Microscopic Posterior Transdural Resection of Cervical Retro-Odontoid Pseudotumors

Yasushi Fujiwara, MD, PhD,* Hideki Manabe,* Tadayoshi Sumida,† Nobuhiro Tanaka,‡ and Takahiko Hamasaki§

Abstract: Retro-odontoid pseudotumors are noninflammatory masses formed posterior to the odontoid process. Because of their anatomy, the optimal surgical approach for resecting pseudotumors is controversial. Conventionally, 3 approaches are used: the anterior transoral approach, the lateral approach, and the posterior extradural approach; however, each approach has its limitations. The posterior extradural approach is the most common; however, it remains challenging due to severe epidural veins. Although regression of pseudotumors after fusion surgery has been reported, direct decompression and a pathologic diagnosis are ideal when the pseudotumor is large. We therefore developed a new microscopic surgical technique; transdural resection. After C1 laminectomy, the dorsal and ventral dura was incised while preserving the arachnoid. Removal of the pseudotumor was performed and both of the dura were repaired. The patient's clinical symptoms subsequently improved and the pathologic findings showed degenerative fibrocartilaginous tissue. In addition, no neurological deterioration, central spinal fluid leakage, or arachnoiditis was observed. Currently, the usefulness of the transdural approach has been reported for cervical and thoracic disk herniation. According to our results, the transdural approach is recommended for resection of retro-odontoid pseudotumors because it enables direct decompression of the spinal cord and a pathologic diagnosis.

Key Words: microscopic spine surgery, transdural resection, cervical retro-odontoid pseudotumor

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From the *Department of Orthopedic Surgery, Hiroshima City Asa Hospital, Asa-kita-ku, Hiroshima City, Japan; §Department of Orthopaedic Surgery, National Hospital Organization Kure Medical Center, Chugoku Cancer Center; ‡Department of Orthopaedic Surgery, Institute of Biomedical & Health Sciences, Hiroshima University; and †Department of Orthopedic Surgery, Saka Midorii Hospital.

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Reprints: Yasushi Fujiwara, MD, PhD, Department of Orthopedic Surgery, Hiroshima City Asa Hospital, 2-1-1 Kabe-minami, Asa-kita-ku, Hiroshima City 731-0293, Japan (e-mail: ys.fujiwara@nifty.com).

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Retro-odontoid pseudotumors are mass lesions formed posterior to the odontoid process, surrounded by the spinal cord, nerve roots, vertebral body, and vertebral artery (Fig. 1). Because of the complex anatomy of the pseudotumor location, the pathology of pseudotumors has remained controversial. To confirm the pathology, a surgical resection is necessary, because even needle biopsies are not available for retro-odontoid pseudotumors.

Although recent studies have clarified that most retro-odontoid pseudotumors are degenerated fibrocartilaginous mass lesions and not true tumors, a pathologic diagnosis and direct decompression are ideal when the pseudotumors are large.

However, the optimal surgical approach for resecting a pseudotumor is controversial. Conventionally, 3 approaches are used: the anterior transoral approach, the lateral high cervical approach, and the posterior extradural approach. However, each of these approaches has its limitations. The anterior transoral approach is reported to have a higher infection rate and the lateral high cervical approach has a risk of vertebral artery injury. Furthermore, those 2 approaches are not familiar to most spine surgeons. Although the posterior extradural resection is the most commonly used, epidural bleeding and adhesion make the excision difficult because the pseudotumors are located in front of the spinal cord.

Therefore, we developed a new surgical procedure for retro-odontoid pseudotumors: a transdural resection with incisions of the dorsal and ventral dura as shown in Figure 1B. In this paper, we describe this innovative surgical technique using a surgical video clip.

SURGICAL INDICATIONS

Indications for this procedure are as follows:

- (1) A retro-odontoid mass lesion causing symptomatic myelopathy.
- (2) Difficult to identify whether or not it is a true tumor.
- (3) The retro-odontoid mass lesion is large enough that direct decompression is necessary.

PATIENT POSITIONING AND SETUP

Surgery was performed with the patient in the prone position, with the head held using a Mayfield skull clamp. The usage of a surgical microscope and intraoperative monitoring using transcranial electrical-stimulated muscle-evoked potentials are recommended.

FIGURE 1. The schema of the retro-odontoid pseudotumor and transdural approach. T indicates pseudotumor; VA, vertebral artery. *Spinal cord.

