



Surgery for dural ossification in association with cervical ossification of the posterior longitudinal ligament via an anterior approach

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Study design: Direct removal of an ossified mass via an anterior approach carries good decompression, to one- or two-level ossification of the posterior longitudinal ligament (OPLL) of the cervical spine. Ossification occasionally involves not only the posterior longitudinal ligament (PLL) but also the underlying dura mater. Defect of the dura mater by resection of the dural ossification (DO) can cause cerebrospinal fluid leakage or neural injury. The technique of resection of OPLL with floating of DO provides satisfactory decompression and avoids dural defect or neural injury in OPLL associated with DO. **Methods:** Four patients developed cervical myelopathy. Radiological examination revealed cord compression due to OPLL associated with DO. **Results:** All patients underwent anterior procedures. After the necessary discectomies and corpectomies, OPLL was resected using a high-speed drill with a 4-mm steel burr and then with a 4-mm diamond burr. When the OPLL became paper-thin, it was separated from the dura mater using a microdissector and a Kerrison rongeur. There was a thin layer of the nonossified degenerated PLL between the residual OPLL and DO. Meticulous dissection of the residual OPLL over the DO was performed without removing the DO at this layer. Fixation was performed with a titanium cylindrical cage. **Conclusion:** This technical note describes the successful decompression of the spinal cord by removing OPLL only, and avoidance of dural defect or neural injury in cases of OPLL associated with DO.

Key words: Anterior cervical approach; dural ossification; ossification of the posterior longitudinal ligament; surgery.

Ossification of the posterior longitudinal ligament (OPLL) is one of the major diseases in which cervical myelopathy or radiculopathy develops.^[1-5] Various operative procedures using either an anterior approach or a posterior approach have been used for treating this disease. Anterior approach is es-

entially performed in cases of one- or two-level segmental OPLL or hypertrophied posterior longitudinal ligament (PLL) with or without associated intervertebral herniated discs, while multilevel laminectomy or laminoplasty is indicated for continuous or mixed-type OPLL.^[6-11] Although anterior decompression of the spinal cord by resection of the ossified ligament combined with anterior arthrodesis can achieve more satisfactory results than posterior approach, surgical tactics are of importance to avoid unexpected complications including cerebrospinal fluid (CSF) leakage and spinal cord damage.^[12-14] Because OPLL is known to involve ossification of the dura mater or to be tightly adherent to the dura mater, unexpected dural, arachnoidal, or underlying neural injury by removing the entire ossified mass may occur, resulting in neurological compromise as well as CSF leakage.^[12,15,16] We describe a surgical technique for dural ossification (DO) associated with OPLL, for achieving satisfactory decompression and for avoiding intraoperative complications in anterior procedures.

Case reports

Patient 1

A 61-year-old man fell down, and suddenly felt weakness in his right arm. An examination revealed 4/5 strength in his right wrist extension, hypesthesia in the right C6 and C7 areas and deep tendon hyper-reflexes in his knee and ankle jerks. Imaging studies revealed segmental OPLL at C4-5 and C5-6 and DO at C4-5. A diagnosis of segmental OPLL with associated DO was made. He underwent anterior approach for decompression and fusion at the two levels. After necessary discectomies and corpectomies, removal of the OPLL using a high-speed drill was performed until the PLL was revealed between the OPLL and DO. The ossified portion of the dura mater was then floated. After confirming good pulsation of the dural theca, anterior fusion with titanium interbody cages

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was performed. The patient showed good recovery postoperatively with improvement of his neurological status.

Patient 2

A 71-year-old man developed numbness in his upper extremities. A neurological examination revealed hypesthesia in the C6, C7, and C8 areas bilaterally. Imaging studies revealed segmental OPLL at C4-5 and associated DO at C5-6, causing cord compression. Anterior procedures were performed. After a necessary corpectomy, OPLL was drilled out with a high-speed drill until the underlying PLL was exposed. When the OPLL was removed, the dura mater with the ossified portion showed good bulging and pulsation. Postoperative X-rays revealed a floated DO. The patient numbness became mild.

Patient 3

A 57-year-old man fell down on the road. After this episode, he felt dysesthesia in his left arm. A neurological examination revealed 2/5 strength in his left deltoid and biceps, 3/5 strength in his left triceps, and hypesthesia in the left C6 area. Imaging studies revealed segmental OPLL at C4-5 and C6-7 and OPLL with DO at C5-6, with cord compression. Direct removal of OPLL using a high-speed drill was performed without removing the DO. Meticulous separation of the OPLL from the ossified dura was performed, however, slight dural laceration occurred. After decompression, the dura mater showed good pulsation. The dura was repaired by placing fascia covered with fibrin glue. Postoperative computed tomography (CT) revealed a floated DO. The patient showed reasonable improvement of the neurological status postoperatively.

