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Research Article

Evaluation of Clinical Outcomes in Lumbar Spine Decompression Performed Via Unilateral Biportal Endoscopy (UBE) in a Six Months Period. Retrospective Case Series

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Abstract

Background: Prior studies have shown that the source of axial back pain or radicular pain can be attributed to intervertebral disc, spinal stenosis, synovial cyst, or bone spurs. These pathologies have been treated surgically for decades with decompression via wide open laminectomy, discectomy or even with fusion procedures when indicated. Unilateral biportal endoscopic (UBE) decompression is a minimally invasive technique for treating such pathologies facilitating decompression while preserving spinal stability. The current study aims to find clinical outcomes of UBE decompression for degenerative lumbar canal stenosis (DLCS) amongst Australian population.

Methods: This is a single centre single surgeon retrospective study and includes patients who underwent UBE for DLCS from November 2022 to April 2023 with a minimum of six months of follow up. Patient's demographic data, peri and post-operative data, and length of stay (LOS) were reviewed. Clinical outcomes was assessed using visual analog scale (VAS) scores for back and leg pain, Oswestry Disability Index (ODI) pre-operatively and at 1, 3 and 6 months and the modified Macnab criteria at final follow up. A repeated ANOVA test was performed to measure the difference between VAS and ODI scores. P-value < 0.05 was considered statistically significant.

Results: The cohort consisted of 32 patients (M:18, F:14) with a mean age of 65.3 ± 12.3. The mean follow up period was 7.9 ± 0.9 months. The average length of hospital stay was 1.5 ± 0.5 days. At the final follow up, the mean VAS for back pain improved from 4.4 ± 0.8 to 2.9 ± 0.2 and the mean VAS for leg pain improved from 7.3 ± 1.1 to 0.3 ± 0.2. ODI scored significantly improved from 25.4 ± 4.3 to 4.8 ± 0.8. The modified Macnab criteria reported excellent in 23 patients (71.87%), good in 9 patients (28.13%). There were 2 dural tears which were managed with dura patch intraoperatively with no further sequelae.

Conclusion: Lumbar spinal decompression with UBE is a safe, predictable technique that achieves excellent results as evident clinically by improvement in VAS and ODI scores, reduced hospital LOS and early return to routine activities.

Keywords: *Lumbar Canal Stenosis; UBE; Endoscopy; Disc Prolapsed; Minimally Invasive Surgery*

Introduction

Most of the cases of Lumbar disc herniations (LDH) and degenerative lumbar canal stenosis (DLCS) that presents as back and leg pain are conservatively treated with analgesics, physiotherapy, and epidural steroid injections. Surgical decompression is performed when there is failure of non-operative management [1]. Traditionally, surgical decompression in form of open laminectomy with or without concomitant fusion procedures has been the standard surgical procedures for decades [2-4]. However, this approach can lead to extensive soft tissue dissection and subsequent muscle degeneration resulting, in failed back surgery syndrome [5,6]. Several randomized control trials have shown that fusion adds little value to decompression for DLCS without any segmental instability [7,8].

In recent years, Unilateral Biportal Endoscopic (UBE) decompression surgery has developed as a novel minimally invasive technique to decompress the neural elements with excellent magnification, illumination and visualization of the surgical field [9]. UBE spine surgery is dynamic in a way that it offers a wide field of view with an independent working portal favoring the surgeons to leverage conventional equipment and familiar anatomical visuals that lessens the learning curve [10]. The initial capital cost needed to equip the hospital for adoption of UBE is much less compared to the uniportal endoscopic spine surgery [11]. UBE allows for better ergonomics, minimizing surgeon fatigue and injury compared to tubular microscopic surgery [12].

There is a paucity of data on clinical outcomes of UBE decompression for lumbar pathologies (LDH and DLCS) amongst Australian population.

Aim of the Study

The current study aims to evaluate the clinical outcomes and complications of UBE decompression performed by a single surgeon for lumbar pathologies amongst Australian population.

Materials and Methods

After obtaining Institutional Review Board (IRB) approval, we performed a single centre retrospective study and included patients who underwent UBE for DLCS from November 2022 to April 2023 with a minimum of six months of follow up. The inclusion criteria were as follows: 1) Patients with lumbar radicular symptoms without severe back pain and refractory to conservative management for at least three months; 2) A diagnosis of DLCS based on clinical history, physical examination, and imaging studies; 3) The absence of significant instability, infection, fracture, or previous spinal surgery history; and 4) A minimum of 6 months of follow up. A total of 32 patients who met the criteria were included in the study. Patient's demographic data, peri-operative data, length of hospital stay (LOS), and complications were collected and reviewed. Clinical outcomes was assessed using visual analog scale (VAS) [13,14] scores for back and leg pain, Oswestry Disability Index (ODI) [15,16] pre-operatively and at 1 and 6 months, and the modified Macnab criteria [17] at final follow up. Written and informed consent was obtained from the patient and their family.