INSTRUCTIONS FOR THE PROCEDURE

The surgical procedure is illustrated in the case of a 66-year-old man who underwent this procedure. His chief complaints were difficulty in walking and hand clumsiness. A preoperative magnetic resonance imaging showed a large retro-odontoid pseudotumor on the right (Figs. 2A, B). A preoperative x-ray demonstrated no obvious instability at C1–C2 (Figs. 2C, D).

Surgery was performed with the patient in the prone position using a Mayfield skull cramp. A surgical microscope and intraoperative monitoring was used. A midline skin incision was applied at C1–C2. After C1 lamina exposure (Fig. 3A), a C1 laminectomy was performed using a diamond burr. Then, the surgical field was filled with saline and ultrasonography was performed to assess the morphology of the pseudotumor and the degree of compression of the dura and spinal cord. The Pro Focus 2202 ultrasound system (BK Medical Co., Boston, MA) and an ultrasound transducer probe 8809 (frequency range: 15–6 MHz; BK Medical Co.) were used. In the current case, the spinal cord remained severely compressed by the retro-odontoid pseudotumor (Figs. 4A, B).

In the axial view (Fig. 4B), the dura completely covered the retro-odontoid pseudotumor, but the spinal cord did not cover it completely.

An extradural resection was initially attempted (Fig. 3B), however, bleeding and adhesion occurred. Therefore, we opted to perform a transdural resection of the pseudotumor. The dorsal dura was incised using a sharp knife (Fig. 3C) while preserving the arachnoid (Fig. 3D). To only cut the dura and preserve the arachnoid, a stitch was made near the location where we planned to cut the dura. Then, the dorsal dura was lifted by pulling the stitch (Fig. 3C, arrow indicates the stitch). After that, the dura was incised carefully using a sharp knife. Once the arachnoid appeared, a microspatula was inserted between the dura and arachnoid to protect the arachnoid. Then, the dura was cut more toward the caudal-rostral axis.

When we gently separated the dura and arachnoid using the microspatula, nerve roots and dentate ligaments were found. In the middle of 2 nerve roots, a dentate ligament, which connects the dura, arachnoid, and spinal cord, was located. The appearance of the dentate

FIGURE 2. The patient's clinical course. The preoperative images. A and B, Preoperative magnetic resonance imaging. C and D, Preoperative dynamic x-ray images.

FIGURE 3. (Continued)

ligament was tooth-like and triangular, and it was easy to distinguish it from the nerve root. After coagulation, the dentate ligament was cut near the dura to provide a wider working space (Fig. 3E).

A dural protrusion caused by the retro-odontoid pseudotumor was observed (Fig. 3F). After coagulation, we incised the ventral dural protrusion (Fig. 3G). After incising the ventral dura, we removed the pseudotumor (Figs. 3H, I). This procedure allows sufficient working space between the spinal cord and the dura after cutting the dentate ligament, however, extreme care is required to prevent spinal cord retraction. Neurophysiological monitoring was carried out throughout this procedure. After excising the pseudotumor, the ventral dura and dorsal dura were repaired using 6-0 nylon sutures (Figs. 3J–L).

In this case, there was no atlantoaxial instability, and no fixation was performed. If fusion surgery were necessary, it could have been performed in the same position.

POSTOPERATIVE MANAGEMENT

After surgery, the patient remains in bed for 2 days without his head being elevated. If there is no leakage of central spinal fluid on the third day, the patient can be allowed to sit. On the fourth day, if the patient has no complaints of a headache or dizziness, the patient can be allowed to walk. A soft collar is applied for about 2 weeks.

FIGURE 3. The surgical procedure. A, The C1 lamina exposed. B, After the C1 laminectomy, an extradural resection was first attempted (arrow). C, The dura was cut using a knife while pulling the dura with a stitch (arrow). D, The arachnoid was preserved after cutting of the dura. E, The dentate ligament was cut (arrow). F, A ventral dural protrusion is shown (arrow). G, After coagulation, the ventral dural protrusion was cut. H, The extruding fragment of the pseudotumor. I, Removal of the pseudotumor. J, After the removal of the pseudotumor. K, Repair of the ventral dura. L, Repair of the dorsal dura. full color online

SURGICAL OUTCOME

The pathologic findings showed a degenerative fibrocartilaginous mass lesion according to hematoxylin and eosin staining (Fig. 5).

