

Case Report



Posterior Approach in C2–3 Disc Herniation: C1 Laminectomy, C2–3 Laminoplasty and Posterior Fixation in C2–3 Disc Herniation

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Received: Jul 5, 2020

Revised: Sep 23, 2020

Accepted: Oct 7, 2020

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Conflict of Interest

The authors have no financial conflicts of interest.

ABSTRACT

C2–3 disc herniation is rare and a definitive treatment of choice has not been established. The purpose of this case report is to suggest posterior approach as one of the best options. A 49-year-old man visited our clinic with a 7-year history of neck pain and occipital headache and a 2-month history of right arm pain. C2–3 intervertebral disc herniation of the central type was diagnosed on magnetic resonance imaging (MRI), and surgery was performed, including C1 laminectomy, C2–3 laminoplasty, and C2–3 posterior fixation. The posterior approach was used because the patient's neck was difficult to operate anteriorly. After 3 months postoperatively, MRI showed widened cerebrospinal fluid space at the C2–3 level. The visual analogue scale score for pain improved in the occipital area and right arm. However, the untouched protruded central disc, subjective weakness in right hand grasping, and numbness persisted. In conclusion, this case highlights posterior decompression and fixation as a good treatment of choice for decompression at the C2–3 level disc herniation, from where it is difficult to remove compressive lesions directly via the anterior corridor.

Keywords: Herniated disc; Laminectomy; Laminoplasty; Cervical spine

INTRODUCTION

High cervical degenerative disc disease is rare, and the overall incidence of disc herniation between C2 and C3 is less than 1%.¹⁾ Upper cervical disc herniations are usually seen in elderly patients, and their mechanisms are related to spondylotic changes. Degenerative changes and loss of soft tissues, such as the intervertebral discs, in the middle or lower cervical regions lead to excessive movement of the upper cervical region and excessive axial load.^{6,13)} It can make the high cervical disc more degenerative and protruded. Although there are several approaches to resolve spinal cord compression due to C2–3 disc herniation, a definitive treatment of choice has not been established. In addition, reports on the treatment are limited.¹⁶⁾ Therefore, we herein report a case of C2–3 intervertebral disc herniation treated with the posterior approach and share the risks and benefits of this approach.

CASE REPORT

After approval from the Institutional Review Board (No. AFCH-20-IRB-009), we retrospectively reviewed medical records of patient who underwent surgery for C2–3 intervertebral disc herniation.

A 49-year-old man presented with neck pain, occipital headache, and right arm pain. Neck pain and occipital headache had persisted for 7 years despite conservative treatment. Two months before, he had developed right arm pain and numbness on the lateral side. In addition, he experienced right arm weakness and motor grade IV. To obtain the diagnosis, we performed three-dimensional cervical spine computed tomography (CT) and magnetic resonance imaging (MRI), which revealed C2–3 disc herniation of the central type compressing the spinal cord (**FIGURE 1**). The patient was obese and had a short neck, so an anterior approach was difficult.⁹⁾ And according to other research, anterior approach can cause some complications such as dysphonia, dysphagia, carotid vessel injury, esophageal and tracheal injury.^{7,9,11,15)} In the published papers, there were surgical methods showing successful results for the anterior approach, but these were also mass invasive surgical methods (**TABLE 1**).¹⁶⁾ This cannot be denied that the stress for postoperative complications and the risk during surgery are clearly high even for experienced surgeons. Therefore, considering the C2–3 posterior approach, we performed vertebral artery CT angiography. It showed left vertebral artery dominant feature and high-riding vertebral artery on the left side and a narrow pedicle (**FIGURE 2**).

There are various treatment approaches for C2–3 disc herniation. However, there is no definite evidence of what approach is more beneficial.¹⁶⁾ In our case, we chose the posterior midline approach to avoid injury of the anterior cervical structures because of the short neck.

