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Successful treatment of continuous ossification of the posterior longitudinal ligament in the lumbar spine using percutaneous transforaminal endoscopic spinal decompression: a case report

Yuexin Tong[1,2,*], Zhangheng Huang[1,2,*], Zhiyi Fan[1,2], Chengliang Zhao[3] and Youxin Song[1]

Abstract

Ossification of the posterior longitudinal ligament (OPLL) of the lumbar spine is rare relative to that of the cervical spine but is often associated with more severe symptoms. Continuous lumbar OPLL is extremely rare. We herein describe a 48-year-old Chinese woman with lumbar spinal stenosis caused by continuous OPLL. She presented with a 5-year history of lower back pain and intermittent claudication. We performed percutaneous transforaminal endoscopic decompression by the posterolateral approach to achieve adequate decompression of the spinal canal up to the lower 1/3 level (0.9 cm) of the L1 vertebral body and down to the upper 1/2 level (1.3 cm) of the L2 vertebral body. After surgery, the patient's neurological function substantially improved, and her visual analog scale scores for the lower back and both lower extremities and her Oswestry disability index were significantly lower than those in the preoperative period. During the 12-month clinical follow-up period, the patient's neurological function was fully restored, and she regained her ability to walk normally. No surgery-related complications

[1]Department of Orthopedic, Affiliated Hospital of Chengde Medical University, Chengde, Hebei, China
[2]Graduate School, Chengde Medical University, Chengde, Hebei, China
[3]Department of Orthopedic, The Affiliated Hospital of Qingdao University, Qingdao, Shandong, China

*These authors contributed equally to this work.

Corresponding author:
Youxin Song, Department of Orthopedic, Affiliated Hospital of Chengde Medical University, No. 36 Nanyingzi Street, Chengde, Hebei Province 067000, China.
Email: syxmed@126.com

were observed. This case report describes a novel surgical approach that may be an effective treatment alternative for continuous lumbar OPLL.

Keywords

Continuous, ossification of the posterior longitudinal ligament, percutaneous transforaminal endoscopic decompression, lumbar spinal stenosis, neurological function, case report

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Introduction

Ossification of the posterior longitudinal ligament (OPLL) is a common cause of spinal canal stenosis and spinal cord compression, which can cause varying degrees of neurological symptoms.[1] OPLL is most common in the cervical spine; it also occurs to a lesser extent in the lumbar spine, where it is often accompanied by more severe symptoms.[2] However, continuous lumbar OPLL is rare.

The optimal surgical modality for lumbar OPLL remains controversial. Current surgical modalities include both anterior and posterior approaches.[3] However, traditional open surgery has some disadvantages, such as excessive blood loss, high complication rates, long hospital stays, and long-term lower back pain after surgery.[4,5] With the rapid development of minimally invasive techniques in spine surgery, endoscopic techniques have been widely applied to treat diseases that cause spinal degeneration.[6,7] Kong et al.[8] first reported the application of endoscopic techniques for the treatment of T1–T2 cervicothoracic PLL ossification. To the best of our knowledge, however, no reports have described the application of endoscopic techniques for the treatment of continuous lumbar OPLL. We herein report a case of lumbar spinal stenosis (LSS) with continuous OPLL treated by percutaneous transforaminal endoscopic decompression (PTED) using the posterolateral approach.

Case presentation

Clinical presentation and imaging findings

A 48-year-old Chinese woman presented with a 5-year history of low back pain and intermittent claudication. Her symptoms had not improved with conservative treatment. The patient came to our hospital for minimally invasive spinal surgery because she had developed pain and numbness in both lower extremities (more severe on the right side) 6 months previously, accompanied by slight numbness in the perineal area. Neurological examination revealed grade 3 right lower extremity muscle strength, grade 4 left lower extremity muscle strength, and bilateral distal sensory decompensation of the middle thigh. Her visual analog scale (VAS) scores were 6 for low back pain, 7 for the right lower extremity, and 4 for the left lower extremity, and her Frankel grade was D. The patient's Oswestry disability index (ODI) was 24 (48%), which was consistent with severe dysfunction. Magnetic resonance imaging showed spinal cord compression from T12 to L2 anteriorly (Figure 1(a) and (b)). Axial computed tomography (CT) showed significant central stenosis of the spinal canal (Figure 1(c)). Sagittal CT