At 1 year after the operation, no difficulty in the motion of the upper and lower extremities was observed. In addition, the patient exhibited no neck pain or limitation in his cervical motion including rotation. A follow-up magnetic resonance imaging at 1 year after surgery showed that there was no pseudotumor and the spinal cord was well decompressed (Figs. 6A, B). A follow-up x-ray at 1 year after the operation showed no progression

of instability; in addition, the range of motion between C1 and C2 was maintained (Figs. 6C, D).

PEARLS AND PITFALLS

First, it is important to preserve the arachnoid during this procedure to prevent central spinal fluid leakage, which would complicate the surgical procedure and increase the risk of postoperative arachnoiditis. Therefore, the incision of the dorsal dura must be done carefully, while lifting the dorsal dura using a single stitch.

FIGURE 4. Intraoperative ultrasonography findings. The spinal cord was still severely compressed by the retro-odontoid pseudotumor even after the C1 laminectomy. SC indicates spinal cord. *Retro-odontoid pseudotumor.

Second, the cutting of the dentate ligament is important to obtain a wider working space. The dentate ligament is connected with the pia mater, arachnoid mater, and dura mater. The role of the dentate ligament is unclear; however, no complications have been reported after the resection of the dentate ligaments thus far.

Third, careful manipulation of the spinal cord is necessary and the usage of intraoperative monitoring is essential. Generally, a slight retraction of the spinal cord is enough for the resection of the pseudotumor because

the width of the spinal cord is narrower than the width of the dura at C1–C2. Therefore, surgeons can access retro-odontoid pseudotumors much easier using the transdural approach than the extradural approach.

Fourth, the location of the incision of the ventral dura must be carefully considered to repair the dura after resection of the pseudotumor. If the incision is made too close to the spinal cord, then surgeons cannot repair the ventral dura. Therefore, surgeons must choose the site of the incision farthest away from the lateral edge of the spinal cord.

FIGURE 5. Pathologic findings in the resected tissues showed degenerated fibrocartilaginous change. [full color online](#)

FIGURE 6. The final follow-up images. A and B, Final follow-up magnetic resonance imaging. C and D, Final follow-up x-ray images.

DISCUSSION

To the best of our knowledge, there have been no reports regarding the transdural resection of retro-odontoid pseudotumors to date; however, the usefulness of the transdural approach has been reported for cervical and thoracic disk herniation. It was first described by Taylor in 1910.¹ Then, Fox and Onofrio² reported the use of the cervical transdural discectomy with a laminectomy in 1994. Fujimoto et al³ described the use of the microscopic transdural cervical discectomy with a laminoplasty in 2002, and Tanaka et al⁴ reported the long-term results of that procedure in 2013.

Furthermore, Coppes et al⁵ reported the use of the thoracic transdural discectomy in 2013 and the following advantages of the transdural approach: (1) the anatomic region is familiar to spine surgeons; (2) all types of thoracic disk herniation can be treated including the medial calcified type; (3) minimal blood loss and perioperative morbidity; (4) no intensive care unit admittance is required; and (5) no fixation of the thoracic spine is required.

The transdural resection of retro-odontoid pseudotumors also has the advantages of less bleeding and less adhesion in the intradural space than in the extradural space. Furthermore, the pseudotumor can be approached much easier via the transdural approach, compared with an extradural approach, because the retro-odontoid pseudotumors are usually located in the central part of the ventral spinal cord.

Chikuda et al⁶ reported that approximately two thirds of retro-odontoid pseudotumor cases previously reported in the literature have obvious atlantoaxial instability; however, the other one third did not. When there is an obvious atlantoaxial instability, it is not difficult to identify the lesions as a pseudotumor, and fusion surgery is recommended in such cases. When there is a large pseudotumor without obvious instability, it is more difficult to diagnose the lesion as a pseudotumor. For such conditions, some groups recommend

fusion surgery, whereas others recommend posterior decompression without fusion, including a C1 laminectomy.⁷ Either treatment can be chosen, however, confirmation of the pathologic diagnosis is ideal because there are higher risks of the lesion being a true tumor compared with cases with obvious instability.

Another advantage of the posterior transdural approach is that additional fusion surgery can be applied during the posterior approach if necessary. In the anterior or lateral approaches, additional fusion surgery cannot be performed during the same approach; however, in the posterior approach, additional fusion surgery can be readily performed during the same approach.

Therefore, a transdural resection is recommended as a useful option for resecting retro-odontoid pseudotumors via the posterior approach, although the procedure should be carried out by surgeons with extensive experience in performing intradural surgeries.

CONCLUSION

In this paper, we reported an innovative surgical technique for the resection of a retro-odontoid pseudotumor using the transdural approach.

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