ORIGINAL ARTICLE

Acta Orthop Traumatol Turc 2014;48(5):479-482
doi: 10.3944/AOTT.2014.13.0046

Role of surgeon handedness in transpedicular screw insertion

Onur YAMAN[1], Emre ACAROĞLU[2]

[1]Tepecik Training and Research Hospital, Department of Neurosurgery, Izmir, Turkey;
[2]Ankara Spine Center, Ankara, Turkey

Objective: The aim of this study was to determine the role surgeon handedness plays in transpedicular screw placement.

Methods: The study included 269 pedicle screws inserted by two right-handed surgeons who stood on different sides of patients and used the free-hand technique. A parallel line was drawn to the endplate of the vertebrae on lateral radiograph. Measurement was made to observe the angle between the screw and the line parallel to the endplate. Angles were classified as cranial '+' when the tip of the screw stood above the endplate line and as caudal '-' when it stood below the endplate line. Angles of screws placed from the right side were compared to those placed from the left.

Results: On the left side, 80 screws (58.4%) were classified as cranial and 82 screws (62.1%) on the right side were classified as caudal. The difference in orientation was statistically significant ($p<0.0001$).

Conclusion: Surgeon handedness appears to have an influence over the orientation of pedicle screws. This may create problems for right-handed surgeons in the insertion of upper level screws from the left side and lower level screws from the right side. Based on this finding, it may be necessary to include ambiguity in handedness as a part of pedicle screw insertion training for spinal surgeons.

Key words: Handedness; insertion; pedicle; screw.

Transpedicular screw placement is one of the most commonly performed procedures in spinal surgery practice. Pedicle screws are widely used for deformity correction and spinal colon stabilization. Screws provide a stronger stabilization of the vertebrae compared to hooks and enhance deformity correction. There are various methods for pedicle screw insertion, which include the free-hand technique, C-arm guided and computer-guided screw insertion.[1,2] The free-hand technique decreases exposure to radiation and surgery time.

In spine practice, right-handed surgeons are usually more comfortable on the right side of the patient during pedicular screw insertion.[3,4] Hand dominance of the surgeon plays a role during insertion of the pedicle screw.

The aim of this report was to determine the role handedness can play in transpedicular screw placement.

Patients and methods

This retrospective study included 269 pedicle screws of 20 patients (mean age: 53 years, range: 18 to 77 years) who underwent pedicle screw instrumentation. Three patients (15%) were male and 17 (85%) female.

Correspondence: Onur Yaman, MD. Tepecik Eğitim ve Araştırma Hastanesi, Nöroşirürji Kliniği, Gaziler Cad. No: 468, Yenişehir, Izmir, Turkey.
Tel: +90 232 – 469 69 69 e-mail: dronuryaman@yahoo.com

Submitted: August 23, 2013 **Accepted:** December 23, 2013

Available online at
www.aott.org.tr
doi: 10.3944/AOTT.2014.13.0046
QR (Quick Response) Code

Fig. 1. Specific digital X-ray analysis software was used to measure angles in all patients. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

Screws were inserted by a right-handed surgeon using the free-hand technique. Patients were operated under general anesthesia by the same surgeon with the patient in the prone position. The level of the spine was confirmed under fluoroscopy. The sagittal trajectory of the probe was based upon the external anatomy of the posterior thoracic spine, the lamina and spinous processes.

Lateral and anterior-posterior radiographs were used for examination. Left and right screws were identified on anterior-posterior radiographs. A parallel line was drawn to the endplate of the vertebrae on lateral radiograph to evaluate the direction of the screws. Measurements were made to observe the angle between the screw and the line parallel to the endplate. Angles were classified as cranial '+' when the tip of the screw stood above the endplate line and as caudal '-' when the tip of the screw stood below the endplate line. Specific digital X-ray analysis software was used to measure the angles for all patients (Surgimap Beta 1.2.1.56; Nemaris Inc., New York, NY, USA).[5-9] Measurements of a patient is shown in Figure 1.