In the prone position, surgery was performed under general anesthesia, and we used the Mayfield fixator to obtain the head-fixed state and slightly flexed neck position for the patient. In addition, intraoperative neurophysiological monitoring was performed to avoid spinal cord and nerve root injuries. A midline incision was made at the C1–3 level posterior neck, and we performed blunt dissection until we reached the posterior tubercle and arch of C1 and the spinous process and lamina of C2–3. After checking the cervical spine level, C1 laminectomy and C2 and C3 laminoplasty were performed for decompression. The reason for

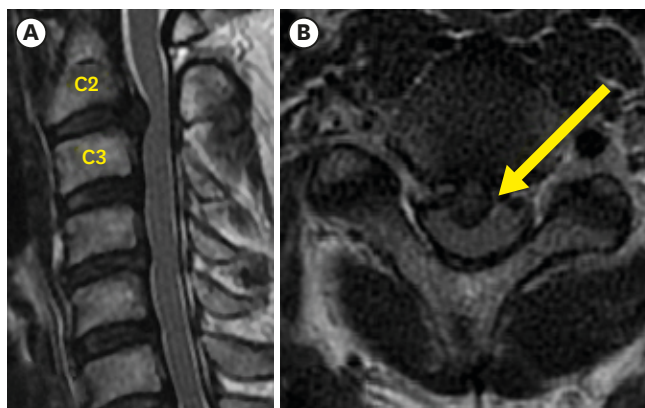


FIGURE 1. Sagittal (A) and axial (B) magnetic resonance images acquired before operation show central disc protrusion and spinal cord compression.

TABLE 1. Review of cases published in literature

Study	Year	Number of cases	Presentation	Location of the disc material	Surgical technique	Outcome
Espersen et al.	1984	1		C2–3 level	Cloward's technique	
Jomin et al.	1986	2		C2–3 level	ACDF	
Rosemberg et al.	1991	2	Myelopathy	Retro-odontoïd	Posterior transdural	1 improved, 1 stable
Nishizawa et al.	1996	1	Myelopathy	Retro-odontoïd	Posterior transdural	
Chen and Luis	1997	1	Myelopathy	Retro-odontoïd	Transoral odontoidectomy+C1–2 fusion	Improved
Nishizawa et al.	1999	3	Myelopathy	2 Retro-odontoïd 1 C2–3 level	Posterior transdural	All improved
Antich et al.	1999	1	Myelopathy	C2–3 level	ACDF	Improved
Campbell	2000	1	Myelopathy	Retro-odontoïd	Transoral odontoidectomy	
Chen	2000	8	Myelopathy	C2–3 level	ACDF	6 improved, 2 stable
Matsutano et al.	2004	1	Myelopathy	Retro-odontoïd	Far lateral	
Deshmukh et al.	2004	1	C2 Radiculopathy	Retro-odontoïd	Posterior extradural	Improved
Türe et al.	2007	1	C3 radiculopathy	C2–3 level	Anterolateral extradural approach	Improved
Chan et al.	2009	1	Myelopathy	C2–3 level	C3 transcorporeal	
Kotil and Sengoz	2011	5	Myelo-radiculopathy C2–3	C2–3 level	Discectomie antérieure+greffe	3 improved, 2 stable
N'Dri et al.	2014	1	Myelo-radiculopathy	C2–3 level	Anterolateral extradural approach	Improved
Current case	2020	1	Myelopathy	C2–3 level	Posterior approach (decompression & fixation)	Improved

This table is sourced from Oka et al.¹⁶⁾

ACDF: anterior cervical discectomy and fusion.