Surgical technique

The instrument setup included basic spine surgery instruments, 0° and/or 30° scope which is commonly used in joint arthroscopy, a radiofrequency console with a wand, continuous saline irrigation system and a 4 mm high speed diamond burr (Figure 1).

Positioning and marking

Patient is positioned under general anesthesia, with a face-cradle prone support system. Slight flexion is done to reduce the lumbar lordosis and open up the interlaminar space on a Wilson frame (Figure 2). Slight flexion and elevation of the knees can help mitigate venous stasis in the legs. Surgical level and anatomical landmarks are marked under fluoroscopy guidance. A true AP projection is obtained and the superior and inferior endplates of the affected disc level, the midline bony structures, and the superior and inferior pedicle of the selected level are marked (Figure 3). UBE surgery is performed with continuous normal saline irrigation to keep the operative field clear and prevent thermal injury [18]. It is important to ensure that the final layer of draping is waterproof to prevent the patient from being soaked by the cold normal saline [19]. Additionally, a smooth drainage system for the saline outflow should be properly set up to prevent complications such as hypothermia [20].

Figure 1: *(a+b) Rotating kerrison punch: 1 mm, 2 mm (c) Nerve root retractor (d) Mallet (e) Nerve hook (f) Double ended instrument- Probe (g) Curved curette (h) Straight osteotome (i) Straight pituitary forceps (j) High speed burr with diamond tip (k) Radiofrequency ablation wand 90°.*

Figure 2: *Patient positioned prone on Wilson frame.*

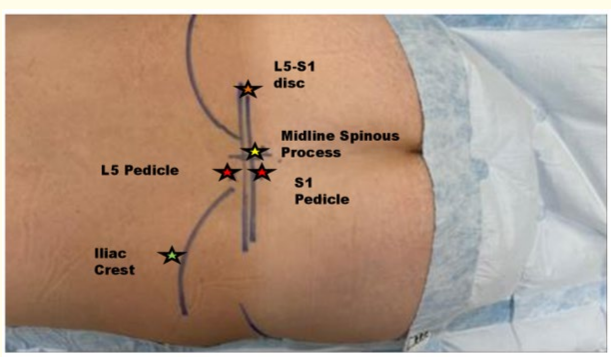

Figure 3: *Skin marking (level and landmarks).*

Portal incisions

At our institute, under fluoroscopy guidance we dock a spinal needle over the inferior edge of the superior lamina of the target level just 1 cm left of the lateral margin of the spinous process. The portals are made 2 to 3 cm apart and made cranial and caudal to the needle inserted. These portal markings normally fall along the medial pedicular line of the cranial and caudal vertebra (Figure 4a and 4b).

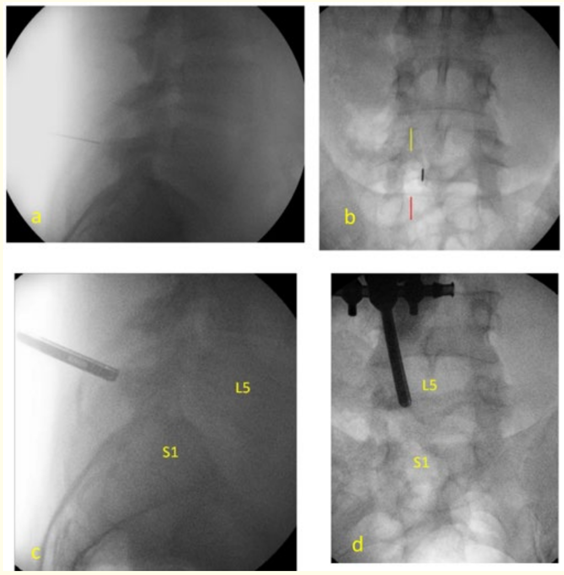

Figure 4: *(a+b) Needle position checked under C-arm. Incision for scope portal (yellow line) and working portal (red line). Check x-ray (c+d) to confirm the level following incision.*

The paraspinal muscles are split, the instrument portal is enlarged, and the soft tissues are gently separated from the interlaminar space using serial dilators up to 10 mm in length. The radio frequency (RF) probe is used to improve the surgical field by ablating soft tissue and identifying the spinolaminar junction, interlaminar space, facet joint, base of spinous process, superior inferior lamina of cranial vertebra, and inferior superior lamina of caudal vertebra (Figure 5).

