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Minimally invasive laminectomy treated thoracic spinal cord compression caused by ossification flavum ligament: first case report in mekong delta, vietnam and literature review

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Keywords:
TOFL: Thoracic ossification of the flavum ligament, minimally invasive laminectomy, tubular retractor system.

ABSTRACT

Thoracic ossification of the flavum ligament is a rare cause of posterior spinal cord compression. The only treatment for this pathology is surgical resection of the ossified flavum ligament to decompress the spinal cord through a laminectomy. A 65-year-old male patient had become increasingly difficult to walk and fall easily for a year, and the symptoms were worse. The diagnosis was thoracic ossification of the flavum ligament in two levels T8-9 and T10-11. He has undergone minimally invasive laminectomy with a tubular retractor system, microsurgery scope, and high-speed drill at the NeuroSpine Unit [Hidden name of Affiliation]. Ossification of the flavum ligament of the thoracic spine is a rare cause of myelopathy. Deficit of the lower extremities without hyperreflexia is often overshadowed by other disorders of the lumbar level or caudal nerve roots. Minimally invasive laminectomy with a tubular retractor system, thus offering several advantages. Preservation of these structures theoretically reduces the likelihood of developing spinal instability. Minimally invasive laminectomy treated TOFL allows complete decompression with minimal damage to important spinal structures.

1. INTRODUCTION

Thoracic ossification of the flavum ligament (TOFL) is a rare cause of myelopathy. Some reports in East Asia from Japan and China have described this spinal disease in detail [1], [2]. The prevalence of TOFL in the Japanese population is about 36% [3]. Individual cases were also reported in other regions such as North Africa, the Middle East, India, the Caribbean, Europe, and North America [4], [5]. The main pathogenesis is the differentiation of fibroblasts into osteoblasts. The flavum ligament has various pathological changes including hypertrophy, ossification, and osteophyte formation that all of these compress the spinal cord [6],

[7]. Most cases occur in the lower thoracic and lumbar vertebra or the thoracolumbar junction. Serious complications lead to paralysis of the lower extremities have been reported only in persons over 25 years of age [8]. Surgical decompression with resection or laminoplasty is the standard treatment for ossification of the flavum ligament, however, it can compromise spinal stability because of posterior column damage. Therefore, minimally invasive to limit the injuries in posterior column especially soft tissue is a trend in treatment [9]. This condition of TOFL, which affects most middle-aged men groups, may be associated with obesity and diabetes [1], [8]. It also may be idiopathic or related to genetic or metabolic diseases [2]. It is often associated with other spinal disorders such as lumbar spinal stenosis [7]. When a flavum ligament ossification situation causes severe thoracic myelopathy, the spinal stenosis often makes it difficult to determine the source of neurological symptoms, especially in the lower extremities [7]. We report a surgical case of thoracic ossification of the flavum ligament through a minimally invasive method with a tubular retractor system, microsurgery scope, and a high-speed drill. This method allows decompressing completely the spinal cord while minimizing damage to nerves, blood vessels, and skeletal muscles, thus maintaining the natural biomechanics of the spine to avoid deformation and secondary spinal instability. This case report is compliant with the SCARE Guidelines 2020 [10].

2. CASE PRESENTATION

2.1 Clinical history

A 65-year-old male patient with a history of pulmonary tuberculosis who received adequate treatment, one year ago was diagnosed with lumbar spinal stenosis at the L2-L5 segment with indications of decompression, fixation, and fusion of the posterior intervertebral bones in another hospital, post-op, the patient's symptoms did not improve much. In the past six months, this person has become increasingly difficult to walk and fall easily. He had difficulty controlling bowel movements and urination, paresthesia, and numbness in both legs. He initially tried physical therapy and medication, but there was no significant improvement in his symptoms. The symptoms were so severe that when he got emergent hospital admission, the patient had to have a urinary catheter and could not move his lower limbs.

2.2 Clinical Examination

Physical examination revealed diffuse weakness of the lower extremities, with muscle strength of 2/5 in all muscle groups. Increased tendon reflexes in both legs with 3+ on the right and left sides. Diarrhea - urinary incontinence, loss of sensation with paresthesia extending from the lower ribs down.

2.3 Imaging

The admission CT and MR images showed severe spinal cord compression at T8-9 and T10-11 segments due to hypertrophy with ossification of the flavum ligament and severed spinal cord compression (Figure 1-2). The surgeons indicated surgical decompression for the patient. We used a minimally invasive approach to preserve the spinous process and the interspinous ligament. Due to the preservation of the soft tissue and facets, we could avoid instability and do not have to fuse the spine in this case.

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Figure 1: MRI (A) and CT-Scan (B) Sagittal images of the injured thoracic spine showed severe spinal cord compression at T8-9 and T10-11 segments due to hypertrophy with ossification of the flavum ligament and severed spinal cord compression.

