Microendoscopic partial resection of the sacral ala to relieve extraforaminal entrapment of the L-5 spinal nerve at the lumbosacral tunnel

Technical note

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The authors report the cases of three patients with L-5 radiculopathy caused by extraforaminal entrapment of the L-5 spinal nerve at the lumbosacral tunnel; this structure comprises the lumbosacral ligament, the sacral ala, and the L-5 and S-1 vertebral bodies. All three patients suffered severe leg pain and neurological deficits compatible with L-5 radiculopathy. Decompressive surgery involved the microendoscopic partial resection of the sacral ala along the L-5 spinal nerve. All patients experienced immediate pain relief postoperatively. Microendoscopic partial resection of the sacral ala is an effective and minimally invasive surgical option for patients with extraforaminal entrapment of the L-5 spinal nerve.

KEY WORDS • extraforaminal stenosis • radiculopathy • lumbar spine • lumbosacral tunnel • sacral ala • decompression • microendoscopy

LUMBOSACRAL junction extraforaminal stenosis causing lumbar radiculopathy is a relatively rare condition, one mainly affecting elderly individuals. Its diagnosis can often be missed, which results in the failed–back surgery syndrome. Extraforaminal stenosis at the lumbosacral junction is not a single clinical entity and can be caused by several different pathological conditions. Wiltse and colleagues reported on 26 patients with lumbar radiculopathy caused by extraforaminal lumbar nerve compression, describing it as the far-out syndrome. According to their report, the lumbar spinal nerve was pinched between the L-5 transverse process and the sacral ala. Nathan, et al., reported the results of a study performed in 42 cadavers; they found that the so-called lumbosacral tunnel, consisting of the L-5 VB, the lumbosacral ligament, and the sacral ala, could cause entrapment of the L-5 spinal nerve. Their description was quite different from the far-out syndrome reported by Wiltse and colleagues. We conducted a cadaveric study focusing on the relationship between the osteophytes of the L5–S1 VBs and the L-5 spinal nerve and found that specimens with osteophytes were more often associated with stenosis of the lumbosacral tunnel than those without. The optimal surgical management of such extraforaminal stenosis has yet to be established. One of the promising surgical options for achieving posterior decompression of the lumbosacral tunnel is partial resection of the sacral ala. The deep location of the extraforaminal lesions in the lumbosacral junction and also the overhang of the posterior iliac crest, however, make the posterior approach to the lumbosacral extraforaminal zone technically challenging. The microendoscopic posterior approach developed by Foley and Smith has been widely used for treating disc herniation and spinal canal stenosis. Recently, this technique has also been applied in an approach to the extraforaminal zone. It allows minimally invasive and well-illuminated visualization of the site of the lesion regardless of its depth. Using this microendoscopic technique, we treated three patients with L-5 radiculopathy caused by stenosis at the lumbosacral tunnel. The purpose of this study was to describe this surgical technique and report the preliminary results of the procedure.

Clinical Material and Methods

Three patients with extraforaminal stenosis at the lumbosacral tunnel underwent microendoscopic partial resection of the sacral ala. All three patients were men whose mean age was 69.3 years (Table 1). All patients had severe leg pain and gait disturbance, and they also exhibited neu-
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![Image 1: Case 2. Preoperative CT scan demonstrating the L5–S1 segment in a 67-year-old man with severe pain in the right leg; he could walk no farther than 50 m. The CT scan shows a prominent osteophyte at the lateral margin of the L5–S1 VBs (arrowheads).](image1)

Rological deficits compatible with L-5 radiculopathy, including sensory disturbance in the L-5 dermatome and weakness of the extensor hallucis longus muscle. The Kemp sign—aggravation of leg pain by extension of the lower back to the affected side—was positive in all the patients. One patient had undergone an L2–4 laminectomy to treat central stenosis 1 year before, and all preoperative symptoms were completely resolved. In all patients, CT scanning revealed prominent osteophytes on the lateral borders of the L5–S1 VBs (Fig. 1). Both magnetic resonance imaging and myelography revealed the absence of a compressive lesion in the spinal canal.

On selective radiculography, we observed that the L-5 spinal nerve was compressed between the osteophytes of

![Image 2: Case 3. Selective radiculogram of the L-5 nerve (arrow), which was pinched between the inferolateral border of the L-5 VB and the sacral ala. The patient experienced immediate pain relief after injection of a local anesthetic.](image2)

![Image 3: Schematic drawings of the lumbosacral tunnel and the area to be decompressed. Left: The posterior oblique view. The L-5 nerve runs through the lumbosacral tunnel, which consists of the lumbosacral ligament, the sacral ala, and the L-5 VB. Entrapped nerve root can be decompressed by resecting part of the sacral ala via an endoscopic posterior approach. Right: The posterior view after decompression.](image3)
the L5–S1 VBs and the sacral ala (Fig. 2); anesthetic nerve root blocks relieved patients’ pain.

**Surgical Technique**

The patient is placed prone on the Hall frame. Using an image intensifier, the site of the skin incision is determined, and a K-wire or an injection needle is placed. Usually, the site is just inferior to the L-5 pedicle and just lateral to the L5–S1 facet joint. After the application of sterile drapes, an approximately 1.6-cm skin incision is made across the previously determined point. The METRx MED system (Medtronic Sofamor Danek, Memphis, TN) is used for the entire procedure. A set of dilators equipped with increasing diameters is used sequentially, and the instruments are finally replaced by a tubular retractor 1.6 cm in diameter. An endoscope is set, and the muscles attached to the L-5 transverse process, lateral aspect of the L5–S1 facet joint, and sacral ala are dissected and removed using a rongeur (Fig. 3).