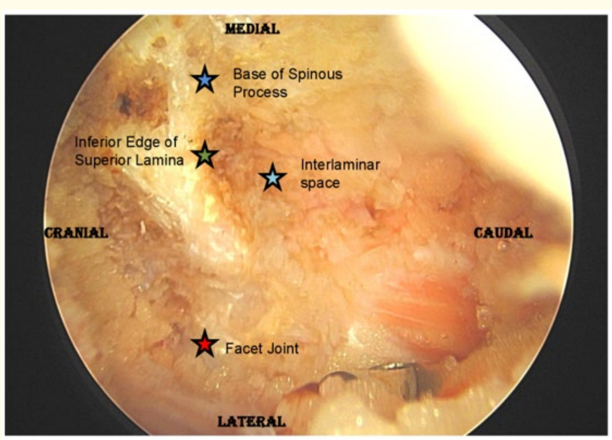

Figure 5: *Soft tissue removal with RF probe, increasing work space.*

Ipsilateral decompression

The spinolaminar junction and other anatomic features become plainly visible once the soft tissue has been removed. An ipsilateral hemi-laminectomy is done for ipsilateral decompression, beginning at the spino laminar junction. The lower half of the superior lamina is resected medially to the spinous process base and cranially to the deep layer of ligament flavum's cranial connection with the aid of a diamond tip burr. To view the medial margin of the lower vertebral pedicle and the lateral edge of the flavum, the medial aspect of the superior articular process is dissected laterally using an osteotome or burr. The inferior component of the ligamentum flavum attachment is drilled down to the distal area of the cranial portion of the lower lamina. The deep layer of the ligamentum flavum connection is liberated from the cranial and caudal attachments on the lamina with the use of a probe, and it is then extracted using a Kerrison punch. The traversing root is traced to the medial boundary of the lower vertebral pedicle in order to determine the lateral extent of decompression. This represents the optimal ipsilateral decompression range.

Contralateral decompression

Using a probe or curettes, the ligamentum flavum is separated from the underside of the contralateral lamina to begin the process of contralateral decompression once ipsilateral decompression has succeeded. The cranial, caudal, medial, and lateral contralateral sublaminoplasty is performed until the margin of the ligamentum flavum can be readily separated. The author prefers to keep the flavum over the dura as a protecting cover while drilling or osteotomizing the medial aspect of contralateral superior articular process. The base of the spinous process is burred, and the bony work extends laterally until it reaches the medial margin of the contralateral lower vertebral pedicle (Figure 6). The ligamentum flavum is then excised with the use of different-sized Kerrison punches. Additionally, in order to prevent an iatrogenic dural tear, the central band of the dura must be observed when removing the flavum with the aid of a Kerrison punch.

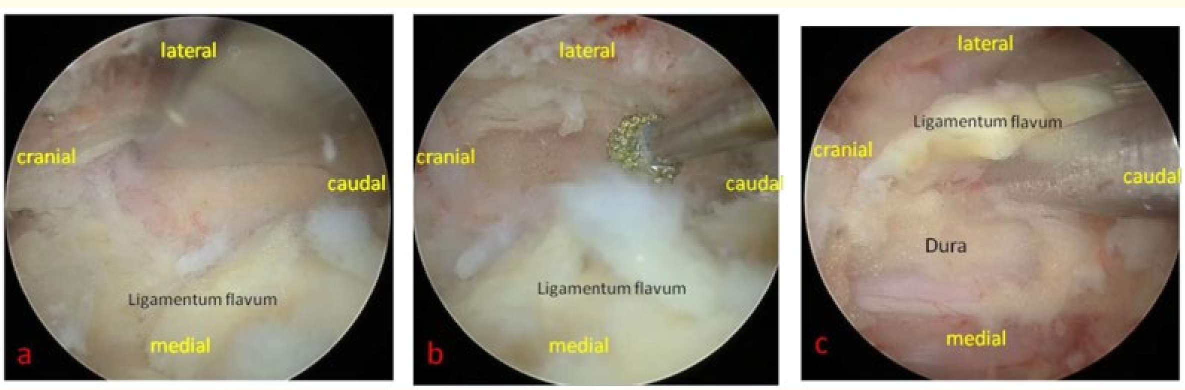

Figure 6: *(a+b) Intraoperative image showing the step of osteotomizing and then drilling the contralateral*

