) c-arm rotation method. The smallest patient weighed 14 kg and the next smallest 17 kg. The average preoperative curve was 60.9 ° (range, 45 ~101 °). CT scans were taken, postoperatively, in the transverse and sagittal sections to evaluate the pedicle screw placement.

Results: The mean preoperative curve of 60.9 ° was corrected to 15.4 ° (range, 3 ~45 °) in the coronal plane, a correction of 74.7%. A mean of 12.1 thoracic screws were inserted per patient. On analysis of the postoperative CT scans, 39(11.1%) of the 350 screws penetrated the medial or lateral pedicle cortices, 8(2.3%) into the medial cortex and 31(8.9%) into the lateral cortex, by mean distances of 3.3 and 3.6 mm, respectively. No screws penetrated the inferior or superior cortices in the sagittal plane, but 16(4.6%) penetrated the anterior cortex. No neurological or vascular complications were encountered, and none of the screws required subsequent replacement.

Conclusions: Thoracic pedicle screw insertion in scoliotic patients, using a posteroanterior c-arm rotation method, allows the en face visualization of both pedicles by rotating the c-arm to compensate for rotational deformity, which makes it a practical, simple and safe method.

Key Words: Scoliosis, Thoracic pedicle screw, C-arm fluoroscopy rotating method

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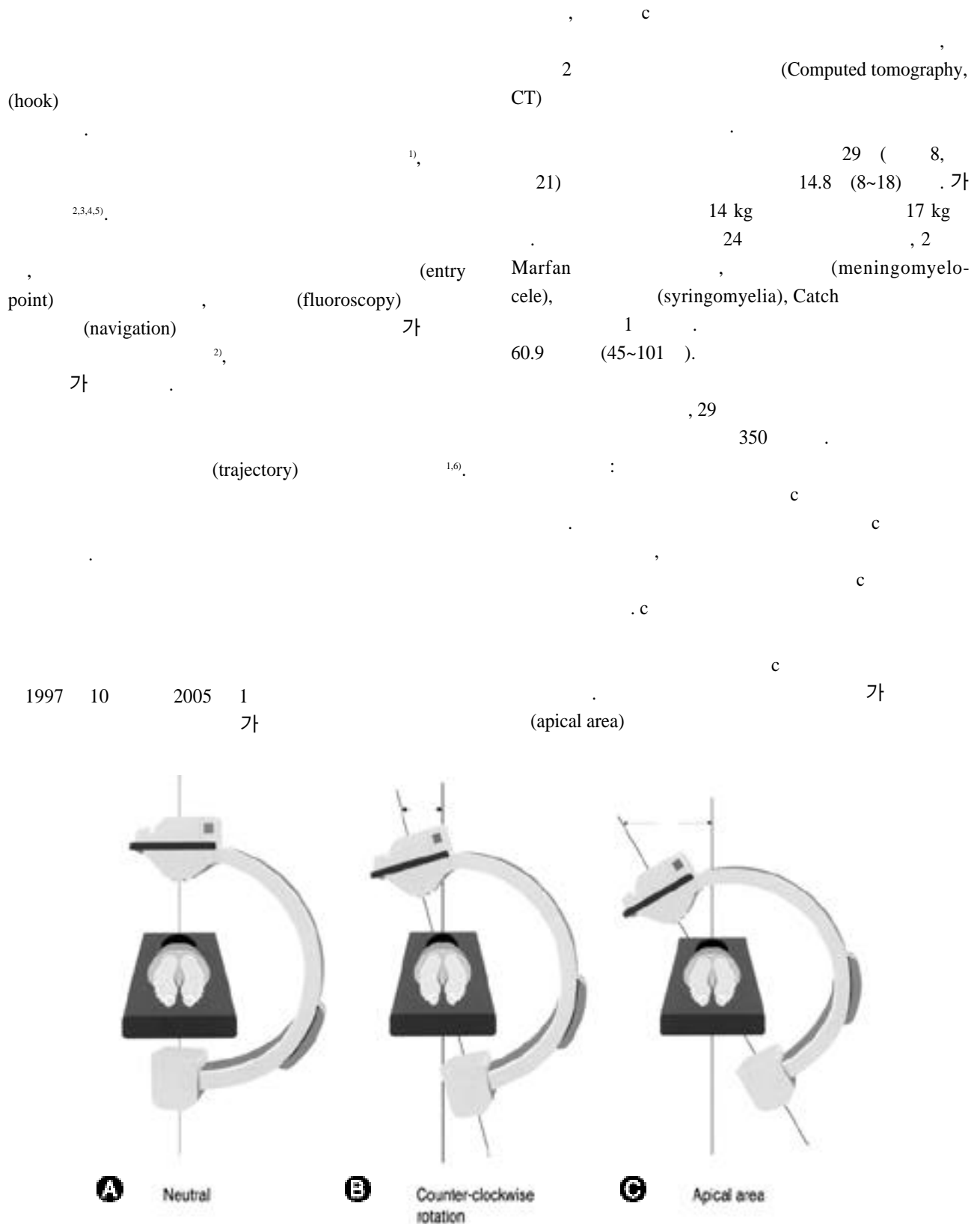


