Surgical treatment of lumbar ossification of the posterior longitudinal ligament

Report of two cases and description of surgical technique

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Classification of the posterior longitudinal ligament, a result of heterotopic ossification, can induce spinal canal stenosis and lead to the development of severe myelopathy. Although numerous authors have reported on OPLL of the cervical and thoracic spine, few have discussed OPLL of the lumbar spine1,2 and no surgical treatment procedure has yet been established for the treatment of lumbar OPLL. We performed surgery in two patients with lumbar OPLL and obtained favorable results. These cases are discussed and the literature reviewed. Our goal was to assess the optimal surgical treatment for OPLL of the lumbar spine.

Case Reports

Case 1

Presentation and Examination. This 37-year-old man presented with gradually worsening bilateral lower-extremity pain of undetermined cause. His height was 188 cm and his body weight 94 kg. He developed pain throughout his lower extremities while moving his body and walking. He also complained of lower-extremity numbness during micturition. Neurological examination revealed sensory disturbances in the nerve distribution of L-2 or lower levels on either side, attenuation of the deep tendon reflexes in the lower extremities, and bladder and bowel disturbances. His JOA score was 14 of 29 on the scale determining therapeutic outcome of low back pain (lumbago).

Arc-like ossification was observed at the L1–2 and L2–3 intervertebral spaces on plain lateral radiographs (Fig. 1 upper left). Magnetic resonance imaging revealed evidence of spinal canal narrowing at these same levels (Fig. 1 upper center). Axial computed tomography (CT) scanning revealed L1–2 and L2–3 OPLL which occupied a large part of the circumference of the spinal canal (Fig. 1 upper right). Based on these findings and observations, the L1–3 OPLL was diagnosed and surgery was conducted.

Operation. From the imaging findings, it was determined that a one-stage excision of the ossified lesion would be possible via the anterior approach. Surgery consisted of lumbar anterior decompressive fusion at the two involved intervertebral levels and bone grafting (Fig. 1 lower left and center). The posterior margin of the VB was obliquely excised using an osteotome, the working space was secured, and the ossified lesion was excised with a surgical airtome (Fig. 1 lower right). After using the airtome to scrape the ossified lesion to the maximal extent, the lesion and the dura mater were carefully separated using a dissector to achieve total excision. There was no dural calcification due to OPLL, and the ossified PLL was completely separated from the dura. No cerebrospinal fluid leakage occurred during the operation. After placing bone grafts at the two intervertebral levels, lumbar instrumentation was also implanted. The patient’s symptoms resolved postoperatively, and his JOA score improved to 23.
Case 2

Presentation and Examination. This 38-year-old man presented with gradually worsening bilateral lower-extremity pain of undetermined cause. His height was 180 cm and body weight 88 kg. He developed pain throughout the whole of the lower extremities. Neurological examination revealed sensory disturbances in the nerve distribution of L-1 or lower levels on either side, attenuation of the deep tendon reflexes in the lower extremities, and bladder and bowel disturbances. His JOA score was 13.

Arclike ossification was observed at the L1–2 intervertebral space on plain lateral radiographs (Fig. 2 upper left). MR imaging revealed evidence of spinal canal narrowing at the intervertebral level. Axial CT revealed L1–2 OPLL, which occupied a large part of the circumference.
of the spinal canal (Fig. 2 upper center). Based on these findings and observations, L1–2 OPLL was diagnosed, and surgery was conducted.

Operation. Because the preoperative imaging findings had revealed that a large part of the spinal canal was occupied by the ossified lesion, a one-stage, anterior-approach surgery, as had been performed in Case 1, was considered unsafe, we undertook a combined anterior–posterior procedure. Pedicle screws were inserted into L-1 and L-3 during the posterior approach, and the L-2 vertebral arch was excised to achieve posterior decompression. In addition, bone grooves were made on either side of L-1 and L-2 (Fig. 2 upper right). Subsequently, the L-2 VB was approached via the anterior route and bone grooves were made, thereby achieving en bloc excision of the ossified lesion (Fig. 2 lower left, center, and right). The ossified PLL was completely separated from the dura mater, which bulged markedly after excision of the ossified lesion. Finally, anterior L1–3 fusion was conducted by placing an iliac bone graft. The patient’s symptoms resolved postoperatively and his JOA score improved to 27.