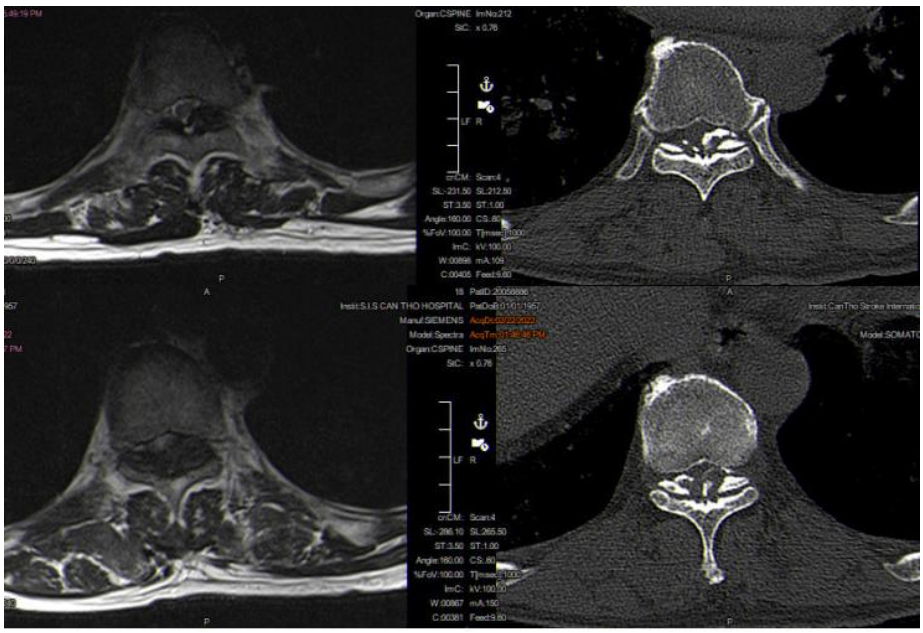

Figure 2: MRI (A) and CT-Scan (B) Axial images at T8-9 (above) and T10-11 segments (below).

2.4 Treatment

The patient was intubated, lying prone position, determining T8-9 and T10-11 level with the C-arm. The skin incision was 5mm in the left from the midline, place the tubular retractor follow by the C-arm screening at T10-11 level. We used the microscope exposed the interspinous space at T10 D11, using the high speed drill to burr the lamina, the ossification flavum ligament was exposed and the spinal cord was decompressed widely on both sides by the high-speed drill and the Kerrison rouges meticulously because the portions of calcification were attached to the dura mater. The tubular retractor system was adjusted to perform the same procedure with the T8-9 level (Figure 3). After all, we continued to perform thorough

hemostats and close the incision (Figure 4).

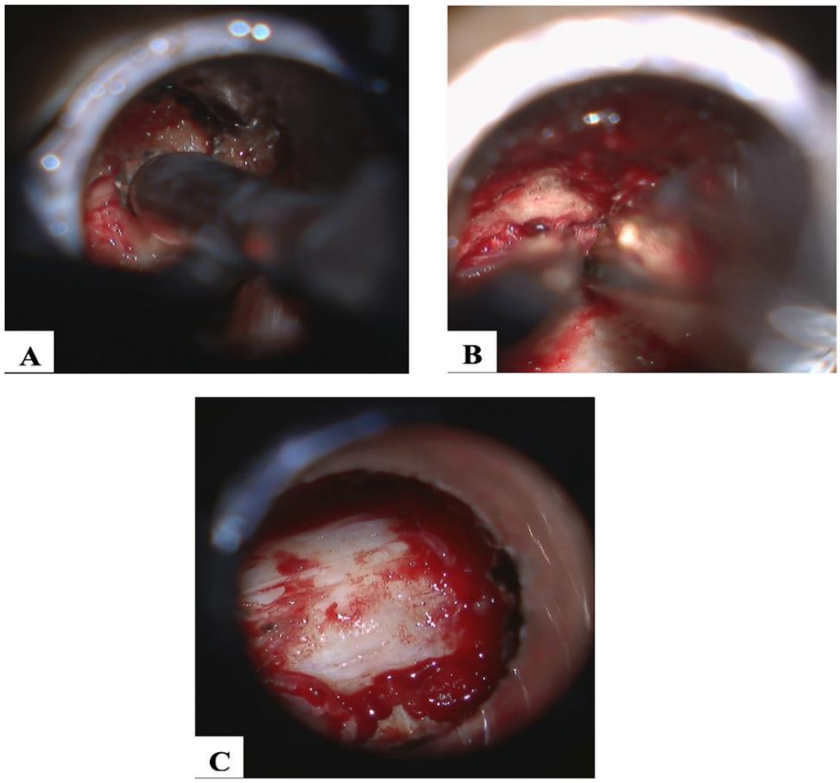

Figure 3: A: tubular retractor system was set and using high-speed drill to decompress ipsilateral spinal cord. B: contralateral decompression. C: spinal cord was widely decompressed.