Fig. 1. Positioning of the c-arm. (A) Place in the posteroanterior position. (B) Rotate the c-arm according to the rotation of the pedicles until they are seen symmetrically on both sides. Most patients require counter-clockwise rotation (when viewed from the feet). (C) More counter-clockwise rotation is usually required at the apical vertebra.

c 가 CT (Somatom Sensation 16, Siemens, Erlangen, Germany, 2002) (chord length),

(Fig. 1). c 가

2 CT

가 (entry 가

point) 10 , 2

7), 1.2 mm K c

(Fig. 2).

(trajectory)

(Fig. 3,

4).

60.9 (45~101)

15.4 (3~45) 74.7%

12.1 ,

350

. : T3, n=7 ; T4, n=38 ; T5, n=37, ; T6, n=40 ; T7, n=39 ;

(rod) . K T8, n=37, T9, n=34, ; T10, n=41 ; T11, n=39 ; T12, n=38.

2 mm drill : CT 350

, (blunt tip probe) 가 39

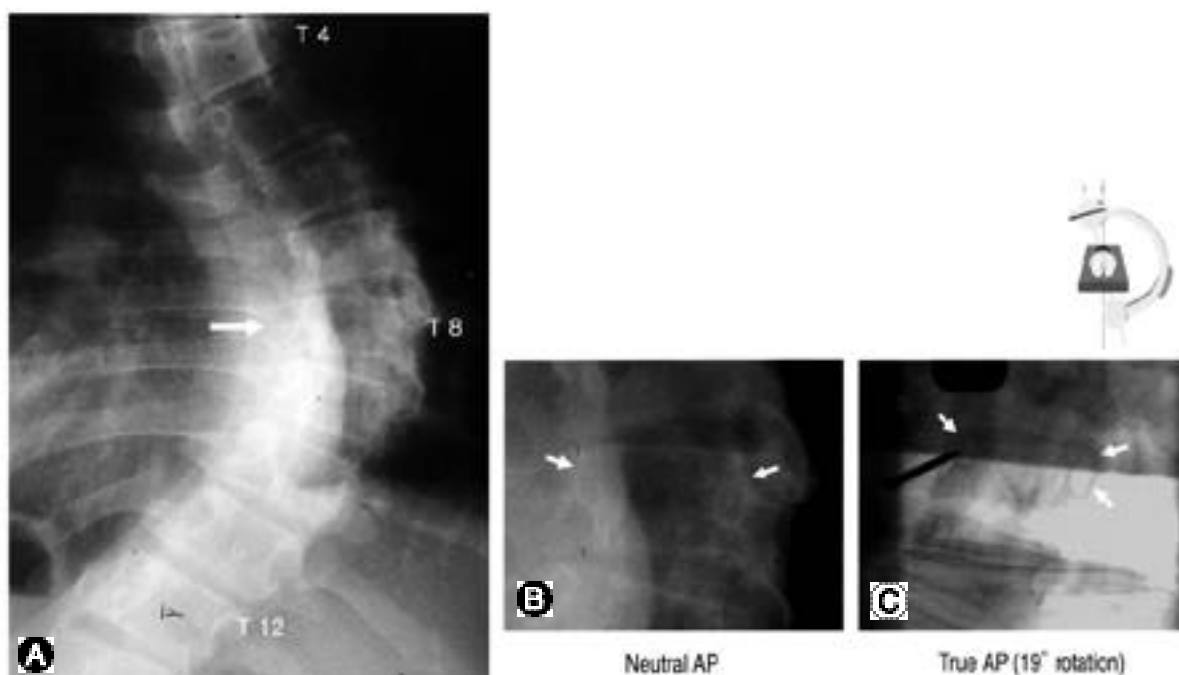


Fig. 2. (A) Case with a 69 degrees Cobb 's angle. (B) Without c-arm rotation, posteroanterior fluoroscopy reveals asymmetrical visualization of both pedicles with a Nash-Moe grade II deformity. (C) 19 degrees counter-clockwise rotation of the c-arm provides en face visualization of both pedicles. This image is familiar to spine surgeons and entry sites for pedicle screw insertion is now easily determined. Entry of the right pedicle at 10 o 'clock and the left pedicle at 2 o 'clock is initiated.

8 (2.3%) 3.3 mm , 20
 7 가 2~4 mm, 1 가 4~6 mm
 31 (8.9%) 3.6 mm
 24 가 2~4 mm, 7 가 4~6
 mm
 (4.6%) 7.6 mm 16 가
 C :
 (perforation rate) 14~69%
 (transverse diameter)
 (trajectory) . Vac-
 0.45 가 c caro, Zindrick 4
 가 4.5 mm 가 , 12 7.8 mm
 29 c 가
 가 Fig. 5 100 30 가 (medial

