Removal of ossified ligamentum flavum via a minimally invasive surgical approach

Case report

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✓Ossified ligamentum flavum (OLF) in the thoracic spine is a rare cause of myelopathy, often presenting with progressive symptomatology over an extended period of time. Surgical decompression via wide laminectomy has been the mainstay of treatment for this symptomatic disease phenomenon, but complications such as kyphotic deformity have developed due to extensive bone removal and release of the posterior tension band. The authors present a case of OLF excised via a minimally invasive microsurgical approach in which an expandable tubular retractor system was used. This approach enables complete decompression of the spinal canal while minimizing nerve, vascular, and musculoskeletal disruption, thus maintaining the native biomechanical disposition of the intact vertebral column. (DOI: 10.3171/FOC/2008/25/8/E7)

KEY WORDS • minimally invasive spine surgery • ossified ligamentum flavum • thoracic spine

OSSIFIED ligamentum flavum in the thoracic spine is a rare cause of myelopathy, with most reports coming from the Japanese and Chinese literature.^{1,3,5,7,8} Infrequent cases have also been reported among other ethnic groups.^{2,10} The majority of patients present following an extended period of increasing symptoms. Surgical decompression with a wide laminectomy or laminoplasty has remained the standard treatment for OLF. We present a case of OLF removed via a minimally invasive surgical approach by using an expandable tubular retractor system.

Case Report

History. This 72-year-old woman presented to her primary care physician with a 4-month history of progressive gait difficulty and frequent falls. She was unable to walk for > 5 minutes without experiencing right leg fatigue and paresthesias. She also reported severe pain in her abdominal region, with a left T-10 dermatomal distribution. She denied bowel or bladder incontinence or retention. The

patient initially attempted physical therapy without significant relief.

Examination. Physical examination revealed diffuse weakness in bilateral lower extremities, with 4/5 strength in all muscle groups. She had bilateral hyperreflexia with 3+ right and 4+ left patellar reflexes in addition to left ankle clonus. She had significant gait ataxia and tended to fall to the right side.

Admission CT and MR imaging studies revealed severe dorsal spinal cord compression from T-9 to T-11 secondary to a calcified ligamentum flavum as well as a chronic compression fracture at T-12 with mild kyphosis (Fig. 1). The patient elected to undergo surgical decompression for her symptoms. We used a minimally invasive approach to leave the spinous processes and interspinous ligaments intact. Due to the preservation of the ligaments and facets, we were able to avoid a fusion in this case.

Operation. Ten milligrams of intravenous dexamethasone was administered preoperatively. A 3-cm skin incision was made with a scalpel slightly to the right of midline, followed by a right paramedian fascial opening with monopolar electrothermy. Fluoroscopically guided serial muscle dilators preceded the placement of a Pipeline Retractor (DePuy Spine, Inc.) over the right T-10 lamina (Fig. 2). A

Abbreviation used in this paper: OLF = ossified ligamentum flavum.

FIG. 1. Axial T2-weighted MR (A) and CT (B) images of the thoracic region revealing severe spinal cord compression due to OLF. Sagittal MR image (C) of the thoracic spine demonstrating stenosis at the T10/11 interspace (arrow) due to the OLF and a chronic compression fracture at T-12 (arrowhead).

right hemilaminectomy was performed using the high-speed drill and Kerrison rongeurs. The spinous process was undercut to enable medial angulation of the tubular retractor and removal of the contralateral OLF (Fig. 2). The retractor system was maneuvered superiorly and inferiorly to perform T-9 and T-11 hemilaminectomies (with undercutting of the opposite side) while preserving the midline spinous processes. Using microdissection techniques, the OLF was excised, a portion of which required removal with a high-speed drill because of adherence to the dura mater. Pathological analysis revealed dense fibrous tissue with ossification consistent with OLF.

Postoperative Course. Postoperatively, the patient experienced complete resolution of her T-10 dermatomal pain. The strength in her lower extremities improved slightly to 4+/5 bilaterally. Postoperative CT scanning revealed adequate decompression of her spinal cord at the T9–10 and T10–11 levels (see Fig. 3A and B). The patient was discharged home on postoperative Day 4. At her 2-month follow-up visit, the patient reported significant improvement in her mobility. Her physical strength had returned to 5/5 bilaterally and she was able to walk long distances. Her previous pain around the T-10 dermatome had completely resolved. At her 1-year follow-up visit, the patient contin-

FIG. 2. A: Intraoperative view of the thoracic spine through the expandable tubular retractor. B: Lateral fluoroscopy showing the position of the expandable tubular retractor. The medial blade was adjacent to the spinous process and the lateral blade of the retractor was retracting the paraspinous muscle.

