

1-2
1-2

Measurements of C1-2 region of Cervical Spine Using MRI for C1-2 Transarticular Screw Fixation

Kyung-Soo Suk, M.D., Ki-Tack Kim, M.D.,
Young-Ho Lee, M.D., Kyung-Nam Ryu, MD*

Department of Orthopaedic Surgery, Diagnostic Radiology,
School of Medicine, Kyung Hee University, Seoul, Korea*

– Abstract –

Study design: The C1-2 region was measured using MRI for a C1-2 transarticular screw fixation.

Objectives: To measure the first and second cervical spine, using MRI for a C1-2 transarticular screw fixation, and find the safe trajectory for the screw.

Summary of Literature Review: Posterior atlantoaxial transarticular screw fixation is an excellent procedure that is associated with high fusion rates. However, there is a potential risk of vertebral artery injury.

Materials and Methods: Sagittal MR images, of the cervical spine transecting mid portion of the C1-2 facet joints, were obtained in 24 patients. The mean age of the patients was 45.5 years. The male to female ratio of the patients was 15:9. From the sagittal images the ideal screw trajectory was made, and 48 oblique axial MR images, depending on the ideal screw trajectory in the sagittal plane, were obtained. On the oblique sagittal images, the width of the isthmic portion of the C2, the ideal length of the transarticular screw, the ideal insertion angle of the screw and the ideal entry point were measured using a PACS digital measuring instrument. The location of the vertebral artery was also evaluated.

Results: The mean width of the isthmic portion of the C2 was 6.2 mm, ranging from 2.3 to 7.6 mm. The mean ideal screw length was 40.5 mm, ranging from 34.0 to 46.8 mm. The mean ideal insertion angle was 1.1 °, ranging from -2.4 to 4.7 °, medially. There were no significant differences in the width or the angle in relation to the sex of the patients. However, the length of the screw was significantly longer in the male (42.1 mm) than the female patients (38.0 mm). Three of 24 patients (3 of 48 C1-2 facet joints) had a narrow isthmus due to a high riding vertebral artery.

Conclusions: A C1-2 transarticular screw fixation has a risk of injury to the vertebral artery. Therefore, the preoperative measurement of the C1-2 region and an evaluation of the vertebral artery are recommended in each patient. A magnetic resonance image is a useful method for easily evaluating the anatomic structure of the C1-2 region, with no additional study.

Key Words: Cervical spine, C1-2 transarticular screw fixation, Magnetic resonance image

Address reprint requests to

Kyung-Soo Suk, M.D.

Department of Orthopaedic Surgery, Kyung Hee University Hospital,

#1 Hoegi-dong, Dongdaemun-gu, Seoul, 130-702, Korea

Tel: 82-2-958-8345, Fax: 82-2-964-3865, E-mail: sks111@khmc.or.kr

1-2 1-2 24 1-2
 (neutralization)
 가 2,3,5) T2
 , , 2 (inferior articular process)
 2 mm 1
 1 2,3,5,6)
 가 1-2
 가 1-2
 1,10-14)
 가 1-2
 가
 1-2
 1-2 2 1-2
 , , 48
 , ,
 가 가
 , ,
 2 1-2
 , ,