The chi-square test was used for statistical comparisons. P values of less than 0.005 were considered significant.

Results

Of the total 269 pedicle screws evaluated, 137 were inserted on the left side and 132 screws on the right side. Among the left side screws, 80 (58.4%) were inserted cranially and 44 were inserted caudally (32.1%). Thirteen screws were inserted parallel to the endplates. Among the right side screws, 39 were inserted cranially and 82 (62.1%) caudally. Eleven screws were inserted parallel to the endplates. This difference in orientation was statistically significant ($p<0.0001$). Parameters are given in Table 1 and Figure 2.

Discussion

Pedicle screws are biomechanically stronger than hooks for spine stabilization. The pullout strength of pedicle screws is stronger and the fusion rates are higher due to larger bone-implant area.[10-12]

Fluoroscopy is a common method used to guide the insertion of pedicle screws. In most surgical series, reported rates of cortical violation are 10% to 20%, although rates as high as 40% have been noted in some series.[13] The rate of complications due to false pedicle insertion is 0% to 0.9%.[14-16] Kim and Lenke[1] described the free-hand pedicle screw technique. Pedicle screw in-

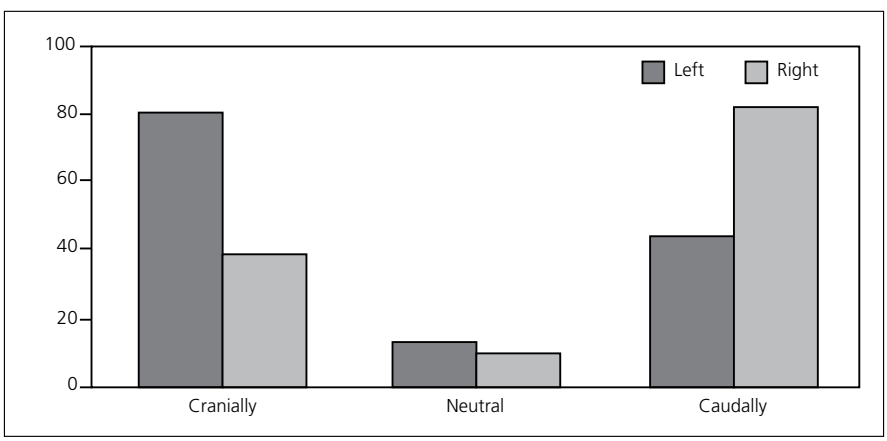

Fig. 2. Graph depicting the difference based on the side.

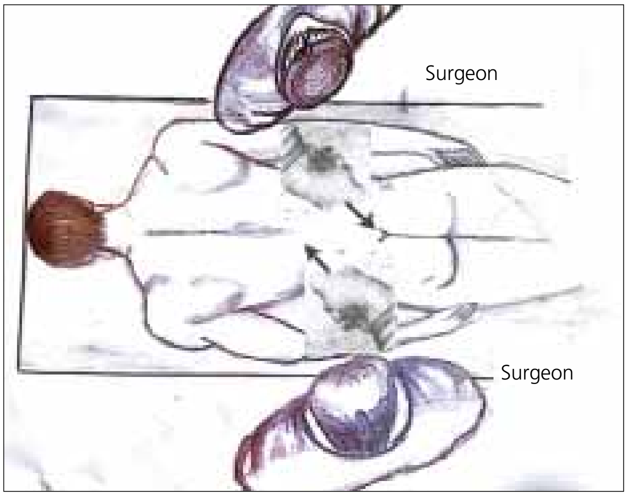

Fig. 3. The most likely explanation of the side difference is shown in this figure. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

sertion is based on anatomical landmarks and the tactile feel of probing the pedicles. Suk et al. described the biplanar pedicle technique in a study in which 4,604 pedicle screws were placed according to their technique; 1.5% of the pedicles were violated medially.[17]

