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Fully-Endoscopic Contralateral L5/S1 Revision Laminotomy and Inside-Out Foraminotomy in a Patient with Posterolateral Fusion Mass: Technical Note

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Abstract

Objectives: To present an awake, fully endoscopic surgical approach for treating radiculopathy that results from L5/S1 foraminal stenosis in a patient who had prior interbody fusion and posterolateral fusion.

Methods: The patient underwent an awake, endoscopic decompression procedure utilizing two different sized cannula and high-speed drill system under direct visualization. Fully endoscopic revision laminotomy was done first through contralateral interlaminar approach. This was followed by endoscopic inside-out foraminotomy.

Results: The operative time was 108 minutes, estimated blood loss was negligible, and the surgery was done as outpatient. There were no intraoperative or postoperative complications. Comparison of preoperative and final clinical metrics demonstrated that Oswestry Disability Index (ODI) improved from 56 to 28. VAS-L improved from 8 to 2. The ODI and VAS-B scores at the last follow-up showed 73% and 78% improvement from the preoperative period respectively, which showed a satisfactory clinical outcome after 1-year follow-up and did not induce postoperative segmental spinal instability.

Conclusion: Fully endoscopic contralateral laminotomy and inside-out lumbar foraminotomy is a safe, effective technique for addressing lumbar foraminal stenosis, especially for patients with lumbar foraminal stenosis that are difficult for ipsilateral transforaminal approach.

Keywords: Spinal instability; Spine surgery; Electromyography; Pain.

Introduction

Degenerative lumbar foraminal stenosis is a common cause of lumbar radiculopathy, accounting for approximately 10% of lumbar degenerative diseases requiring surgical procedures [1]. The surgical goal of treatment for symptomatic lumbar foraminal stenosis is alleviation of symptoms through adequate neural decompression while preserving the anatomy and stability of the spine. Foraminotomy through the Wiltse approach is considered a gold standard for stenosis or disc herniation of the foraminal or extraforaminal area [2]. However, the Wiltse approach may lead to inadequate decompression, post-operative neurologic symptoms and complications due to limited visualization [3]. Advances in optics and endoscopy have allowed better visualization and more precise spine surgery, and lumbar foraminotomy through transforaminal approach has been reported with good results [4-8]. However, in patients with prior posterolateral fusion mass, or the L5/S1 level with high iliac crest, it is very challenging for ipsilateral transforaminal approach. Here we report a fully endoscopic contralateral revision laminotomy and inside-out lumbar foraminotomy technique in a patient with L5/S1 foraminal stenosis who had prior L5-S1 interbody fusion and posterolateral fusion mass.

Materials and Methods

A 57-year-old male underwent multiple prior surgeries by another surgeon from 2005 to 2009, including L4-S1 posterolateral fusion and L5-S1 interbody fusion, hardware removal. He has been having chronic left sided lower back pain, left buttock pain, and left leg pain and left leg numbness in an L5 dermatomal pattern. The pain continued years despite interventional pain management. An electromyography (EMG) study showed a left L5 radiculopathy and a computed tomography (CT) lumbar spine demonstrated left L5/S1 foraminal stenosis (Figures 1A-1C).

We assessed clinical outcomes using the visual analogue scale (VAS-L) for leg pain at preoperative examination, and follow-up examinations. We also recorded Oswestry disability index (ODI) scores at preoperative and follow-up examinations. Preoperative radiological studies included lumbar spine standing X-rays, computerized tomography (CT). Surgical time, any complications, estimated blood loss, and duration of hospitalization were also recorded.

Surgical technique

The patient was positioned prone on the Wilson frame and the procedure was done under local analgesia with intravenous sedation; the level of anesthetic was titrated so the patient was able to communicate with the surgeon throughout the procedure. Two Joimax® (Germany) TESSYS® endoscopic system was used for the procedure (Figures 2A and 2B). All surgical instruments were introduced under continuous irrigation and direct visualization through the intra-endoscopic working channel. With a 12 mm longitudinal incision 5 cm off the midline to the right side, contralateral revision laminotomy was done first with the iLESSYS Delta endoscopic system (Joimax, Irvine, USA). This system has a 10.2 mm inner diameter cannula; the endoscope has a 10 mm outer diameter and a 6 mm working channel, and a 15-degree viewing angle. Under endoscopic view, decompression was achieved using the 4.5 mm high-speed endoscopic drill (Figure 2C). Endoscopic graspers were used to remove ligamentum flavum and prior scar tissue, and endoscopic Kerrison punches (both 40-degree angle and 90- degree angle) with 1.5 mm and 3.0 mm footprints were used to remove additional bone and ligament (Figure 2D). Meticulous dissection of the interface between the scar tissue and the dura was done with blunt-tipped nerve hook.

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Figure 1A: Axial CT lumbar spine demonstrating prior L4-S1 fusion, bilateral posterolateral fusion mass, and left L5/S1 foraminal stenosis.

Figure 1B: Sagittal CT lumbar spine demonstrating prior L4-S1 fusion, bilateral posterolateral fusion mass, and left L5/S1 foraminal stenosis.