Discectomy

After the spinolaminar junction has been exposed, the bone work is initiated with a diamond tip burr, initially resecting the superior lamina's lower aspect before proceeding laterally and partially resecting the facet joint's medial aspect. The flavectomy is the next procedure to be carried out after the completion of the bone work. It's critical to distinguish the ligamentum flavum's (LF) boundaries. Next, the LF edges are separated with a curette or a probe. Additionally, the flavectomy is carried out from cranial (lower aspect of superior lamina) to caudal (superior aspect of inferior lamina) using Kerrison punches (#2 - #3) until the dural sac is exposed. The discectomy is then carried out. The superior articular process (SAP) is medially to the disc space. Once the disc herniation has been located, a 15-blade annulotomy is performed. After that, the herniated disc is extracted with pituitary forceps. Sometimes the dural sac is gently retracted using a nerve root retractor or probe to make a clean field around the entire ruptured disc. Using radiofrequency (RF), hemorrhage management and annuloplasty are carried out following confirmation with a nerve hook that no residual pieces exist (Figure 7).

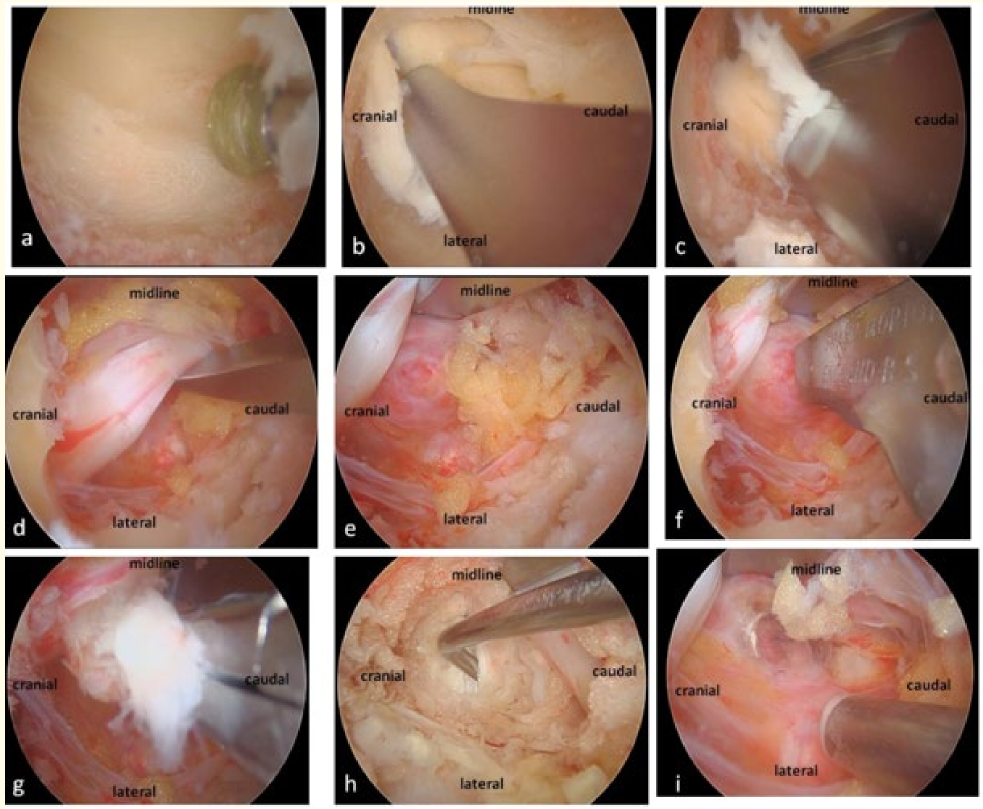

Figure 7: *Discectomy steps with a left sided approach (a) Drilling the inferior portion of superior lamina and medial aspect joint (b) Identifying the edges of ligamentum flavum and detaching it with a probe (c) Performing flavectomy with a Kerrison punch (d) Dural sac exposure (e) Lumbar disc herniation with nerve root retraction (f) Annulotomy with a 15 number blade (g) Discectomy and removing fragments with a pituitary (h) Checking with nerve hook for remaining disc fragments (i) Annuloplasty with RF probe.*

Statistical analysis

All statistical analyses were performed using SPSS (IBM Corp.). Parametric data are provided as means ± standard deviations. Nonparametric data are provided as frequency (percent). Patient data was analyzed using the repeated ANOVA test. The $p < 0.05$ was considered statistically significant.