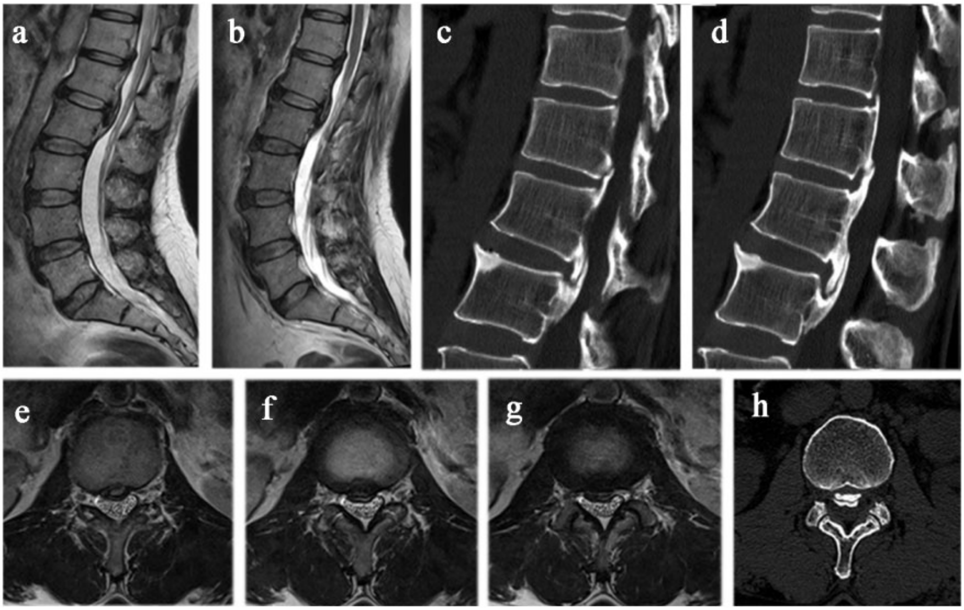

Figure 1. Imaging of the patient on admission. Preoperative (a, b) sagittal and (e–g) axial T2-weighted magnetic resonance images of the patient on presentation demonstrated localized ossification of the posterior longitudinal ligament (OPLL) at T12–L2, compressing the spinal cord. The OPLL at T12–L1 showed mild compression, while L1–L2 was severely compressed. (c, d) Sagittal and (h) axial computed tomography showed significant central stenosis of the spinal canal as well as OPLL extending from T12 to L2, being most prominent at the level of the inferior rim of the L1 pedicle–L2 pedicle.

showed OPLL extending from T12 to L2, most prominent at the level of the inferior rim of the L1 pedicle–L2 pedicle, with more than 30% compression (Figure 1(d)). After systematic evaluation of the disease, the diagnosis was T12–L2 LSS due to continuous OPLL, and the responsible segment was determined to be L1–L2. Open surgery was recommended. However, the patient and her family adamantly refused open surgery. Therefore, we planned an alternative treatment strategy because our group has accumulated extensive experience in the treatment of LSS as well as bone masses protruding into the spinal canal due to thoracolumbar burst fractures using PTED; furthermore, we have improved the PTED technique to achieve decompression of the intervertebral foramen area, lateral recess area, central canal area, and contralateral lateral recess area.[9,10]

Surgical procedure

We performed PTED using the posterolateral approach as follows. With the patient placed in the left prone position on a radiolucent surgical bed, a soft roll was placed below her waist. Fluoroscopy with a C-arm was performed to confirm the L1–L2 level. A line perpendicular to the posterior midline was traced, and a point 10 cm from the midline was selected as the entry point for the needle. The operation area was disinfected, and the skin was infiltrated with 5 mL of 1% lidocaine. At the selected entry point, the puncture needle was inserted at 15° to the body surface, and an approximately 1-cm skin incision was made at the entrance of the guidewire after passing a guidewire through the needle. Dilators and bone drills of increasing diameter were then inserted in sequence to dilate the soft and bony tissue and gradually grind away the ventral bone on the superior articular process of the L2 vertebral body through a dorsal approach. A working cannula was placed along the guidewire after the L1–L2 right foraminoplasty, as shown in Figure 2. After the transforaminal endoscopic spine system was inserted, it was possible to see the osseous compressions filling the spinal canal (Figure 3(a)). The dural sac was severely compressed and moved dorsally. First, a nucleus pulposus forceps was applied to remove the protruding disc and hyperplastic ligamentous tissue in the intervertebral foramen area and the space between the disc and ligamentum flavum to relieve the nerve compression. Next, the bony channel of the intervertebral foramen was enlarged and reshaped using a curved osseous chisel and a power grinding drill to provide the working cannula and