Figure 4: Minimal invasive incision size

2.5 Post-operation

Post-op, the patient gradually improved muscle strength in both legs and reached a score of 4/5 when discharged. His urinary catheter was withdrawn on the 6th post-op day. Post-op CT images showed complete decompression T8-9 and T10-11 levels of the spinal cord (Figures 5-6). The patient was discharged on the 7th postoperative day. Following examination after three months, the patient reported that

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his mobility had improved significantly. Muscle strength in both legs returned to 5/5 on both sides so that he was able to walk about 50 meters without any help.

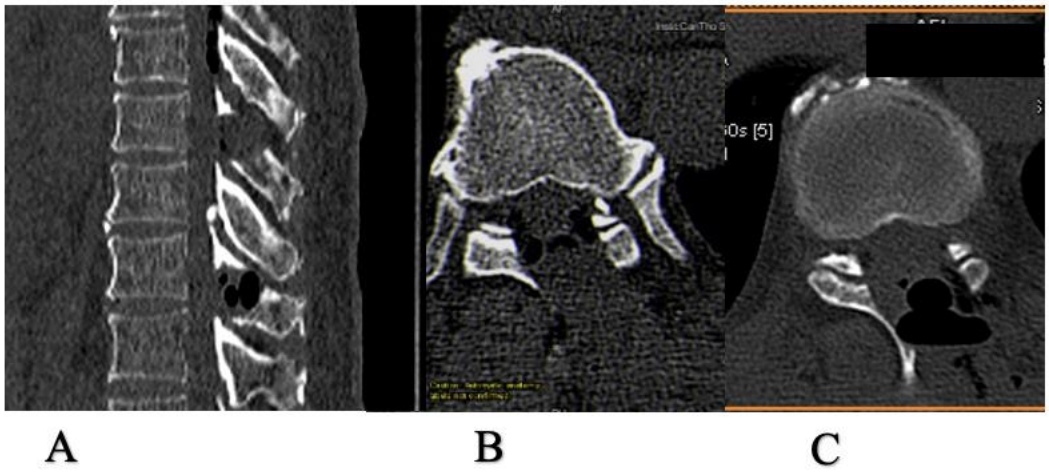

Figure 5: CT-Scan Sagittal image of the injured thoracic vertebra levels have been decompressed (A); CT Scan Axial image of T8-T9 level (B) and T10-T11 level (C) have been decompressed.

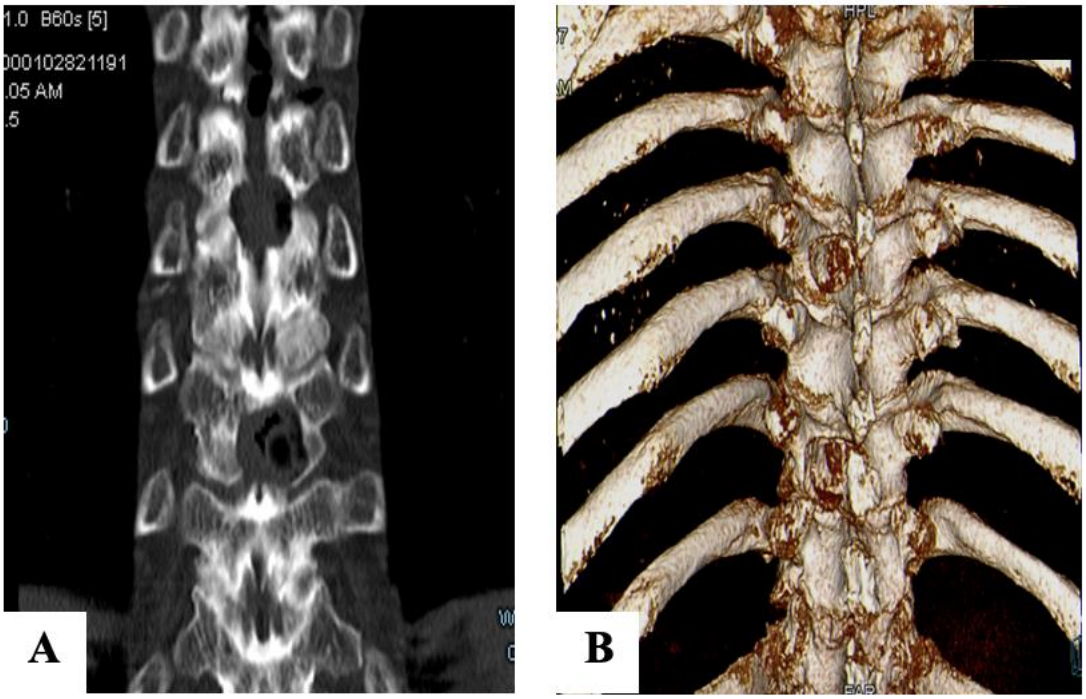

Figure 6: CT-Scan Coronal image (A) and 3D reconstruction of thoracic spine (B) showed decompression in two positions