Because of the special properties of the pedicles, the rate of neurological deficit is low in the false insertion of pedicle screws. The medial wall of the pedicle is anatomically stronger than the lateral wall. Medially oriented screws usually do not penetrate the medial wall due to the plasticity of the medial wall.[1,2] In the present study, 269 pedicle screws were evaluated. 58.4% of the transpedicular screws on the left side were inserted cranially and 62.2% on the right side caudally. The most likely explanation for this difference is that the right-handed surgeon stands facing the patient's foot and applies force to insert the pedicle screws on the right side. The surgeon turns towards the patient's head during pedicle screw insertion on the left side (Fig. 3).

The surgeon has to stand perpendicular to the patient in order to avoid disorientation of the pedicle. Sagittal trajectory of the screw must be kept in the right position by the help of both hands. Learning to use both hands during surgery may decrease the rate of false screw insertion.

In conclusion, surgeon handedness appears to have an influence over the orientation of pedicle screws. While the exact reason has not been determined, dexterity or proprioception may be involved. The surgeon should be aware of this potential problem and take precautions during the operation to prevent failure.

Conflicts of Interest: No conflicts declared.

Table 1. Angle measurements of the inserted screw.

T5, Left																-14				
T6, Left	-17		-5													-10				
T7, Left	-6		+7													-3		-12	-1	
T8, Left	-8		+2	+4												-3			+1	-1
T9, Left	-9		+1	+1	-23												0		+8	
T,10 Left	+8		-10	-15	+6	0		+3					+3				+1	-12	+6	+1 4
T,11 Left	+13		0	+1	-8	+4		+1		0	+6		+2		+8	+1 1	0		+6	
T,12 Left	+1	0	+3	+1	-15	-8		+1		+1	+8	-8	+1	+12	+12	+1 2	+7			
L1, Left	-9	+3	-6	+13		-12		+1		+10	+1 9	+4	+6	+7	+4				-5	
L2, Left	0	+2	+7	+1	+4	+3	-4	-3		+1	0	0	-12	+5			+1	+8		
L3, Left	0	-4	+1 0	+1	+7	-3	-4	-10	+1 4	+9	0	-11	-7	+1	+1	+5	+5	-2	-10	0
L4, Left	0	-3	-11	+4	+8	+6	+9	-17	+3	+3	+2	+6	-6	+5	+13		+11		-4	+1 3
L5, Left	+16		-13	+15				+20		+5	-2		-11	+11		+1	+9		-5	

T5, Right																+9		+12		-9
T6, Right	-17		-1													-5		+14		-8
T7, Right	0		-17													-7			-20	
T8, Right			-26	-4														-19	-9	-10
T9, Right	-8		-8		+14												-5		-10	
T,10 Right			+1	-10	-13	-10		-6					-2				-8	-4	0	0 4
T,11 Right	-5		-6	-16	-1	-1		-13		0	-20	+7			+10	+13	0		+2	
T,12 Right			-1	-16	-21	-12		-8		-9	-16	+2	-4	-2	+13		+2		-3	
L1, Right	+1	-1	+2	+10	-11	+2		-10		-12	-17	0	+2	-8	+13				+3	
L2, Right	0	-1	-14	-14	+8	-10	-4	+2	+8	-1	0	0	+4	-7			+2	-4		
L3, Right	+22	-14	+4	-1	-8	-6	+9	-3	-3		0	-6	-3	+5	+2	-16	+4	-4	-13	-12
L4, Right	0	-2	+2	-2	-14	-3	-6	-8		-11	-13	-2		+2	+23		+6		-24	+4
L5, Right	+17		+3				-3			-3	-6			-2	+1	+5			-15	