Patient 4

A 58-year-old man developed painful numbness in his left

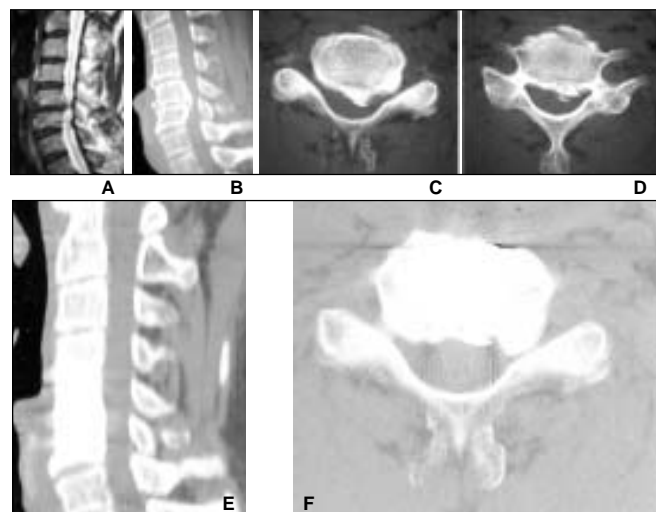


Figure 1: (Case 4) Sagittal reconstruction of computed tomography (CT) and axial CT showed segmental ossification of the posterior longitudinal ligament (OPLL) with dural ossification causing cord compression at C5 and C6 (A-D). One-year follow-up CT demonstrated evacuation of intracanalicular ossified components without causing canal stenosis (E, F)

arm 2 years ago. A neurological examination showed 3/5 strength in his left deltoid and 4/5 in his left biceps, hypesthesia in the left C5 and C6 areas and increased deep tendon reflexes in the knee and ankle jerks. Sagittal CT reformation revealed a double-layer ossification at C5-6, and magnetic resonance (MR) imaging demonstrated cord compression at the same level. Anterior approach with direct removal of OPLL combined with interbody fusion was performed at C4-5 and C5-6. The ossified portion of the dura mater was not drilled. Postoperatively, the patient showed good recovery. Postoperative sagittal CT reformation revealed evacuation of OPLL as well as DO [Figure 1].

Surgical technique

The patient is placed in the supine position with the head slightly extended [Figure 2]. A transverse skin-fold incision is made, beginning at the midline and crossing the anterior border of the sternocleidomastoid muscle. The appropriate surgical level is confirmed by intraoperative portable radiography. After necessary discectomies, the vertebral bodies (VBs) are partially removed using an appropriate reamer. The residual VBs are removed using a high-speed drill. When the underlying OPLL is exposed, a high-speed drill with a 4-mm cutting burr is used for gross thinning of the OPLL. After the

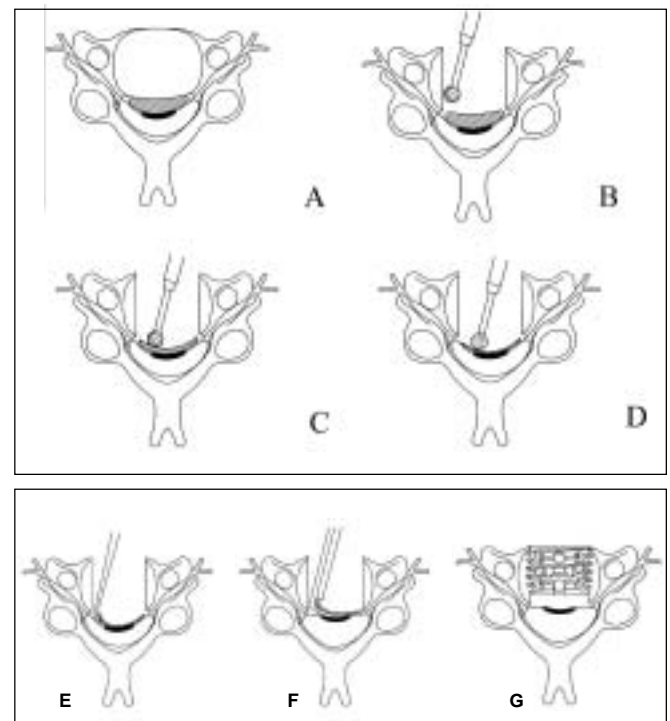


Figure 2: After necessary discectomies and corpectomies, ossification of the posterior longitudinal ligament (OPLL) is roughly drilled using a high-speed drill with a 4-mm steel burr until the OPLL becomes grossly thin (A-C). The thinned-out OPLL is further drilled using a high-speed drill with a 4-mm diamond burr (D). The paper-thin OPLL and the thin posterior longitudinal ligament (PLL) are meticulously separated from the ossified dura mater using a microdissector and a 1-2-mm Kerrison rongeur (E, F). After satisfactory decompression of the spinal cord with the floating dural ossification (DO), a titanium cylindrical cage is placed for internal fixation (G)