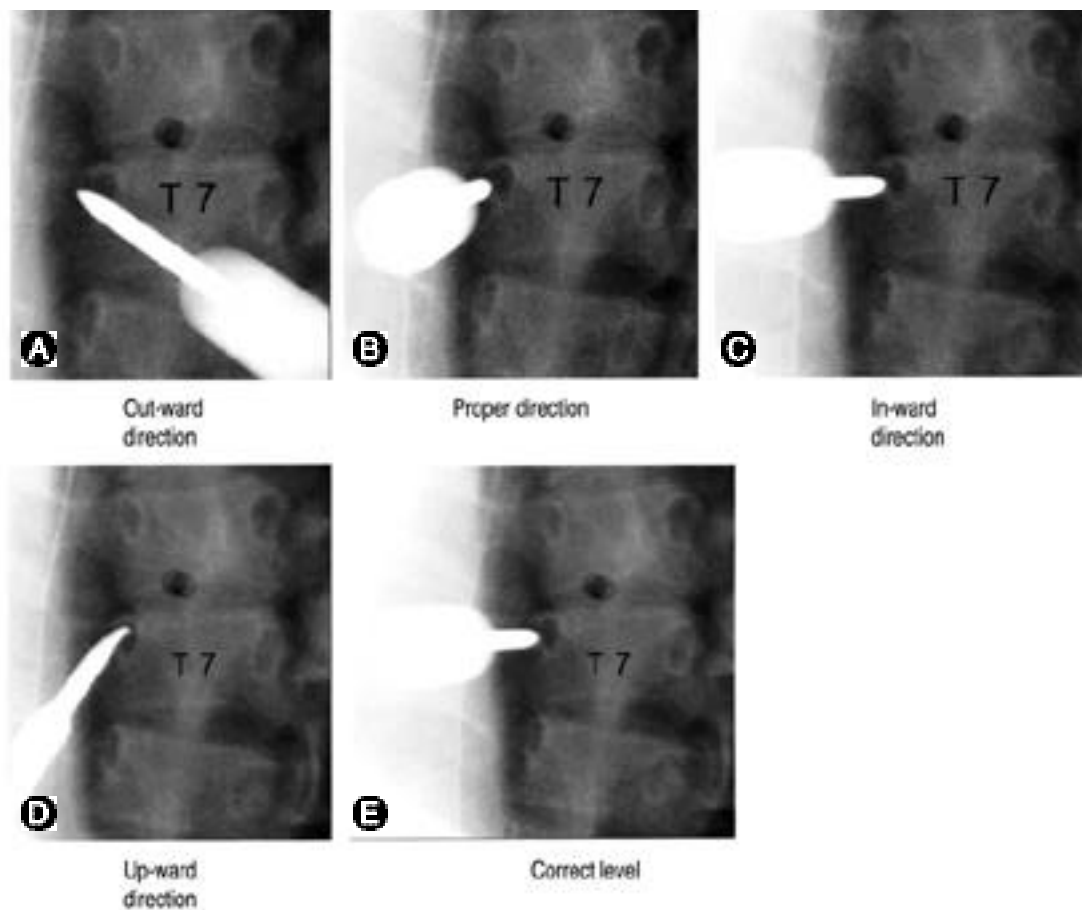


Fig. 3. Pedicle screw trajectory can be evaluated with the PA imagery because insertion is performed with both pedicles en face. (A) Axial image revealing: lateral deviation of screw trajectory. (B) Proper trajectory. (C) Medial deviation. (D) Up-ward direction. (E) Correct trajectory.

6)

. IGSS 3 57%

CT (CT based 3 dimensional navigation)¹⁸⁾ 2

(fluoroscopy based 2 dimensional navigation virtual fluoroscopy)¹⁵⁾ 가 가 . Youkilis¹⁹⁾ CT

(significant violation)가 2.5%

가 data (registration process)