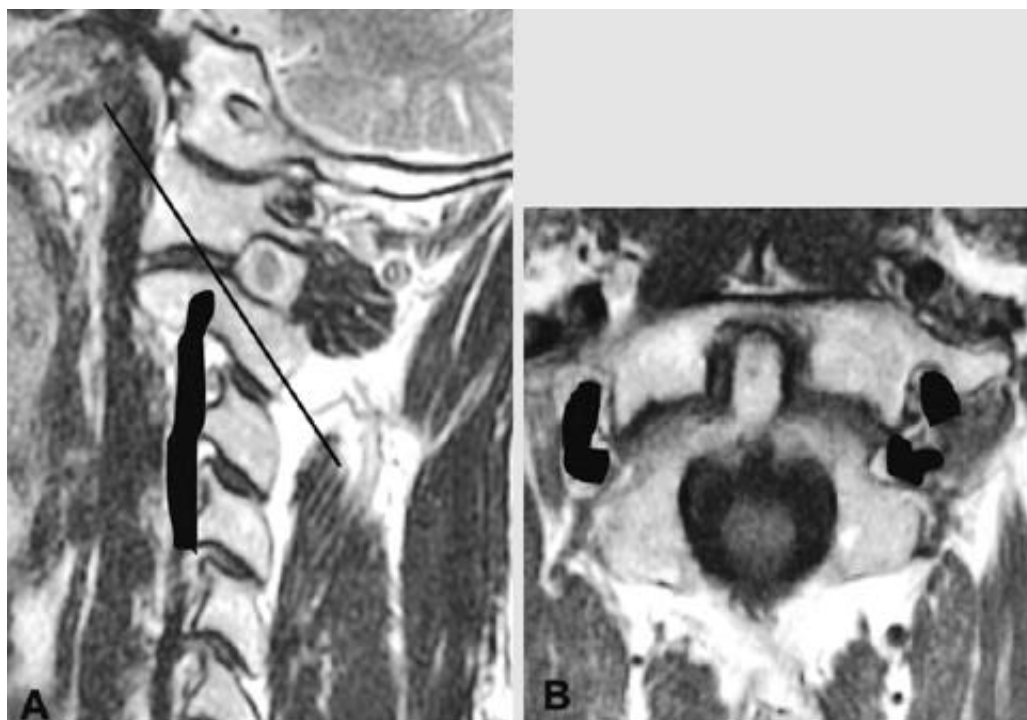


Fig. 1. A sagittal MR image of the cervical spine transecting center of the C1-2 joint. Black line is an ideal trajectory of the C1-2 transarticular screw. Vertebral artery is marked as black color (A). An oblique axial image of the C1-2 joint obtained along the ideal trajectory line on the sagittal MR image. Vertebral artery is marked as black color (B).

(Fig. 2). PACS

digital

가 2

1 가 3

Pearson correlation

analysis 가

45.5 (21-65) 15 9

Independent sample T-test

2 6.2 (3.3 ~ 8.6) mm

2 mm, 2.5 mm

1.1 (-2.4 ~ 4.7)

40.5 (34.0 ~ 46.8) mm

person's correlation coefficient

0.994 (0.990-0.998)

pearson's correlation coeffi-

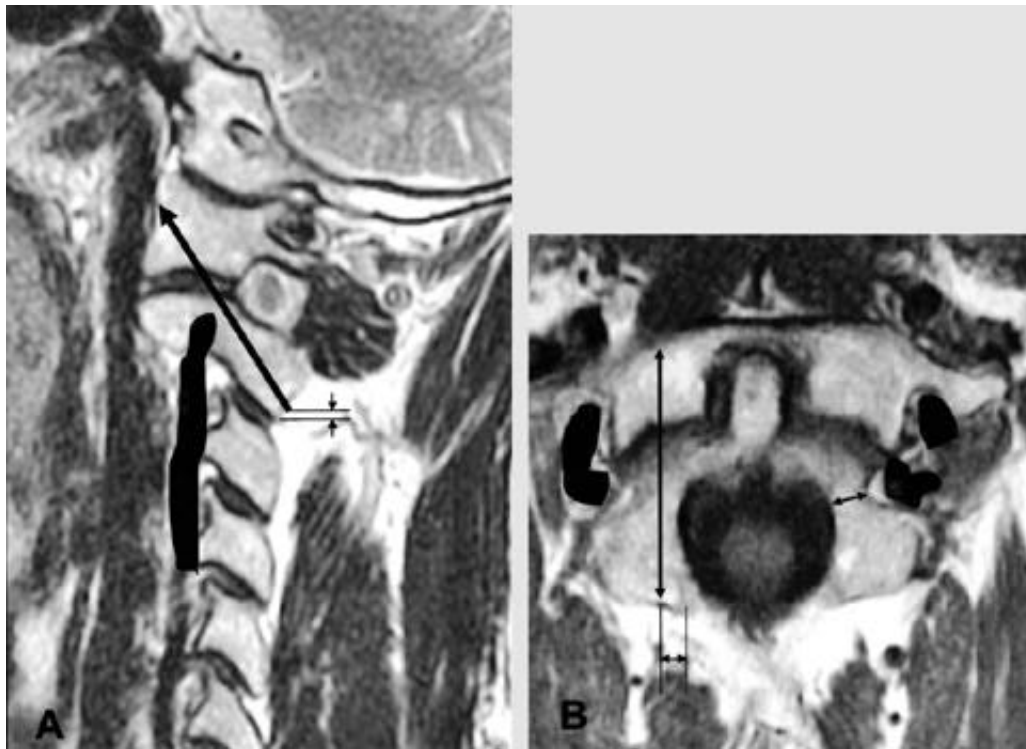


Fig. 2. Ideal entry points, insertion angle and length of the C1-2 transarticular screw were on the sagittal and oblique axial MR images using PACS digital measuring instrument.

Table 1. Measurements of C1-2 region for transarticular screw fixation

	Mean	Male	Female	Significance (P)
Width of isthmus of C2 (mm)	6.2	6.3	6.1	0.534
Entry point				
From lower margin of inferior articular process of C2 (mm)	2.0 proximal	2.0 proximal	2.0 proximal	
From medial margin of inferior articular process of C2 (mm)	2.5 lateral	2.7 lateral	2.4 lateral	0.845
Insertion angle (degree)	1.1	1.1	1.1	0.992
Length of screw (mm)	40.5	42.1	38.0	0.000



Fig. 3. A sagittal MR image of the cervical spine shows high-riding vertebral artery

cient 0.990 (0.980-0.996)

2 (6.3 mm,
6.1 mm , P=0.534), (P=0.845), (1.1 , 1.1 , P=0.992)

(42.1 mm,
38.0 mm, P=0.000)

가 (Table 1).