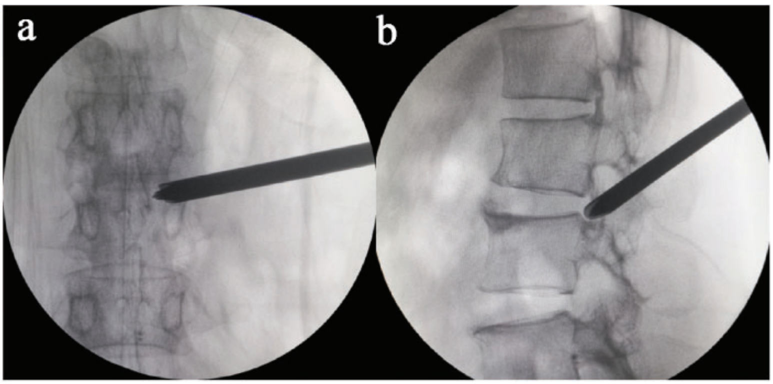

Figure 2. C-arm fluoroscopy. (a) The distal end of the cannula was extended close to the median part of the spinal canal. (b) The cannula tip reached the posterior–superior end of the L2 vertebra.

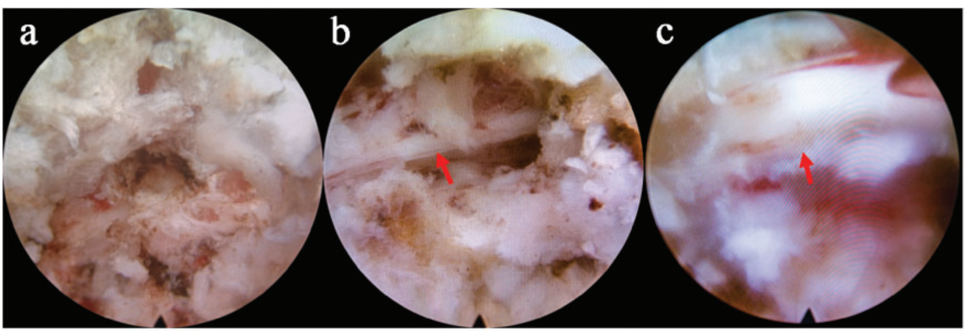

Figure 3. (a) After insertion of the transforaminal endoscopic spine system, it was possible to see the osseous compressions filling the spinal canal. (b) The dural sac was visible after surgical decompression to a certain extent, but the ventral side of the dural sac was still compressed by the ossification of the posterior longitudinal ligament. (c) At the end of the surgery, the osseous compression on the ventral side of the dural sac was sufficiently excised and the dural sac resumed pulsating.

the endoscope sufficient space for movement. The bony compressive materials in the intervertebral foramen area, lateral recesses, central canal, and contralateral lateral canal were finally removed (Figure 3(b)), and decompression was extended toward the head and caudal ends of the spinal canal. Intraoperatively, a portion of the lesion was found to be severely adherent to the dural sac, and a small number of floating lesions adherent to the dura were not resected to avoid dural tears and other injuries. When adequate ventral decompression of the exiting nerve root and dural sac had been achieved (Figure 3(c)), the throbbing of the dural sac resumed and the patient's lower extremity pain and numbness were significantly relieved; thus, the criteria for the end of the operation were met. A drain was placed before finishing the surgery. The operation lasted 2 hours, and the blood loss of this minimally invasive surgical procedure was very limited. The procedure was performed using a percutaneous transforaminal endoscopic spine system (MaxMoreSpine® System; Hoogland Spine Products, Unterföhring, Germany).

Follow-up

On postoperative day 1, the patient's right lower limb muscle strength increased to grade 4 and her left lower limb muscle strength increased to grade 5. Numbness and discomfort in the perineal area and both lower extremities were also significantly relieved. The VAS scores for low back pain and right lower extremity pain decreased to 2, and the VAS score for left lower extremity pain decreased to 1. The ODI decreased to 18. The preoperative Frankel grade was D, and the postoperative grade was E. Postoperative CT and magnetic resonance imaging showed a significant reduction in spinal cord compression in the L1–L2 spinal canal (Figure 4). During the 12-month follow-up period, the patient had a VAS score of 1 for low back pain and experienced disappearance of the pain and numbness in both lower extremities as well as the numbness in the perineal area. Her ODI decreased to 1, and she regained her ability to walk normally. The patient's clinical function scores are shown in Table 1.

