Minimally invasive approach to extraforaminal disc herniations at the lumbosacral junction using an operating microscope: case series and review of the literature

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Surgical access to extraforaminal lumbar disc herniations is complicated due to the unique anatomical constraints of the region. Minimizing complications during microdiscectomies at the level of L5–S1 in particular remains a challenge. The authors report on a small series of patients and provide a video presentation of a minimally invasive approach to L5–S1 extraforaminal lumbar disc herniations utilizing a tubular retractor with microscopic visualization. (DOI: 10.3171/FOC/2008/25/8/E10)

KEY WORDS • extraforaminal disc herniation • far lateral disc herniation • lumbosacral junction • minimally invasive spine surgery

EXTRAFORAMINAL lumbar disc herniations, otherwise known as far lateral lumbar disc herniations, are relatively rare and comprise 1–12% of all lumbar disc herniations.^{1,2,6,10,17,44,46,48,50,54,56,59} The approach to an ELDH is more complex than the more common posterolateral or central disc herniation due to an increased risk of postoperative instability from extensive facetectomy, inadequate decompression, or nerve root injury.^{5,9,13,18,20,22–24,33,34,41,49,51–53,60} The LSJ is difficult to access due to specific anatomical constraints at this level including compression of the L-5 nerve root by the sacral ala.^{33,44,47} In this report we describe a minimally invasive access for resection of an ELDH at L5–S1 using a muscle-splitting tubular retractor and an operating microscope. Minimally invasive access to ELDHs has been reported previously^{6,17,33} utilizing an endoscopy-assisted approach.⁴⁴ The microscopic visualization described in the present study is more familiar to most spine surgeons and does not hinder the identification of the pertinent anatomical structures.

Methods

Four patients with symptomatic extraforaminal disc herniations at L5–S1 were included in the study. The operative technique is described below and shown in Video 1.

Abbreviations used in this paper: ELDH = extraforaminal lumbar disc herniation; LSJ = lumbosacral junction.

Windows Media (broadband):

http://mfile.akamai.com/21490/wmv/digitalwbc.download.akamai.com/21492/wm.digitalsource-na-regional/foc08-74Pirris_video.asx

After the induction of general endotracheal anesthesia, patients are positioned prone on the operating table with chest bolsters. The lumbosacral region is prepared and draped in sterile fashion. Fluoroscopy is used to identify the medial border of the L-5 transverse process on anteroposterior imaging, and a 3-cm incision is made 1 cm lateral to this site, allowing the angled trajectory necessary to identify the L5–S1 extraforaminal space safely. Sequential dilators are advanced to create a muscle-splitting corridor for the tubular retractor system, which is secured in place via a table-mounted multiaxis flexible arm (Fig. 1). The operating microscope is positioned over the tube for the remainder of the procedure.

The overlying muscle on the L-5 transverse process is dissected free with a monopolar cautery. Once on bone, the dissection continues inferiorly to expose the lateral pars, facet, and sacral ala. Depending on the anatomical constraints in the individual patient, it is sometimes necessary to drill the superior aspect of the sacral ala to create a functional working space. A Woodson is cautiously used to palpate the neuroforamen and overlying pedicle. A nerve stimulator is used to identify and dissect free the exiting L-5 nerve root, which is gently retracted superiorly to allow visualization of the lateral disc space in its axilla. If necessary, the lateral pars may be resected by using a long, angled drill with a small bur bit. This tool fits easily into an 18- or 22-mm working channel.

FIG. 1. Artist's depiction of the axial plane of a tubular retractor used for access to the removal of an extraforaminal disc herniation.

The epidural veins are cauterized and sectioned. This maneuver is facilitated by the use of long bayoneted bipolar tips on a low current setting. A down-biting curette is used to remove overlying osteophytes preventing access to the lateral disc space. The annulus is opened in cruciate fashion and traditional microdiscectomy techniques are used to decompress the nerve root. Copious irrigation is performed and meticulous hemostasis is maintained. The tubular retractors are removed allowing the split muscle to return to its native position. The fascia, deep dermis, and skin are closed in routine fashion.

Results

All 4 patients included in this case series had improvement in their preoperative symptoms and none suffered any perioperative complications. The results are summarized in Table 1.