Discussion
Ossification of the spinal ligament was reported in 1925 by Knaggs in 1925 and in 1942 by Oppenheimer. Kovacs collectively referred to ossification of the posterior part of the lumbar VB, osteophyte (spur) formation at the posterior margin of the VB and OPLL as “sciatica hook.” MacNab referred to OPLL as “traction spur.” Numerous cases have been reported from Japan since 1960, when Tsukimoto reported one case of cervical OPLL. In 1975, the Research Group for Ossification of Spinal Ligament sponsored by the Japanese Ministry of Health, Labour and Welfare, proposed that the disease was intractable, and since then the disease has been continually studied and investigated. Although the disease is well recognized in Korea, Taiwan, countries in Southeast Asia, and Japan, its incidence is very low in Western countries. Thus, there is a distinct racial difference in its incidence.

Lumbar OPLL has not yet been clearly characterized. Furthermore, there have been fewer reports published on lumbar OPLL than on cervical OPLL. To the best of our knowledge, there are only 22 reports from Japan in the lit-
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erature, and surgical treatment of the disease has been discussed in 18 of them.3-4,10-11 In these 18 reports of OPLL, 77 patients were treated surgically; the procedure was posterior decompression in 55, posterior decompression and fusion in two, hemipectomy in 16 (in whom herniation was associated with OPLL), anterior decompression in two, and anterior fusion in two patients.

It has been reported that lumbar OPLL is difficult to differentiate from a dislocation of the posterior vertebral angle, spur on the posterior margin of the VB, and calcification of the intervertebral disc. In our patients, the following findings and observations suggested the diagnosis of lumbar OPLL: arclike ossification along the course of the PLL; absence of marginal separation of the VB of the posterior lumbar spine; and lack of spondylotic changes or abnormal mobility, which could be associated with spur formation. In addition, systemic osseous deposition and OPLL in the cervical spine were present in the two cases.

There is a unique margin between the spinal canal and the intervertebral foramina of the lumbar spine. Therefore, the frequency with which OPLL manifests clinically is low when the lumbar region is involved. The presence of severe stenosis is required before nerve root signs are manifested in cases of OPLL. Noda, et al.,9 reported that signs of nerve root involvement do not appear until stenosis involves 30% or more of the spinal canal. The mechanisms underlying the development of lumbar OPLL are closely related to the anatomical characteristics of the PLL. In other words, the PLL in the lumbar spine is broad at the upper levels, but its width decreases superinferiorly. Therefore, when OPLL of the lumbar spine is associated with spinal canal compression, it is frequently found in the upper lumbar spine. Under this condition, cauda equina syndrome often develops as well (as in our two cases). On the other hand, the incidence of nerve root signs due to OPLL is low when the lower lumbar spine is involved, and in such cases herniation of the intervertebral disc is considered to be the more likely cause of nerve root compression. In addition, one should exercise caution when diagnosing lesions at multiple intervertebral levels. If the high incidence of asymptomatic OPLL is kept in mind, the examiners can often predict correctly that the symptoms may improve after herniomyotomy alone.

No definite procedure for lumbar OPLL has been established, and in the majority of reports concerning surgical treatment of OPLL, the authors have described achieving decompression via the posterior approach, with excision of the ossified lesion. Although relatively good results have been reported for decompression by this approach alone, we consider excision of the ossified lesion via the anterior approach to be the most reasonable for treatment of lumbar OPLL. Posterior decompression is a relatively easy surgical procedure, but it has been reported that OPLL may spread in the caudal and cranial directions and that it may increase in thickness postoperatively or even during its natural course. Therefore, we believed that anterior approach excision of the lesion is particularly useful as a radical operation for OPLL. The anterior approach is useful because it does not involve invasion of the paraspinal muscles or separation of the spinal nerve tissue.

In the operation after scraping the ossified lesion with a surgical airtool, the ossified lesion and the dura mater are carefully separated with a dissector for total excision of the ossified lesion. When it is impossible to separate the ossified lesion from the dura matter because of strong adhesions of the former to the latter (that is, ossification of the dura mater), it might be sufficient to float the lesion for spinal decompression. In the event of occupation of a large part of the spinal canal by the ossified lesion, as in Case 2, combined anterior–posterior surgery would seem to be the safest surgical option. It is extremely important to select the surgical procedure according to the individual patient’s morbidity conditions.

Conclusions

We surgically treated two patients with OPLL of the lumbar spine and obtained favorable results. Much attention should be paid to the spinal level of the symptoms when establishing the diagnosis of OPLL, and the surgical procedure must be selected according to individual patient’s morbidity condition because disc herniation may occasionally be associated with OPLL. Excision of the ossified lesion via the anterior approach is a reasonable surgical option.

References

2. Epstein NE: Ossification of the yellow ligament and spondylodiscitis and/or ossification of the posterior longitudinal ligament of the thoracic and lumbar spine. *J Spinal Disord* 12:250–256, 1999

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