2 가

1-2

가 24 3 , 48

1-2 3 (Fig. 3).

1-2
Mager¹⁴⁾

Grob

가

1-2

가

1,7,10-14)

1-2

1-2

가

가

가

. Coric¹⁾ 1-2
(arteriovenous fistula)

, Prabhu¹¹⁾ 1-2

가

. Wright Lauryssen¹⁴⁾ 101

1318

2492

1-2

4.1%

0.2%

가 0.1%

Song¹²⁾

1-2

가

가

가

7,8,10)

7,9,10)

3

1-2

가

2

2

1-2

1-2

2 mm
1
2 1/4
(Fig. 2).
(high-riding vertebral artery) 가
3 (Fig. 3).
(oblique axial MR image)
가
1-2
(Fig. 2).
3
24 3 (12.5%), 48
1-2 3 (6.3%) 1-2
(Fig. 3).
Neo 9) 1-2
27
7
2
1-2 2
mm , 2.5 mm 2
2 1/4
1-2
12.5% , 6.3%
1-2 (high riding vertebral artery)
가
1-2
가
가

REFERENCES

- 1) **Coric D, Branch CL, Wilson JA and Robinson JC:** Arteriovenous fistula as a complication of C1-2 transarticular screw fixation. Case report and review of the literature. *J Neurosurg*, 85:340-3, 1996.
- 2) **Grob D, Crisco J, Panjabi MM and Dvorak J:** Biomechanical evaluation of four different posterior atlantoaxial fixation technique. *Spine*, 17:480-90, 1991.
- 3) **Grob D, Jeanneret B, Aebi M and Markwalder T:** Atlantoaxial fusion with transarticular screw-fixation. *J Bone Joint Surg*, 73-B:972-6, 1991.
- 4) **Grob D and Magerl F:** Surgical stabilization of C1 and C2 fractures. *Orthopade*, 16:46-54, 1987.
- 5) **Hurlbert RJ, Crawford NR, Choi WG and Dickman CA:** A biomechanical evaluation of occipitocervical instrumentation: screw compared with wire fixation. *J Neurosurg*, 90 (1 Suppl):84-90, 1999.
- 6) **Jeanneret B and Magerl F:** Primary posterior fusion C1/2 in odontoid fracture: indications, technique, and results of transarticular screw fixation. *J Spinal Disord*, 5:464-75, 1992.
- 7) **Madawi AA, Casey AT, Solanki GA, Tuite G, Veres R and Crockard HA:** Radiological and anatomical evaluation of the atlantoaxial transarticular screw fixation technique. *J Neurosurg*, 86:961-8, 1997.
- 8) **Mizuno J and Nakagawa H:** Spinal instrumentation for unstable C1-2 injury. *Neurol Med Chir*, 39:434-9, 1999.
- 9) **Neo M, Matsushita M, Iwashita Y, Yasuda T, Sakamoto T and Nakamura T:** Atlantoaxial transarticular screw fixation for a high-riding vertebral artery. *Spine*, 28:666-70, 2003.
- 10) **Paramore CG, Dickman CA and Sonntag VK:** The anatomical suitability of the C1-2 complex for transarticular screw fixation. *J Neurosurg*, 85:221-4, 1996.
- 11) **Prabhu VC, France JC, Voelker JL and Zoarski GH:** Vertebral artery pseudoaneurysm complicating posterior C1-2 transarticular screw fixation: case report. *Surg Neurol*, 55:29-34, 2001.
- 12) **Song GS, Theodore N, Dickman CA and Sonntag VK:** Unilateral posterior atlantoaxial transarticular screw fixation. *J Neurosurg*, 87:851-5, 1997.
- 13) **Suk KS, Kim KT, Lee SH:** C1-2 transarticular screw fixation as a revision surgery for failed C1-2 fusion. *J Kor*

Spine Surg, 9:251-6, 2002.

- 14) **Wright NM and Laurysen C:** *Vertebral artery injury in C1-2 transarticular screw fixation: results of a survey of the AANS/CNS section on disorders of the spine and*

peripheral nerves. American Association of Neurological Surgeons/Congress of Neurological Surgeons. J Neuro - surg 88:636-40, 1998.

:									
:	1-2				1-2				
:									
:	24		1-2						
					48		1-2		
2									
					가	가			PACS
digital					45.5		15	9	
:	2		6.2 (2.3 - 7.6) mm						40.5 (34.0 - 46.8) mm
			1.1 (-2.4 -4.7)						
					가 42.1 mm,	가 38.0 mm			
가			2						가 24
3		48	1-2	3	1-2				
:	2		6.2 mm		1-2				
12.5%		6.3%	1-2	1-2					
			1-2					1-2	
가				가					
				가					
:		1-2							

:

1

Tel: 82-2-958-8345, Fax: 82-2-964-3865, E-mail: sks111@khmc.or.kr