Discussion

We describe a method for minimally invasive access to resection of an ELDH at L5–S1 using a muscle-splitting tubular retractor and an operating microscope. This technique adds another option to the surgeon's armamentarium for treating this difficult problem. As noted in previous publications, access to ELDHs is more complex than the more common posterolateral or central disc herniations due to the elevated risk of postoperative instability from an extensive facetectomy, inadequate decompression, or nerve root injury.^{5,9,13,18,20,22–24,33,34,41,49,51–53,60} The overall incidence of ELDH is not known, but has been reported to encompass 1–12% of symptomatic lumbar disc herniations.^{1,2,6,10,17,44,46,48,50,54,56,59} The LSJ is difficult to access due to the specific anatomical constraints at this level including compression of the L-5 nerve root by the sacral ala (Fig. 2).^{33,44,47}

Extraforaminal disc herniations and the associated symptoms due to compression of the exiting nerve root were first described by Macnab³⁷ in 1971 in his discussion of negative disc space explorations in patients with radiculopathy. Abdullah and colleagues¹ then described the clinical syndrome in 1974 which is typically more severe than that caused by the more commonly located posterolateral disc herniations. The “extreme lateral” syndrome described by Abdullah et al. is well characterized and includes marked pain due to involvement of the dorsal root ganglion, with a greater tendency for neurological deficits.^{11–13,44,46} The proximal lumbar levels are more typically involved in ELDHs,^{2,7,8,14–18,44} probably due to the narrower pedicle widths at these levels, which allow for increased disc area in the lateral zone.^{44,48,59} Of all ELDHs reported in the literature, L5–S1 involvement has been reported in

TABLE 1

*Summary of results of microscopic minimally invasive L5–S1 extraforaminal discectomies**

Age (yrs), Sex	Complications	Estimated Blood Loss (ml)	Prolo Score		
			Preop	Postop	FU
58, F	none	50	10	16	3
62, M	none	50	12	18	11
57, M	none	50	8	20	3
73, M	none	75	8	18	6

* FU = length of follow-up in weeks.

6.5–25% of cases since the advent of MR imaging.^{7,13,19–21,27,35,39,43–46,48,50}

In patients in whom conservative treatment has failed, various surgical approaches have been utilized. Midline incisions with subperiosteal dissections are familiar to most spine surgeons, but often include a significant amount of facet resection, which can lead to postoperative back pain due to destabilization of the motion segment.^{14,17,18,20,22–24,28,29,34,55} The paramedian approach, such as that described by Wiltse and Spencer,^{61,62} requires the splitting of muscles with less bone resection and provides a more direct approach to the neural foramen.^{3,7,17,39,43} However, this approach is not as familiar to many spine surgeons.¹⁷ Some surgeons have recommended a combined approach because it permits both medial and lateral access to the neural foramen.^{8,13–15,28,34,36} To obtain adequate visualization of the anatomy for the combined approach, extensive stripping and lateral mobilization of the paraspinal muscles is required, which may lead to increased postoperative pain and paraspinal muscle dysfunction.^{26,31,32,38,42,57,58} The use of percutaneous techniques has been reported,^{4,30} but these are of limited value when free disc fragments and bone compression are present.¹⁷ The successful removal of free fragments and foraminal stenosis in surgically treated patients with ELDHs has been reported in 72–92% of patients.^{2,3,8,14–16,36,39,43}

The surgical approach is best guided by the individual

FIG. 2. Photograph of a fresh-frozen human cadaver specimen illustrating the anatomical constraints to the minimally invasive approach to an extraforaminal disc herniation at the LSJ. F = lateral facet of L-5; P = pars interarticularis of L-5; A = sacral ala; D = intervertebral disc at L5–S1; TP = transverse process of L-5.

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patient's lesion and anatomy. The paramedian approach with muscle splitting generates the least amount of osteoligamentous injury thus limiting postoperative instability.⁴⁴ The anatomy of the LSJ presents unique challenges. Reulen et al.⁵¹ have described the rigid bone confines of the intertransverse operative corridor, which grows tighter caudally in the lumbar spine secondary to a wider pars interarticularis at L-5, a shorter distance from the caudal transverse process to the superior edge of the inferior articulating process, and a higher frequency of a prominent accessory process.^{44,51} Additionally, difficulty in achieving adequate open posterior or posterolateral access through a midline incision with subperiosteal dissection is created by a prominent iliac crest, wider disc space, oblique pedicles, and more coronally oriented facet joints.⁴⁴

The goals of minimally invasive spinal approaches are to reduce postoperative pain and recovery time while maintaining proper visualization of the important anatomical structures that permit adequate neural decompression.^{6,16,17,44} The advantages of the minimally invasive, muscle-splitting intertransverse approach to ELDHs include a shortened operative exposure time and with less muscle destruction, preservation of the facet joint, and preservation of surrounding soft tissues, thus reducing the formation of scar tissue.³³ Additionally, open paramedian approaches to resection of ELDHs require a more lateral to medial approach⁵⁰ which will be limited by the position of the iliac crest for those at L5–S1.