Because the space between the sacral ala and the L-5 transverse process is narrow, partial resection of the inferior aspect of the proximal one third of the L-5 transverse process and the lateral edge of the L5–S1 facet joint is performed to help identify the exiting L-5 spinal nerve when necessary. We resect the longitudinal fibers of the iliolumbar ligament attached to the L-5 transverse process. By dissecting the overlying fat tissue, the L-5 spinal nerve is usually identified at the extraforaminal zone; a partial resection of the sacral ala is performed for decompression along the nerve by using an air drill and Kerrison rongeur. Throughout the entire procedure, the tubular retractor is

**Fig. 4.** Case 2. Intraoperative photographs and schematic drawings of microendoscopic decompression. The right sacral ala (SA) was partially resected under microendoscopic magnification.  
A: The L-5 nerve is identified (arrowheads) and retracted rostrally along sacral ala, which is partially resected using an air drill (AD) and a Kerrison rongeur.  
B: Schematic drawing of the features depicted in A.  
C: The microdissector (MD) is passed over the anterior cortex of the sacral ala into the pelvic cavity along the L-5 nerve (arrowheads).  
D: Schematic drawing of the features shown in C. C = caudal; L = lateral; M = medial; R = rostral; TP = transverse process of L-5.
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repositioned in various directions to allow optimal views of the surgical field (the so-called wanding technique). Partial excision of the sacral ala is continued until a microdissector can be passed over its anterior cortex and into the pelvic cavity along the L-5 spinal nerve (Fig. 4).

No attempt is made to remove the VB osteophytes or to dissect the lumbosacral ligament because the L-5 nerve can usually be freed after the ala is resected. The patients are encouraged to stand up and walk the day after surgery.

Results

All the patients experienced immediate pain relief after the surgery, with disappearance of the neurogenic claudication. Postoperative CT scanning revealed adequate resection of the sacral ala (Fig. 5). At the follow-up examination conducted after a mean interval of 31 months, the improvement of the clinical symptoms was maintained in all the patients. The mean Japanese Orthopaedic Association score for low-back pain (maximal score 29) was 10.6 before the surgery, whereas at the follow-up examination the mean score had increased to 18.6, reflecting a reduction in low-back pain. The mean recovery rate was 42.7% (Table 1), the mean operative time was 141 minutes, and blood loss was less than 14 g. The three patients required a single repository administered immediately after surgery; narcotic analgesia was not required. Neither intra- nor postoperative complications occurred in any patient.

Discussion

Extraforaminal stenosis at the lumbosacral tunnel is a distinct pathological condition that manifests as L-5 radiculopathy. The diagnosis is based on the presence of neurological deficits caused by L-5 nerve root compression and on radiological findings, including CT evidence of prominent osteophytes at the posterolateral borders of the L-5 and S-1 VBs and selective lumbar radiculographic demonstration of L-5 nerve compression between these osteophytes and the sacral ala. When a selective L-5 nerve root block relieves pain, the diagnosis is confirmed.7

This condition can be managed surgically via the anterior or posterior approach. Although effective results have been associated with direct resection of the osteophytes via the retro- or transperitoneal endoscopic approach,5,7 this route is unfamiliar to most spine surgeons, not to mention being technically demanding. The posterior approach to the lumbosacral extraforaminal zone may be a less complicated alternative. The paraspinous posterior approach reported by Wiltse, et al.,14 is a well-known and well-established route by which to reach the extraforaminal zone.5,8 The aid of an operative microscope allows better visualization of the surgical field. Although this approach may be ideally suited for levels rostral to the L5–S1 segment, the presence of the iliac crest and the steep anterior sacral inclination make this route to the extraforaminal zone at L5–S1 technically challenging because the decompressive procedures should be performed within the limited, cephalocaudally oblique surgical field. The use of a microendoscope not only makes the procedures less invasive but also allows the surgeon to obtain a magnified and well-illuminated view of the lumbosacral anatomy without limiting the surgical field, as occurs when using the so-called wanding technique; therefore, microendoscopic decompression could be the most favorable surgical method for the treatment of extraforaminal stenosis at the lumbosacral tunnel. The disadvantages of this method include the long operative duration and a steep learning curve.

Although we believe that the sacral ala should be resected caudally and anteriorly along the L-5 nerve root, the optimal extent of the decompression has yet to be established. Satisfactory decompression can usually be confirmed by the loss of tautness of the L-5 nerve and the ability to pass the microdissector smoothly into the pelvic cavity beyond the anterior border of the sacral ala.

Summary of findings in three patients undergoing microendoscopic partial resection of the sacral ala*

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* JOA = Japanese Orthopaedic Association; MMT = manual muscle test; NC = neurogenic claudication; SD = sensory disturbance; SLRT = straight leg–raising test; + = present; − = absent.

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In conclusion, microendoscopic partial resection of the sacral ala is an effective and minimally invasive method by which to relieve the extraforaminal entrapment of the L-5 nerve at the lumbosacral tunnel.

References

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