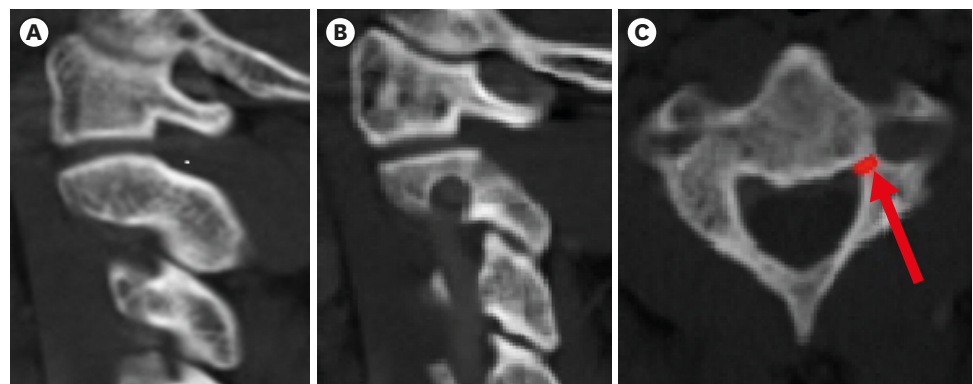


FIGURE 2. Vertebral artery CT angiography shows left high-riding vertebral artery (B) compared to the right vertebral artery (A). The axial image (C) shows a narrow pedicle on the left side (red arrow). A narrow pedicle is defined by a pedicle width of 4 mm or less, which is measured in axial CT scans. CT: computed tomography.

C1 laminectomy was spinal cord kinking at the C1 posterior arch when the spinal cord shifted to the posterior side after C2–3 decompression. In addition, we performed C2–3 laminoplasty instead of C2–3 laminectomy because recent studies have reported various disadvantages of laminectomy, such as instability of the vertebra, acceleration of deformity, epidural soft-tissue scar change and adhesion with the dura mater, and insufficient protection of the spinal cord due to the absence of posterior elements, such as the lamina.^{12,18)} Therefore, we performed laminoplasty and added posterior instrumented fixation to stabilize the vertebra. In case of laminoplasty alone, if motion remains, the possibility of disc protrusion progression remains and postoperative cervical kyphosis was reported up to 10.8% in retrospective study.³⁾ Because of that reason, we thought posterior instrumented fixation can be benefit to stabilize disc progression and prevent cervical kyphosis. In this step, we performed posterior screw fixation at the C2–3 level, in which the pars screw was used on the left side of C2 because of the high-riding vertebral artery, and pedicle screw was used for the right side C2 and lateral mass screws were used for both sides of the C3.

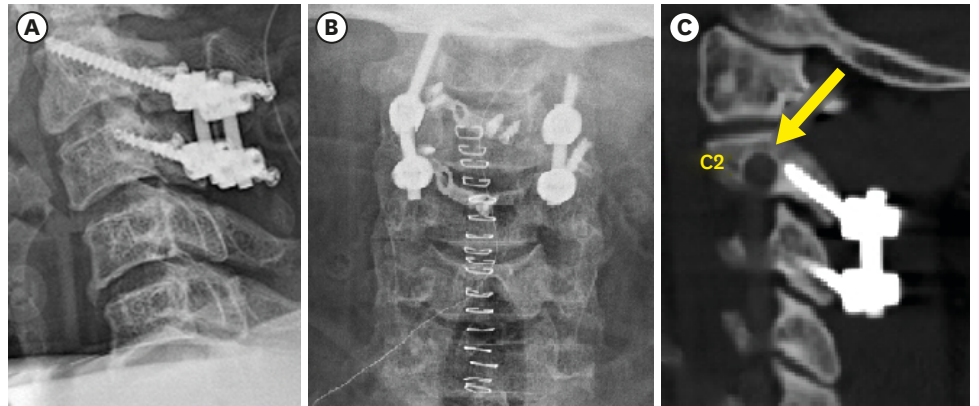


FIGURE 3. Radiography shows safe insertion of the C2–3 pars and pedicle screw (A, B), and postoperative computed tomography angiography shows no injury of the left vertebral artery (arrow, C).

At the end of the procedure, a C-arm radiography image was acquired to confirm the accuracy of the C2–3 level screw fixation state.

Postoperative radiography and vertebral artery CT angiography showed no injury of the left high-riding vertebral artery at the C2 level and safe insertion of the pars and pedicle screws (**FIGURE 3**).