, hardware software (Fig. 5, 6). c

가 Fig. 5 20

c (c-arm fluoroscopy) Belmont

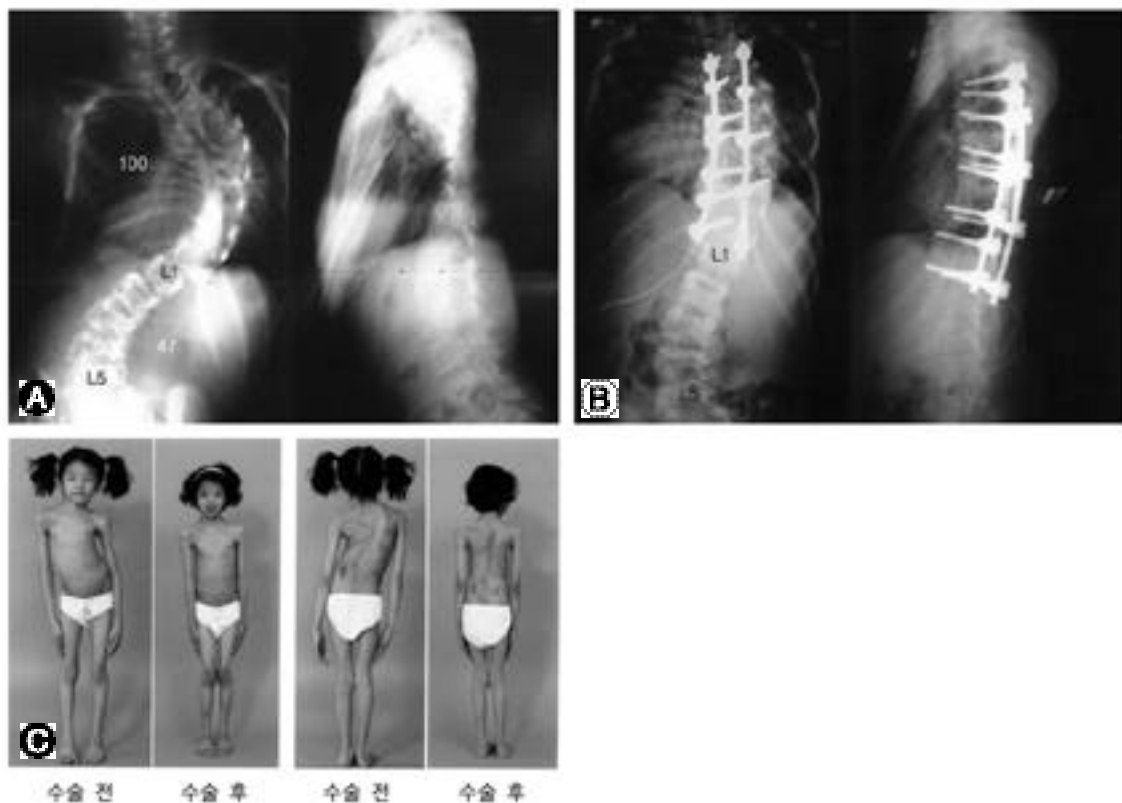


Fig. 5. A 14 kg scoliosis patient using the rotating posteroanterior c-arm fluoroscopic guidance technique. (A) The patient with severe imbalance and a Cobb's angle of 100 degrees. (B) Pedicle screws used to correct the thoracic curve. (C) Improvement of truncal imbalance post-operatively.

가 . Lenke ¹⁵⁾

가

가

가

가

fluoroscopy

(virtual fluoroscopy)

가

가

Lenke ¹⁵⁾

1.4~14%,

가 1~8 mm

0~0.9% ,

Lenke ¹⁵⁾

가

가

가

가