Discussion

We have herein presented a case report of the application of PTED in the treatment of LSS due to continuous lumbar OPLL. After surgery, the patient's symptoms were significantly relieved and her neurological function was significantly restored. At 2 weeks postoperatively, the patient's preoperative symptoms had completely disappeared. She remained symptom-free at the 12-month follow-up and was able to return to normal life and work.

There is no definitive surgical approach for multi-segmental lumbar OPLL; at present, the anterior and posterior approaches

Table 1. Clinical characteristics.

	Preoperative period	1 day postoperatively	12 months postoperatively
Lower limb VAS score			
Right	7	2	0
Left	4	1	0
Low back VAS score	6	2	1
ODI	24	18	1
Frankel grade	D	—	E

VAS, visual analog scale; ODI, Oswestry disability index.

are the most common surgical approaches in the clinical setting.[11] The posterior approach is less invasive and easier to perform than the anterior approach. However, considering that LSS caused by lumbar OPLL is mainly due to ventral compression of the spinal cord, surgical treatment using the anterior approach may be the most reasonable technique. Surgery via the anterior approach removes the ossified ligaments to completely decompress the spinal cord and form a solid spinal fusion for relieving the pressure on the injured spinal cord. However, this approach is also associated with technical difficulties such as cerebrospinal fluid leakage and dural sac injury.[12] In recent years, endoscopic surgery has been widely used to treat diseases that cause spinal degeneration.[13] Compared with other surgical methods, PTED has the advantages of high success rates, minimal injury, and rapid recovery, and it can significantly reduce the need for soft tissue stripping and the incidence of medically induced injuries.[14]

There is also some controversy regarding whether continuous OPLL requires excision. We believe that the decision to perform excision of the OPLL should depend on whether the OPLL is involved in the disease pathogenesis; the difficulty and risk of resection; and the segment, location, size, and scope of the OPLL. The responsible segment first needs to be confirmed by imaging findings, the patient's symptoms, and the physical examination findings. The OPLL must be removed when it is clear that it is contributing to the cause of the disease and when the difficulty and risk of removal are not significant. If the ossified structures located in the central canal are not involved in the pathogenesis and are minor, excision can be avoided. However, such structures may be excised if excision is technically feasible and the risk is manageable. Therefore, we performed surgery on this patient with decompression of only the responsible segment (L1–L2) and resection of the OPLL, without decompression of the T12–L1 segment. Our choice proved to be appropriate, and the patient's postoperative neurological function was significantly restored. Although some authors believe that OPLL is a progressive disease that can increase in severity even after decompression, our follow-up indicated that OPLL can be left untreated if it has not yet caused symptoms.[15,16]

In the present case, resection of the OPLL extended from the lower 1/3 (0.9 cm) of the L1 vertebra to the upper 1/2 (1.3 cm) of the L2 vertebra, and the decompression of the spinal canal reached the contralateral lateral recess area (Figures 3 and 4). By measuring the length of the resected OPLL in the sagittal position, we found that the length reached 2.8 cm, which is necessary for symptomatic relief in patients with OPLL. The range of foraminoplasty can be expanded under intraoperative endoscopy to facilitate complete decompression. The foraminoplasty technique is based on shaping with sequential bone drills supplemented by endoscopic power grinding drills and a bone chisel. If the patient has a severe intraoperative neurological reaction (e.g., intolerable pain, reduced muscle strength of the lower limbs, or increased numbness), it is not necessary to force the bone drill to enter the depth of the spinal canal, and the endoscopic application of the power grinding drill and endoscopic bone chisel can be used to supplement foraminoplasty. Furthermore, our patient was confirmed to have slight adhesion between the dural sac and OPLL. To avoid surgical risks such as dural sac tears and cerebrospinal fluid leaks, we attempted floating decompression of the lumbar OPLL through a percutaneous endoscope. Endoscopic decompression is first performed to treat easily resectable soft tissue lesions to relieve nerve compression; this is followed by the application of a

