Ossification of the Posterior Longitudinal and Yellow Ligaments on the Lumbar Spine

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Abstract

Ossification of the posterior longitudinal ligament and ossification of the yellow ligament are the main causes of spinal canal stenosis. This article describes a case of ossification of the posterior longitudinal and yellow ligaments on the lumbar spine. The patient presented with gradually worsening left lower-extremity ache and pain. The deep tendon reflex was hyperreflexia in the lower extremities. Disturbances existed in the bladder and bowel. The ossified lesion of ossification of the posterior longitudinal ligament was observed at L5-S1, and plain lateral radiographs and computed tomography revealed ossification of the yellow ligament on L3, which occupied a large part of the spinal canal. Because of the findings on the preoperative radiographs, we performed posterior approach decompression and bone grafting and excised the ossified lesion. Pedicle screws were inserted from L3 to S1. The patient’s symptoms disappeared postoperatively, and his Japanese Orthopaedic Association score was 25 two weeks postoperatively.

No standard surgical procedure exists for the treatment of lumbar ossification of the posterior longitudinal ligament, but it is important to select a surgical procedure according to individual patient conditions. Many factors, such as local mechanic stress, tissue metabolism, high glucose, and genetics, contribute to the progression of ossification of the posterior longitudinal and yellow ligaments on the lumbar spine. However, the mechanism is unclear. Further study and long-term follow-up on lumbar ossification of the posterior longitudinal ligament is needed.

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ossification of the posterior longitudinal ligament can cause spinal canal stenosis and lead to severe myelopathy. Many authors have reported ossification of the posterior longitudinal ligament of the cervical and thoracic spine, but few have reported ossification of the posterior longitudinal ligament of the lumbar spine, especially lumbar ossification of the posterior longitudinal ligament with ossification of the yellow ligament. Until now, no standard surgical procedure existed for the treatment of the lumbar ossification of the posterior longitudinal ligament. The mechanism of lumbar ossification of the posterior longitudinal ligament is unclear. This article describes a case of a patient with lumbar ossification of the posterior longitudinal and yellow ligaments who underwent surgery and had a favorable result.

**CASE REPORT**

A 62-year-old man presented with gradually worsening left lower-extremity ache and pain. His height was 172 cm, and he weighed 60 kg. He developed pain and ache throughout his lateral left thigh to foot while walking. He reported left lower-extremity numbness during motion. Neurological examination revealed sensitivity in the nerve distribution of L5-S2. The deep tendon reflex was hyperreflexia in the lower extremities. Disturbances existed in the bladder and bowel. His Japanese Orthopaedic Association (JOA) score was 10 of 29, determining the therapeutic outcome of low back pain.

Plain lateral radiographs revealed arc-like ossification at L5-S1 (Figure 1). Computed tomography (CT) scan revealed L5-S1 ossification of the posterior longitudinal ligament, which occupied a large part of the spinal canal (Figures 2, 3). Ossification of the yellow ligament was observed at L3 (Figure 4). Magnetic resonance imaging (MRI) revealed spinal canal narrowing at the same levels. Ossification of the posterior longitudinal ligament and ossification of the anterior longitudinal ligament were found on the thoracic spine (Figure 5). Lumbar ossification of the posterior longitudinal and yellow ligaments were diagnosed.

Because the preoperative radiographs showed that part of the spinal canal was occupied by the ossified lesion and other levels had severe stenosis, we performed posterior-approach decompression. The laminas of L3-S1 were excised to achieve wider decompression, and pedicle screws were inserted at L3-S1. The ossified lesion was excised via osteotome and scraped at the maximal extent. No dural calcification existed due to ossification of the posterior longitudinal and yellow ligaments. Lumbar instrumentation was implanted, and we placed bone grafts at both sides of L3-S1. The patient’s symptoms disappeared postoperatively, and his JOA score was 25 two weeks postoperatively. He reported no postoperative left lower-extremity ache, pain, or numbness.