FIG. 3. Sagittal (A) and axial (B) views obtained in a postoperative CT scan demonstrating removal of the OLF and decompression of the spinal canal. Lateral radiograph (C) of the lower thoracic and lumbar spine obtained 1 year postoperatively revealed no progression of the mild deformity at T-12 due to a chronic compression fracture.

ued to do well with resolution of her pain, and she continued to maintain her mobility. A lateral radiograph revealed no progression of the mild kyphotic deformity from her chronic compression fracture at T-12 (see Fig. 3C).

Discussion

Ossified ligamentum flavum of the thoracic spine is a rare cause of myelopathy. In a recent study, Aizawa et al.¹ estimated that the annual rate of symptomatic OLF requiring surgical intervention is approximately 0.6 per 100,000 inhabitants. Most patients present with symptoms of numbness and tingling in the lower extremities, radiculopathy, and back pain.^{1,3} Myelopathic signs such as gait disturbance and hyperreflexia are also common. Patients often have long-standing symptoms, usually in excess of 1 year, prior to the establishment of the diagnosis.^{1,3-5,7} Controversy exists as to whether symptom duration is a reliable predictor of outcome.⁴ In this particular case, the patient presented after only 4 months of symptomatic myelopathy, which may be a contributing factor to her expeditious full recovery.

Ossified ligamentum flavum most commonly occurs in the lower thoracic spine, primarily at T-10 and T-11.^{1,3-5} The upper thoracic spine represents another small peak of OLF.^{1,3-5} These levels are located close to the thoracolumbar and cervicothoracic junctions, and hypermobility has been suggested as the causative agent.⁵

Surgical decompression is the mainstay of treatment for symptomatic OLF.

Currently, a bilateral laminectomy is the standard surgical approach used by most practitioners.^{1,3,5,7} This leads to excellent visualization and complete resection of the pathological lesion. However, most cases of OLF involve multiple levels, thus necessitating an extended surgical decompression. Several studies have revealed that multilevel laminectomies with removal of the ligaments and facets for the treatment of OLF have resulted in the delayed development of a kyphotic deformity.^{5,6,8} Preservation of the facets and/or ligaments is necessary to avoid a fusion. Therefore,

some authors advocate the use of laminoplasty as a treatment option.⁸ However, some authors have found the outcome from laminoplasty less favorable, and often technically difficult due to the adherence of the OLF to the dura mater.⁵ Modifications to the traditional laminectomy include the use of image guidance to minimize native bone resection; others perform an in situ fusion with local bone autograft.^{5,9}

In this case, we used a minimally invasive approach with an expandable tubular retractor system, thus offering several advantages. The use of the expandable tubular retractor allows us to minimize muscle dissection and tissue trauma (denervation and devascularization). We are also able to achieve bilateral laminectomies by undercutting the inferior spinous process, leaving the posterior tension band in place, minimizing disruption to the supraspinous ligament, interspinous ligament, and paraspinal muscle. Preservation of these structures theoretically reduces the possibility of the development of kyphotic deformity. It was especially important in this case due to the presence of a chronic compression fracture at the adjacent level (at T-12). Moreover, by repositioning, angling, and maneuvering the tubular retractor and microscope, we were able to obtain a wide view of the spinal canal with minimal facet disruption.

Conclusions

In patients with thoracic spinal cord compression secondary to OLF, the goal of surgical decompression is to remove the calcific tissue safely and effectively. Although this can be achieved through a wide laminectomy, potential complications such as kyphotic deformity may develop due to the extensive bone removal. The use of an expandable tubular retractor system and microscope allows a wide surgical field of view while minimizing the disruption to surrounding soft tissue and bone structures. This approach allows complete decompression of the spinal cord with minimal alteration to the biomechanical strength of the vertebral column. In this case, we were able to avoid a fusion and the development of delayed kyphosis despite the presence of an old fracture at the adjacent level.

Disclosure

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