In addition, postoperative radiography showed some cervical parameters^{4,5,20} such as cervical lordosis (CL: Cobb angle between the lower endplates of C2 and C7) of 6.4°, a C2–3 angle (angle between the lower endplates of C2 and C3) of 3.5°, and a C2–7 sagittal vertical axis (SVA: distance from the posterosuperior corner of C7 to a vertical line from the center of the C2 vertebra) of 30.1 mm compared to the pre-operative measured values of 7.7°, 1.5°, and 51.63 mm, respectively (**FIGURE 4**). Normal ranges of CL and C2–7 SVA in adults are 19.2±11.9° and 12.0±9.6 mm, respectively.²⁰ Initially, our patient's cervical parameter values

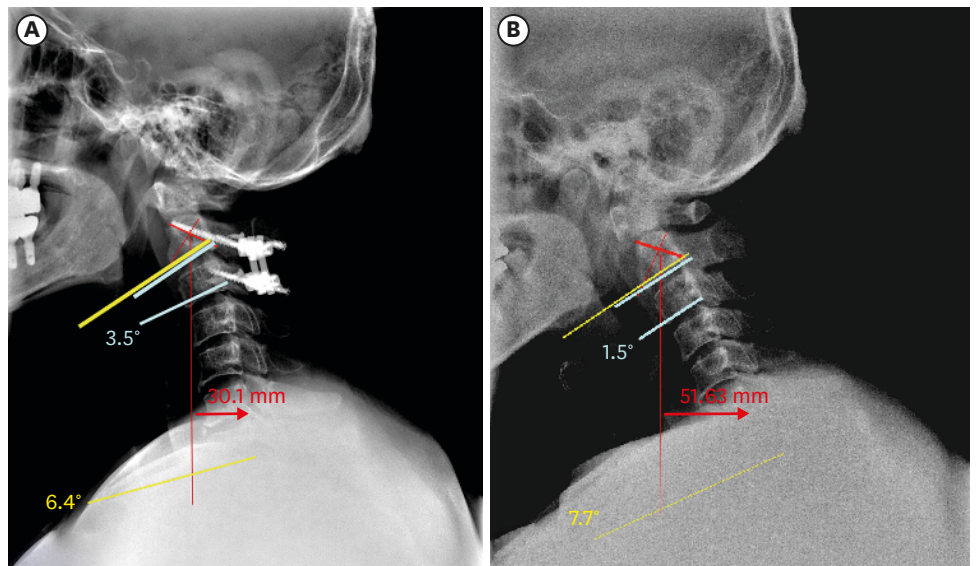


FIGURE 4. Lateral preoperative cervical spine radiography (B) shows C2–7 CL (yellow) of 7.7°, a C2–3 angle (skyblue) of 1.5°, and a C2–7 SVA (red) of 51.63 mm. Postoperative radiography (A) shows CL of 6.4°, a C2–3 angle of 3.5°, and a C2–7 SVA of 30.1 mm. There is no significant change in CL or C2–3 angle, but C2–7 SVA has improved, indicating the improvement of sagittal imbalance. CL: cervical lordosis, SVA: sagittal vertical axis.

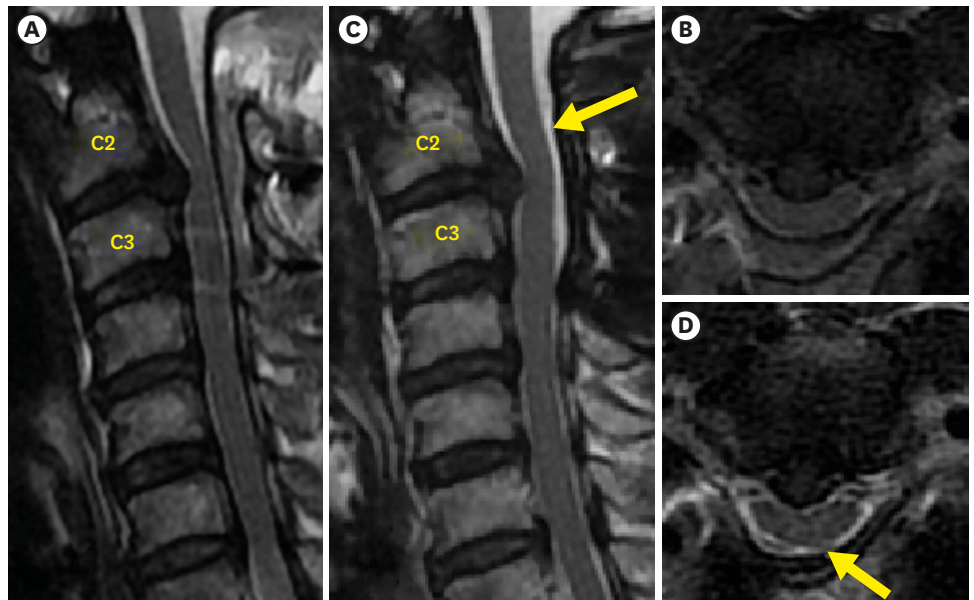


FIGURE 5. After 3 months, magnetic resonance imaging shows expansion of the posterior space (yellow arrow) of the C2–3 spinal cord (C, D) compared to the preoperative MRI (A, B). MRI: magnetic resonance imaging.