References

1. Kim YJ, Lenke LG. Thoracic pedicle screw placement: free-hand technique. Neurol India 2005;53:512-9. CrossRef
2. Lehman RA Jr, Polly DW Jr, Kuklo TR, Cunningham B, Kirk KL, Belmont PJ Jr. Straight-forward versus anatomic trajectory technique of thoracic pedicle screw fixation: a biomechanical analysis. Spine 2003;28:2058-65. CrossRef
3. Heini P, Schöll E, Wyler D, Eggli S. Fatal cardiac tamponade associated with posterior spinal instrumentation. A case report. Spine 1998;23:2226-30. CrossRef
4. Minor ME, Morrissey NJ, Peress R, Carroccio A, Ellozy S, Agarwal G, et al. Endovascular treatment of an iatrogenic thoracic aortic injury after spinal instrumentation: case report. J Vasc Surg 2004;39:893-6. CrossRef
5. Cho KJ, Suk SI, Park SR, Kim JH, Kang SB, Kim HS, et al. Risk factors of sagittal decompensation after long posterior instrumentation and fusion for degenerative lumbar scoliosis. Spine 2010;35:1595-601. CrossRef
6. Husson JL, Mallet JF, Parent H, Cavagna R, Vital JM, Blamoutier A, et al. Applications in spinal imbalance. Orthop Traumatol Surg Res 2010 May 4. [Epub ahead of print]
7. Korovessis P, Repantis T, Papazisis Z, Iliopoulos P. Effect of sagittal spinal balance, levels of posterior instrumentation, and length of follow-up on low back pain in patients undergoing posterior decompression and instrumented fusion for degenerative lumbar spine disease: a multifactorial analysis. Spine 2010;35:898-905. CrossRef
8. Lonner BS, Auerbach JD, Sponseller P, Rajadhyaksha AD, Newton PO. Variations in pelvic and other sagittal spinal parameters as a function of race in adolescent idiopathic scoliosis. Spine 2010;35:E374-7.
9. Schwab F, Lafage V, Patel A, Farcy JP. Sagittal plane considerations and the pelvis in the adult patient. Spine 2009;34:1828-33. CrossRef
10. Hackenberg L, Link T, Liljenqvist U. Axial and tangential fixation strength of pedicle screws versus hooks in the thoracic spine in relation to bone mineral density. Spine . 2002;27:937-42. CrossRef
11. Lee CS, Kim MJ, Ahn YJ, Kim YT, Jeong KI, Lee DH. Thoracic pedicle screw insertion in scoliosis using posteroanterior C-arm rotation method. J Spinal Disord Tech 2007;20:66-71. CrossRef
12. Liljenqvist U, Hackenberg L, Link T, Halm H. Pullout strength of pedicle screws versus pedicle and laminar hooks in the thoracic spine. Acta Orthop Belg 2001;67:157-63.
13. Wang VY, Chin CT, Lu DC, Smith JS, Chou D. Free-hand thoracic pedicle screws placed by neurosurgery residents: a CT analysis. Eur Spine J 2010;19:821-7. CrossRef
14. Belmont PJ Jr, Klemme WR, Dhawan A, Polly DW Jr. In vivo accuracy of thoracic pedicle screws. Spine 2001;26:2340-6. CrossRef
15. Fisher CG, Sahajpal V, Keynan O, Boyd M, Graeb D, Bailey C, et al. Accuracy and safety of pedicle screw fixation in thoracic spine trauma. J Neurosurg Spine 2006;5:520-6.
16. Guzey FK, Emel E, Hakan Seyithanoglu M, Serdar Bas N, Ozkan N, Sel B, et al. Accuracy of pedicle screw placement for upper and middle thoracic pathologies without coronal plane spinal deformity using conventional methods. J Spinal Disord Tech 2006;19:436-41. CrossRef
17. Suk SI, Kim WJ, Lee SM, Kim JH, Chung ER. Thoracic pedicle screw fixation in spinal deformities: are they really safe? Spine 2001;26:2049-57.