3. DISCUSSION

Ossification of the flavum ligament of the thoracic spine is a rare cause of myelopathy. This pathology all most diagnosed in the lower thoracic or thoracolumbar junction [1]. The kyphosis of the thoracic spine could be related to mechanical stress, making the ligaments in this region more susceptible to ossification [6], [7]. TOFL may be idiopathic or related to other diseases, including ankylosing spondylitis and Forestier's disease. Patients with myelopathy due to specific lesions of the lower thoracic often present with

lower limbs pain, numbness, and neuropathic pain, consistent with symptoms of the lower extremities. In fact, with or without lumbar spinal stenosis, most patients with the TOFL still have low back and leg pain, numbness, or dysfunction. Deficit of the lower extremities without hyperreflexia is often overshadowed by other disorders of the lumbar level or caudal nerve roots [6]. In patients with complex features, thoracic pathology is difficult to diagnose. Despite the high incidence of combined spinal stenosis, several reports described the clinical cases both of lumbar and thoracic spinal stenosis [6]. The patient, in this case, had decompression surgery and intervertebral fusion from L2-L5, then the symptoms did not improve but worsened. It is also clear that when the condition is combined, the symptoms of TOFL could be obscured and ignored. Magnetic resonance imaging and computed tomography are essential for diagnosis because both provide initial information for surgical planning. Computed tomography accurately depicts the bone anatomy and shows the ossification of the ligaments more accurately than magnetic resonance imaging, which is essential for surgical planning. In a different way from a CT scan, MRI helps diagnose spinal cord and other soft tissue injuries, especially when there are multisegment compressions [1]. In addition, combining 3D reconstruction with Syngo software and Pacs system allows the surgeon to understand thorough the injury and thereby have a perfect surgical plan while explaining vividly and easily to the patient his condition and the surgical planning.

Surgical decompression is the mainstay of treatment for this pathology with symptomatic. Currently, bilateral laminectomy is the standard surgical method used by most surgeons. This method results in perfect decompression and complete resection of the pathological lesion. However, most cases of TOFL involve multiple levels, thus requiring invasive surgery. Multilevel decompression with the removal of the flavum ligament and facet joints led to the gradual development of spinal instability. Preservation of the surface joint is necessary to avoid bone fusion. However, TOFL is often adherent to the dura mater. Therefore, the rate of complications around surgery is up to 35%, and the most frequent are dural tears and cerebrospinal fluid leaks [11]. Anatomically, the spinal canal at the thoracic level is smaller than at the lumbar, which allows less capacity for manipulation. Therefore, surgery is difficult to perform at the thoracic level as at the lumbar. The high-speed diamond drill is encouraged during the surgical procedure to reduce the risk of damage to the spinal cord and blood supply caused by Kerrison rongeur [9].

In this case, we used a minimally invasive approach with a tubular retractor system, thus offering several advantages. The tubular retractor system allows us to minimize muscle dissection and tissue injury. Bilateral laminectomy could be performed by resectioning the inferior part of spinal processes as also as preserving the posterior ligamentous complex and minimizing disruption to the supraspinal, interspinous, and paraspinal ligaments. Preservation of these structures theoretically reduces the likelihood of developing spinal instability. Furthermore, by adjusting the position, angle view, manipulation, and microscope, we have a clear vision of the canal, making surgery easy and less complicated. Since the calcified portions adhere firmly to the dura and constrict the spinal canal, the high-speed diamond drill is an effective tool to help the surgeon burr the bone as much as possible, form as paper, and remove out delicately, without causing tearing of the dura mater and damage to the spinal cord.

4. CONCLUSIONS

TOFL is a rare disease commonly associated with thoracic cord secondary compression. It is initial to safely and effectively remove the calcified tissue. Although the decompression could be done through a laminectomy, potential complications such as spinal instability result from the extensive open surgery. Pre-operative planning and consultation for patients by 3D visualization of lesions on Syngo software and PACS system and the use of tubular retractor system and microscope allow a wide range of surgical vision resulting in high surgical outcomes. Combination with a high-speed diamond drill, they minimize damage

to the surrounding bony and soft tissue structures and help patients feel more assured. This minimally invasive approach allows complete decompression with minimal damage to important spinal structures. In this case, we could avoid having to fuse the patient's spine. This case is the first case reported in the Mekong Delta, Vietnam was treated at [Hidden name of Affiliation].

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