showed decreased cervical lordosis and increased C2–7 SVA, indicating an increase in sagittal imbalance. Postoperatively, there were no significant changes in CL, and sagittal imbalance had improved. Moreover, the C2–3 angle showed no significant change from preoperative 1.5° to postoperative 3.5°.

MRI showed posterior decompression at the C1–3 level; however, due to the epidural hematoma, the spinal cord was still mildly compressed (**FIGURE 5A & B**).

After 3 months postoperatively, the visual analogue scale score for pain improved from 7 to 2 points in the occipital area and from 7 to 3 points in the right arm. MRI showed that the posterior epidural collection had resolved, and posterior cerebrospinal fluid (CSF) space in the spinal cord had expanded compared to preoperative MRI (**FIGURE 5C & D**). However, the right hand grasping subjective weakness and numbness persisted.

DISCUSSION

C2–3 disc herniation is very rare, with an incidence rate of less than 1% of all cases of cervical disc herniation.¹⁾ In addition, there is no definite choice of treatment. Approximately, literature review shows this as the 31st case published in the literature on C2–3 disc herniation and 8th case of using the posterior approach (**TABLE 1**).¹⁶⁾ However, all cases reported so far included surgical approaches for discectomy of the herniated discs. To the best of our knowledge, this is the first case without a direct protrusion disc removal.

Outcomes of previously reported cases were almost good and improved.¹⁶⁾ However, there was no consensus on the most appropriate approach. In our case, the posterior approach was considered to avoid other risk factors. Anterior approaches are extremely difficult in patients with a short and thick neck, and there is a possibility of injury to the anterior

cervical structures, such as carotid vessels and branches and cranial nerves.⁹⁾ In a review of 85 patients who underwent this approach to the cervico-thoracic spine (C3–T1), 9 (11%) had postoperative voice changes while 3 (3.5%) had permanent vocal cord paralysis.^{7,11,15)} The strict lateral approach is rarely used and is therefore limited to the lateral foraminal hernia.¹³⁾ We decided to choose the posterior approach for the aforementioned reasons. When planning the posterior approach, the risk of vertebral artery injury should be considered in case of a high-riding vertebral artery.^{8,10,17,19)} This can occur when posterior screw insertion occurs.

A high-riding vertebral artery was defined as an isthmus height of 5 mm or less and/or internal height of 2 mm or less on a sagittal image, which is 3 mm lateral to the cortical margin of the spinal canal wall at C2.^{2,14)} Our case fulfilled the criteria for the diagnosis of the high-riding vertebral artery; therefore, we used a pars screw on the C2 left side to avoid vertebral artery injury.

For 12 months follow-up period, the patient's symptoms improved significantly, and MRI revealed that the subarachnoid space through which CSF flow was secured using sufficient decompression. In addition, there was no deformity of cervical spine so far, no injury of the high-riding vertebral artery after pars screw fixation.

Limitations of our case report are; 1) short follow up to evaluate the long-term outcome, 2) unexplainable symptoms and signs corresponding to the C2–3 spinal level lesion, 3) the uncertainty of C1 laminectomy in the delayed swan neck deformity, 4) persisting untouched protruded central disc's fate.

CONCLUSION

There are various surgical approach methods for C2–3 disc herniation, but we concluded that in case of a short neck, decompression and stabilization through the posterior approach can also be a good treatment option. In addition, if the diagnosis of a high-riding vertebral artery can be made using vertebral artery CT angiography, safe insertion of the posterior screw at the C2 level is possible using another screw insertion method, such as the pars screw insertion method.

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