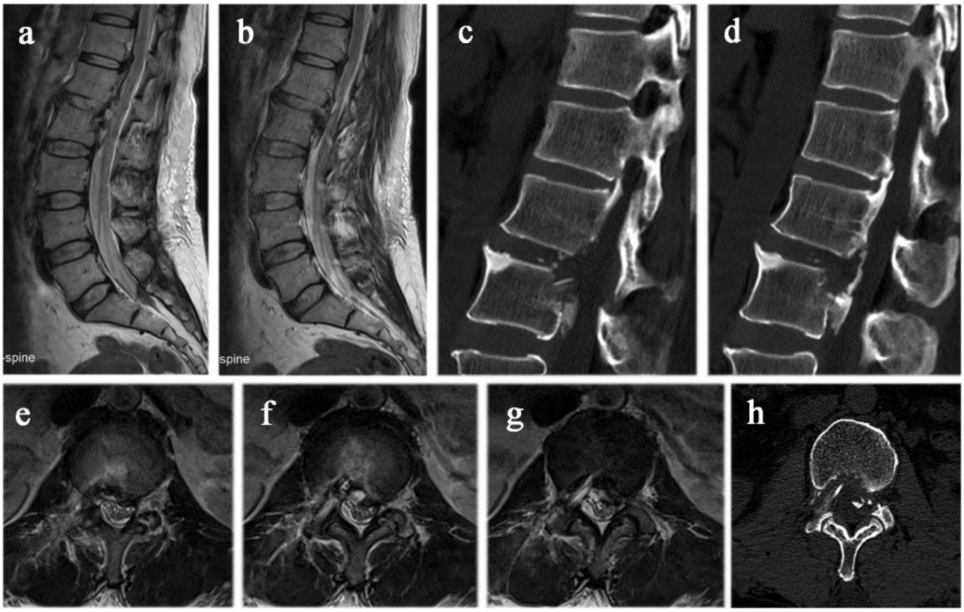

Figure 4. Postoperative (a, b) sagittal and (e–g) axial T2-weighted magnetic resonance images and (c, d) sagittal and (h) axial computed tomography images. (c) The decompression was sufficient, and the bony masses that had adhered to the dural sac were also removed. (g) The decompression range reached the opposite side. (d) Some residual bony masses that had been heavily adhered to the dural sac were treated with the "floating method" with no substantial oppression.

power grinding drill and bone chisel to remove the base of ossified lesions so that they resemble an eggshell, and radiofrequency therapy is then applied to moderately separate the nerve and the shell of the ossified lesions. A bone chisel is inserted to lightly peel the nerve, and the chisel is then gradually inserted into the underlying gap to shred the sclerotic lesion shell. The lesion is removed piece by piece using conventional endoscopic techniques; however, some of the fragmented osseous mass and ligaments that had been seriously adhered to the dural sac can be left unresected. Particular attention should be paid to the following three points during the operation. First, the ventral side of the exiting nerve root and its intersection with the epidural capsule, as well as the lower edge of the superior vertebrae, should be carefully treated. Second, special care should be taken when performing foraminoplasty of the caudal end of the intervertebral foramen, and the surgeon should remove the osteophyte at the upper margin of the lower vertebral body and part of the osteophyte on the upper inner wall of the pedicle. Third, the extremely large bony compressions in the spinal canal should be treated with a curved osseous chisel, power grinding drill, and holmium laser for ventral decompression. The residual shell should also be finally treated.

In this report, we have described the implementation of PTED in the treatment of LSS due to continuous OPLL with satisfactory results and have summarized our treatment philosophy. In the near future, PTED may be an effective treatment alternative for continuous OPLL. However, PTED for the treatment of LSS due to continuous OPLL is not without its limitations. First, the results may not be as good as those of open surgery for patients with multiple responsible segments. Second, there is greater difficulty in achieving complete decompression of the vertebral canal under endoscopy, the learning curve is longer, and there is a risk of recurrence if resection is not complete. Finally, because this study was only a case report, further practice and research are needed to confirm our findings.

Conclusions

Our case report describes a novel surgical approach that has good short-term efficacy; however, the long-term patient outcomes are unclear, and recurrence is possible. Large prospective studies are needed to further evaluate the efficacy of PTED for continuous OPLL.

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Authors' contributions

Yuexin Tong and Chengliang Zhao conceived the study design. Yuexin Tong, Zhangheng Huang, and Zhiyi Fan supervised the data collection and literature review. Yuexin Tong drafted the manuscript. Yuexin Tong revised the manuscript. Chengliang Zhao is responsible for this article.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

Ethics

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. This study was approved by the Institutional Review Board of the Affiliated Hospital of Chengde Medical University.

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ORCID iDs

Chengliang Zhao https://orcid.org/0000-0002-2673-3398
Youxin Song https://orcid.org/0000-0003-2954-0871

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