**DISCUSSION**

Lumbar ossification of the posterior longitudinal and yellow ligaments cause lumbar spinal stenosis by compressing the cauda equina or lumbar spinal nerve roots. Reports on lumbar ossification of the posterior longitudinal ligament combined with ossification of the yellow ligaments.
ment are limited, and their prevalence and mechanism remain unclear. To our knowledge, lumbar ossification of the posterior longitudinal ligament is rarer than cervical or thoracic ossification of the posterior longitudinal ligament because it is less commonly reported in the literature. Epstein\(^\text{3}\) reported that 70% of ossification of the posterior longitudinal ligament was found on the cervical spine, 15% on the thoracic spine, and 15% on the lumbar spine. Ossification of the posterior longitudinal ligament is rarely recognized as a cause of typical lumbar diseases. Okada et al\(^\text{5}\) reported that 10 (0.16%) of 6192 patients had symptoms directly affected by lumbar ossification of the posterior longitudinal ligament. Ossification of the posterior longitudinal ligament combined with ossification of the yellow ligament is rarely reported in the literature.

Lumbar ossification of the posterior longitudinal ligament is difficult to differentiate from the formation of osteophytes, epiphyseal of the vertebral body, and calcification of the intervertebral disk in some cases.\(^\text{9}\) In our case, ossified lesions with arc-like ossification of the intervertebral spaces at L5-S1 on the posterior surface of the vertebral body intraoperatively supported the diagnosis of lumbar ossification of the posterior longitudinal ligament. Ossification of the posterior and anterior longitudinal ligaments were also observed on the thoracic spine.

Ossification of the posterior longitudinal ligament is rarely reported in the lumbar spine, and the mechanism is unclear. Local mechanic stress, tissue metabolism, and genetics may be related, with the onset or progression of ossification. Ishida\(^\text{7}\) reported that the expression level of osteogenic potential cells is high in the ossification of posterior longitudinal ligament. Localized anatomical stress and abnormalities of hormone and bone metabolism stimulate this ligament, which is in a high osteogenic activity and may cause the pathology of the ossification of the posterior longitudinal ligament. Furukawa\(^\text{8}\) showed that the ligament cells derived from patients with ossification of the posterior longitudinal ligament (ossification of the posterior longitudinal ligament cells) were cyclicly stretched as a type of mechanical stress enhanced the expressions of several marker genes related to bone remodeling. This result indicated that ossification of the posterior longitudinal ligament cells are transformed into cells that are highly sensitive to mechanical stress and may induce the progression of ossification of the posterior longitudinal ligament.

Liu et al\(^\text{9}\) analyzed 19 single nucleotide polymorphisms in 4 candidate genes (RUNX2, BMP-2, COL6A1, and VDR) of 200 Han individuals. The express level of RS1321075 and RS12333172 in RUNX2 differed between the patients and the controls. Both loci were located on chromosome 6 and exhibited linkage disequilibrium, which may increase the incidence of ossification of the posterior longitudinal and yellow ligaments. Li et al\(^\text{10}\) reported that high glucose enhances type I collagen synthesis and expression of early osteogenesis genes induced by bone morphogenetic protein-2 in rat spinal ligament cells. Hyperglycemia plays an important role in the progression and onset of ossification of the posterior longitudinal ligament. The detailed mechanism of lumbar ossification of the posterior longitudinal ligament needs further study.

No well-established procedure exists for the treatment of lumbar ossification of the posterior longitudinal ligament. We achieved decompression via the posterior approach, with excision of the ossified lesion. Tamura et al\(^\text{6}\) reported that the anterior approach is the most reasonable procedure for the treatment of lumbar ossification of the posterior longitudinal ligament because previous reports in the literature show that ossification of the posterior longitudinal ligament may spread from the caudal to the cranial direction and increase in thickness postoperatively. The anterior approach does not involve invasion of the paraspinal muscles or separation of the spinal nerve tissue. If ossification of the dura mater exists, it might be sufficient to float the lesion for spinal decompression.

Okada et al\(^\text{5}\) reported that 10 patients with ossification of the posterior longitudinal ligament underwent surgery. 2 of them with the anterior approach. The mean preoperative JOA score was 5, whereas the mean postoperative JOA score was 16. Overall, the symptoms improved immediately postoperatively. In the 8 patients who underwent the posterior approach (posterior decompression and fixation, n=3), the mean preoperative JOA score was 6, and the mean postoperative JOA score was 25. All patients achieved favorable results.

The procedure for the treatment of ossification of the posterior longitudinal ligament needs further clinical study.\(^\text{10}\)

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