Figure 1C: Coronal CT lumbar spine demonstrating prior L4-S1 fusion, bilateral posterolateral fusion mass, and left L5/S1 foraminal stenosis.

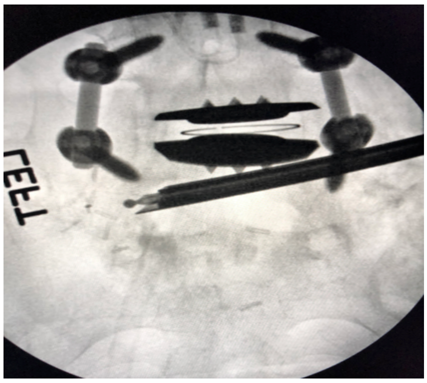

Figure 2A: Intraoperative fluoroscopy image demonstrating contralateral revision laminotomy.

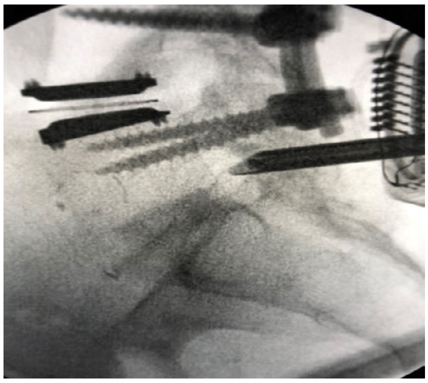

Figure 2B: Intraoperative endoscopic image demonstrating contralateral revision laminotomy.

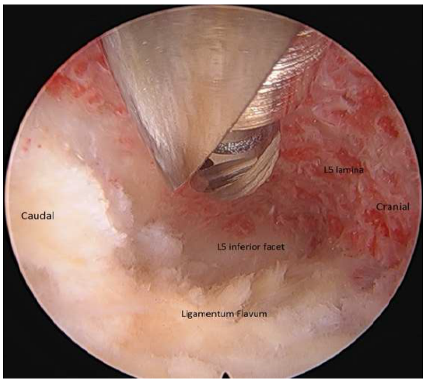

Figure 2C: Under endoscopic view, decompression was achieved using the 4.5-mm high-speed endoscopic drill.

Subsequently, a dilator was placed above the thecal sac under direct visualization (Figure 2E) and a different, smaller working sheath was placed over the dilator. The Joimax® (Irvine, USA) TESSYS® endoscopic system with a 25-degree viewing angle was used. Foraminotomy was done with high-speed drill (Joimax® Shrill, 3.5 mm diamond abrasor) (Figures 3A and 3B) by drilling the proximal aspect of the superior S1 facet to enlarge the left L5/S1 foramen (Figure 3C), the cranial approximately 50% of the superior articular process of the thickened facet joint was removed. The superior articular process in the foramen must be completely removed enough until the ligamentum flavum is exposed (Figure 3D). The exiting root was visualized under direct endoscopic vision and protected behind the bevel of the cannula. After removing the superior articular process, the ligamentum flavum around the foramen was removed using a curette, endoscopic forceps and Kerrisons. Flexible forceps and a curved probe can decompress and dissect in all corners of the endoscopic view. A bipolar coagulator (Joimax, Irvine, USA) was used for both tissue ablation and hemostasis. The final step is confirmation of free mobilization of the exiting nerve root (Figure 3E).

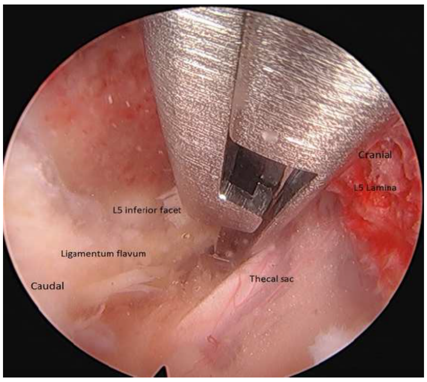

Figure 2D: Dilator over the thecal sac for exchange to a smaller cannula.

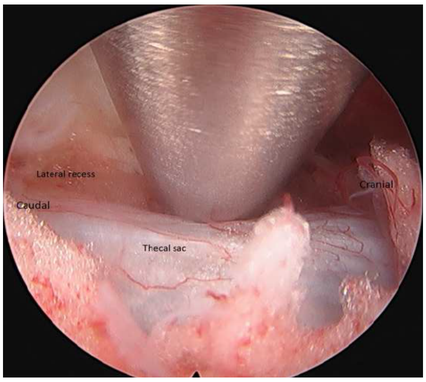

Figure 2E: A dilator was placed above the thecal sac under direct visualization.

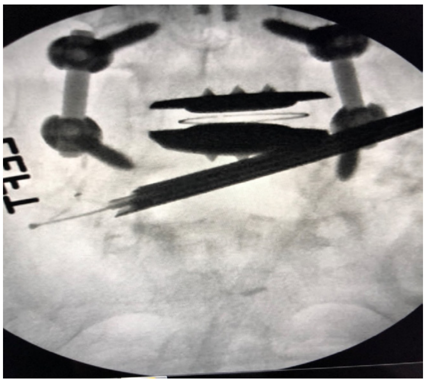

Figure 3A: Intraoperative fluoroscopy and endoscopic images.