(plastic deformation) 가

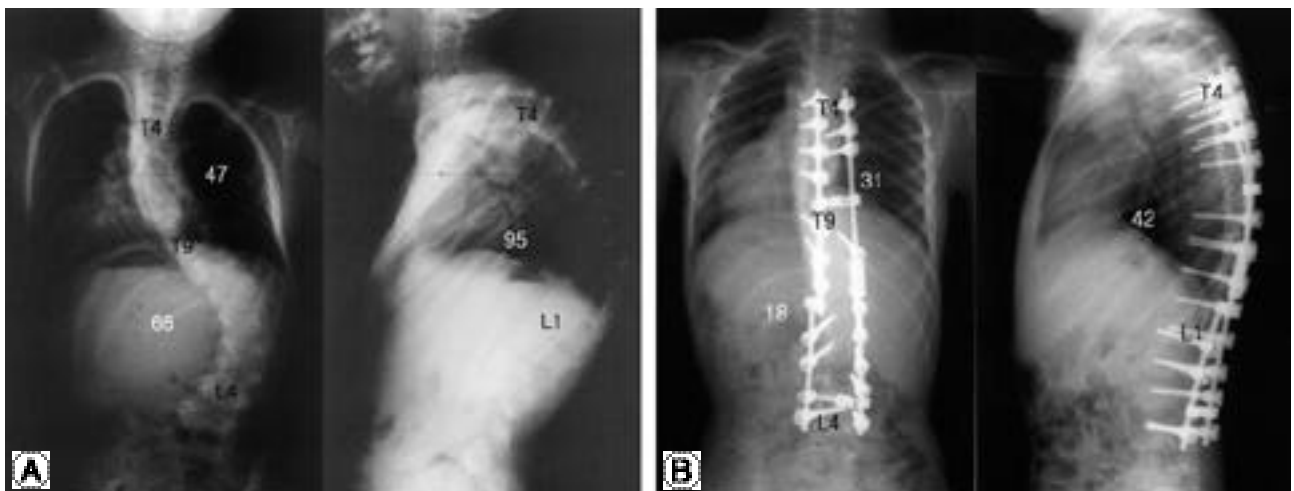


Fig. 6. A 17 kg kyphosis patient using the rotating posteroanterior c-arm fluoroscopic guidance technique. **(A)** The patient with 95 degrees kyphosis and 47 degrees scoliosis of the thoracic spine. **(B)** An almost normal curvature after pedicle screw insertion and correction of T4-L4.

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:

: c

:

c

29

350

: 350

39

(11.1%)

.8

(2.3%)

, 31

(8.9%)

.16

(4.6%)

7.6

mm

,

.

:

c

c

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