O'Toole and colleagues⁴⁴ reported that the use of progressive dilators and a tubular retractor minimizes the barrier effect of the iliac crest and recommended judicious resection of the sacral ala to allow access to the disc from a lateral approach while avoiding excessive facet resection.^{25,40,44,48} This retractor system is easily adaptable to performing a possible laminotomy in cases where a combined intra- and extraforaminal approach is necessary to completely decompress the nerve root.⁴⁴

The microendoscopic discectomy technique for the treatment of far lateral disc herniations was initially reported by Foley et al.¹⁷ in a case series of 11 patients. These patients had herniations at L3–4 or L4–5, and all achieved excellent or good results based on Macnab criteria. Cervellini and colleagues⁶ reported on their experience in 17 patients with far lateral disc herniations at L3–4 and L4–5 who underwent surgical treatment with the microendoscopic discectomy technique. All patients achieved excellent or good results. Due to anatomical constraints, the authors claimed that treatment of far lateral disc herniations at the L5–S1 level with this technique is not possible.

Authors of previous reports of minimally invasive access to ELDHs at the LSJ have used endoscopic visualization through the tubular retractor⁴⁴ or microscopic visualization through a self-retaining speculum.³³ O'Toole et al.⁴⁴ described the far lateral microendoscopic discectomy approach with a 1.8-cm incision. They then used progressive muscle-splitting dilators and placed an 18-mm tubular retractor with an endoscope attached within the tube, and fixed the apparatus in position with a flexible arm. The patient enjoyed immediate pain relief, was discharged home 3 hours postoperatively, recovered his normal gait, and returned to full work and social duties.

Kotil and colleagues³³ reported on their surgical results in 14 patients with far lateral disc herniations at L5–S1 over a

4-year period. Their minimally invasive intermuscular approach involved a 3-cm transverse incision above the dorsal curvature of the ilium, followed by incision and dissection of the lumbodorsal fascia to retract them from the rim of the ilium. Further exploration was performed with the fingertip to define landmarks such as the transverse process, iliolumbar ligament, lateral edge of the L5–S1 facet, and upper rim of the sacrum with the costal process. Next, a self-retaining speculum was placed and the operating microscope brought into the field. After drilling the costal process of the sacral ala and performing any further bone resection as necessary, the exiting L-5 nerve root was identified and decompressed by discectomy. The outcomes in 13 (92%) of the 14 patients were excellent or good, and the patients were able to return to their previous occupations and activity levels. The 1 patient (8%) with a fair outcome was found to have extensive scarring around the nerve root on MR images obtained at the 2-month postoperative examination.

The approach described in this article is a truly minimally invasive approach as described by O'Toole et al.⁴⁴ in that we have used muscle-splitting techniques with progressive dilators through a stab incision in the skin. The primary difference between the 2 is the use of the operating microscope. Most spine surgeons have been trained using the operating microscope and are very familiar with its nuances. The views obtained through endoscopy are undoubtedly exceptional and the purpose of this study is not to dissuade surgeons who are familiar working with the endoscope. However, the use of endoscopy entails an extensive learning curve for the surgeon and operating room staff, occupies some of the working space in the tubular retractor, and incurs a significant expense for the purchase and maintenance of the necessary equipment.

The successful early outcomes obtained in this small series reflect the probable viability of this procedure. Given the small sample size and lack of sustained follow-up, no statistical correlations were calculated. The efficacy of a microdiscectomy for the relief of painful ELDHs at the LSJ has been well documented in the literature. The goal of the present study is to present an effective and truly minimally invasive muscle-splitting approach while utilizing the familiar operating microscope at the L5–S1 level.

Conclusions

For complex extraforaminal disc herniations at the LSJ, a viable surgical option is to perform the nerve root decompression and discectomy via a minimally invasive, muscle-splitting approach with a tubular retractor and operating microscope. The patients in this limited series exhibited initial symptom relief and suffered no intraoperative complications. This approach provides excellent visualization of the pertinent anatomy while utilizing familiar tools.

Disclosure

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