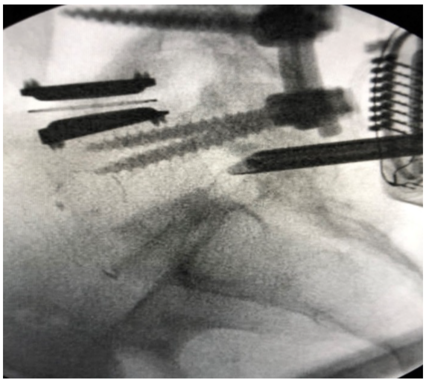

Figure 3B: Intraoperative fluoroscopy and endoscopic images.

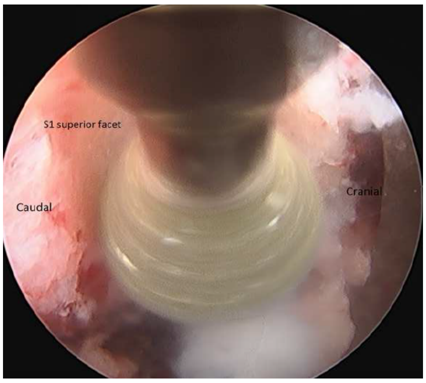

Figure 3C: Demonstrating left L5/S1 inside-out foraminotomy with high-speed drill under direct visualization.

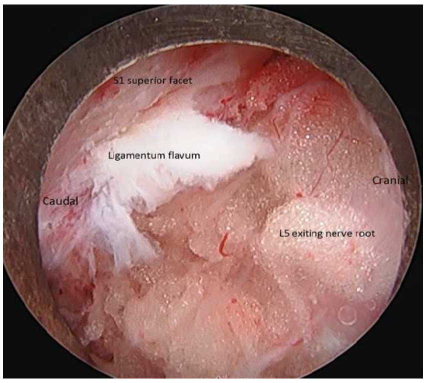

Figure 3D: Demonstrating left L5/S1 inside-out foraminotomy with high-speed drill under direct visualization.

Results and Discussion

The operative time was 108 minutes, estimated blood loss was negligible, and the surgery was done as outpatient. There were no intraoperative or postoperative complications. And the patient's pain improved immediately after surgery. Comparison of preoperative and final clinical metrics demonstrated that Oswestry Disability Index (ODI) improved from 56 to 28. VAS-L improved from 8 to 2. The ODI and VAS-B scores at the last one-year follow-up showed 73% and 78% improvement from the preoperative period respectively.

Endoscopic spine surgery has been shown to be associated with lower rate of intra- and perioperative complications compared with reported rates of other minimally invasive or open spine surgeries [9]. The transforaminal approach (through the "foraminal window") is more difficult in foraminal decompression than in intracanalicular decompression. The ipsilateral transforaminal approach to a severely stenotic neuroforamen and thorough decompression has been challenging, especially for the L5/S1 level in patients with high iliac crest and/or with prior posterolateral fusion mass. The patient in this case report actually did have left L5/S1 foraminotomy with ipsilateral transforaminal approach elsewhere but was unsuccessful.

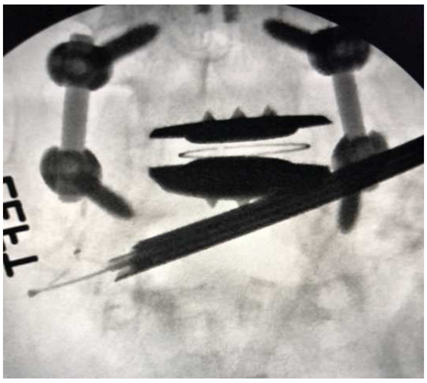

Figure 3E: Nerve hook in the decompressed foramen.

A thorough understanding of foraminal anatomy is fundamental for considering how to safely access the disc space. The use of conscious sedation decreases the side effects caused by general anesthesia and allows for patient-based neuromonitoring with continuous patient feedback. To achieve adequate decompression, the superior articular process in the foramen must be completely removed enough until the ligamentum flavum is exposed, and the exiting root must be fully decompressed from the entrance of the foramen to the extraforaminal area.

Translation or sagittal rotation did not occur after endoscopic total facetectomy in severe foraminal stenosis as such surgery minimizes tissue damage and protects the ligamentous structure [10]. Youn et al. reported that no instability occurred in endoscopic partial facetectomy [11]. The absence of lumbar instability after endoscopic surgery is speculated to be because it is much less invasive and minimizes destruction of posterior elements including facet joints. Precise decompression can be performed under a magnified endoscopic field with direct visualization, reducing excessive facet joint destruction or exiting nerve injury.

Conclusion

In conclusion, the fully endoscopic inside-out foraminotomy is an effective minimally invasive surgical technique without causing postoperative spinal instability or neurologic complications of the exiting nerve root. It could be a minimally invasive alternative method that can effectively decompress foraminal stenosis, especially in difficult cases secondary to anatomy (high iliac crest) or prior posterolateral fusion mass.

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