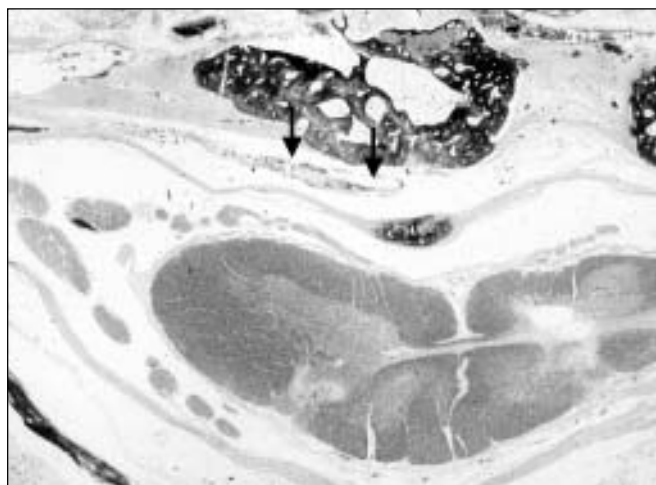


Figure 3: A cross-sectioned spinal cord taken from autopsy specimen showed severe cord compression with cystic cavity caused by ossification of the posterior longitudinal ligament (OPLL) associated with dural ossification (DO). There was a thin layer of the posterior longitudinal ligament (PLL) between OPLL and DO (arrow) (Kluver-Barrera stain, original magnification x 40)

OPLL becomes thin, the head of the high-speed drill is changed from a steel burr to a diamond burr. The residual OPLL continues to be drilled until it becomes paper-thin. Then, the OPLL is meticulously separated from the underlying dura mater using a microdissector. There is a thin layer consisting a nonossified degenerated PLL between the OPLL and the ossified portion of the dura mater [Figure 3]. The residual thinned-out OPLL and the PLL over DO are resected from the dura mater and its ossified portion using a microdissector and a small Kerrison rongeur. The ossified portion of the dura mater is left alone to avoid dural defect and CSF leakage. After the OPLL is removed, the dura mater becomes bulged and shows good pulsation. Hemostasis is achieved by an electrical cautery. An interbody cage with a 10-, 12-, or 14-mm inner diameter packed with bone chips, derived from the corpectomy, is then placed for maintaining a original cervical alignment. Intraoperative radiography is used to confirm the appropriate placement of the cage before routine closure of the wound.

Discussion

There are two surgical procedures for the treatment of OPLL: (1) direct removal of the ossified mass via an anterior approach, or (2) decompression in which the techniques of laminectomy or laminoplasty are used, via a posterior approach.^[1,2,9,17] Although the decision should be based on patient age, severity of symptom, type of OPLL, and the surgeon's preference, anterior decompression of OPLL generally achieves more satisfactory results than posterior decompression in cases of one- or two-level OPLL.^[2,18–20] However, CSF leakage occurs during 4.5–32% of multilevel anterior cervical corpectomies with fusion performed for OPLL.^[13,14] Accumulation of CSF in the wound may cause delay of wound heal-

ing, delayed kyphotic deformity, or infection or airway obstruction.^[6] Furthermore, nerve root herniation or spinal cord damage may occur through the dural defect during surgical manipulation. Thus, we describe a new technique for avoiding those complications.

DO associated with OPLL has been documented by several authors.^[16,21,22] It is almost inherently obvious that CT would be the most accurate method in such cases. Hida et al. and Mizuno et al. defined the double-layer sign on CT, which is most common in segmental OPLL, as being characterized by anterior and posterior rims of hyperdense ossification separated by a central hypodense mass, the hypertrophied but nonossified PLL.^[16,22]

In our technique, the usual necessary discectomies and corpectomies are performed first to expose the OPLL. OPLL is usually removed using a high-speed drill with a 4-mm steel burr until it becomes thin, because the ossified mass is composed of solid lamellar bone. Sporadic bleeding in OPLL can be managed with packing bone wax. When the OPLL becomes thin, the head of a drill should be changed from a steel burr to a diamond burr to prevent accidental damage of the underlying dura mater. When the OPLL is further thin and cracked, it becomes mobile. At this point, drilling of the OPLL is terminated, and the thinned-out OPLL and nonossified hypertrophic PLL are separated from the dura mater, using a microdissector, and are then resected piecemeal using a 1–2-mm Kerrison rongeur after a small piece of cotton is inserted into the space between the OPLL and the dura mater. It could be dangerous to tilt the residual DO, because of involvement of the dura mater or further compression of the deformed spinal cord. In fact, minor CSF leakage occurred during this procedure as shown in Case 3. Therefore, one who performs this procedure should be careful not to grasp and remove a large piece of the residual ossified or hypertrophied PLL. This manipulation prevents the dura mater from tearing due to adhesion. Ossified portion of the dura mater can be separated from the OPLL, because there is a thin layer of the PLL between the OPLL and DO in cases of double-layer pattern. The remaining isolated DO floats and becomes mobile, and eventually may not compress the spinal cord as shown [Figure 1].

The indication of this technique is essentially for one- or two-level segmental OPLL associated with a double-layer DO, while three- or more-level OPLL is indicated for a posterior approach. Continuous or mixed-type OPLL with DO should also treated by a posterior approach, because the dura mater may be extensively involved in OPLL, and no layer of the PLL may exist between the OPLL and DO.

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