Results

The cohort consisted of 32 patients. The demographic parameters are shown in table 1. The mean follow up period was 7.9 ± 0.9 (6 - 9 months). The average length of hospital stay was 1.5 ± 0.5 days. The average duration of surgery for LDH was 53.3 ± 2.4 minutes and for DLCS was 65.6 ± 10.9 mins (Table 2). Exact estimated blood loss was not recordable due to continuous water irrigation throughout the procedure. Most of the patient were ambulatory within 24 hours except one who had complication in terms of dural tear.

Parameter	
n	32
Age (y)	65.3 ± 12.3
Sex, M/F	18/14
Diagnosis for operation Degenerative lumbar canal stenosis (DLSC) Lumbar disc herniation (LDH)	 28 (87.5%) 4 (12.5%)
Level L1-L2 L2-L3 L3-L4 L4-L5 L5-S1	 0 3 9 13 7
Pre-operative duration of symptoms (months)	7.6 ± 4.3
Follow-up (months)	7.9 ± 0.8
BMI	26.3 ± 2.9
Smoker	8 (25%)

Table 1: *Demographic data.*

Sr. No.	Operative Data	Mean ± SD
1	Duration of surgery (mins)	
	LDH	53.3 ± 2.4
	DLCS	65.6 ± 10.9
2	Length of Hospital Stay (days)	1.5 ± 0.5

Table 2: *Operative and peri-operative data.*

At the final follow up, the mean VAS for back pain improved from 4.4 ± 0.8 to 2.9 ± 0.2 and the mean VAS for leg pain improved from 7.3 ± 1.1 to 0.3 ± 0.2. ODI scored significantly improved from 25.4 ± 4.3 to 4.8 ± 0.8 (Table 3). According to the modified Macnab criteria, the final outcomes were excellent in 23 patients (71.87%), good in 9 patients (28.13%) (Table 4).

Clinical Outcome Measure					
	Pre op	**1 month post op**	**3 months post op**	**6 months post op**	**p-value**
VAS back pain	4.4 ± 0.8	3.3 ± 0.3	3.1 ± 0.3	2.9 ± 0.2	P < 0.00001
VAS leg pain	7.3 ± 1.1	1.7 ± 0.7	0.8 ± 0.5	0.3 ± 0.2	P < 0.00001
ODI	25.4 ± 4.3	13.5 ± 1.7	7.6 ± 2.2	4.8 ± 0.8	P < 0.00001

Table 3: *Clinical outcomes measure at different time intervals.*

Result	N
Excellent	23
Good	9
Fair	0
Poor	0

Table 4: *Modified Macnab criteria results.*

There were 2 complications in form of dural tear which was managed intraoperatively with dura patch with no further sequelae. These patients were advised strict bed rest for 48 hours and later were mobilized. There were no infection or wound related complications.

Discussion

Adequate decompression and freeing of neural structures is the most critical factor in the surgical treatment of DLCS and LDH. Conventionally, this was done via a open laminectomy approach which involved extensive dissection of paraspinal muscles resulting in their fatty degeneration, atrophy and increased wound related issues. Also, extensive dissection of soft tissue structures and posterior elements via this approach can potentially result in increase post operative back pain and iatrogenic instability [21]. Various minimally invasive (MI) approaches have been proposed to enhance recovery after surgery and minimize surgical wounds and injury to the paraspinal muscles [22-24]. However, there are drawbacks to consider, such as limited visual field, limited working space, a steep learning curve, compromised treatment results, and potential complications [25]. It is important to weigh these drawbacks against the benefits when deciding on the appropriate surgical approach. Advances in technology and surgeon experience have helped overcome some of these challenges, but the appropriate indications for minimally invasive surgery still need to be determined.

More than 50% of facet joint damage might result in segmental instability, highlighting the importance of the facet joint complex for posterior stabilization [26]. The goal of minimally invasive techniques is to accomplish decompression without compromising the facet joint complex's structural integrity. Facet undercutting has been proposed as a way to avoid excessive facet joint destruction, although it can be difficult with open or microendoscopic techniques. However, with an endoscopic method, such as UBE, the surgeon's visual point can be advanced into the lamina or into the contralateral lateral recess and foramen, allowing for accurate examination of the problematic diseased structures without visual constraints.

As a minimally invasive surgical procedure for treating spinal canal stenosis and lumbar disc herniation, the UBE decompression technique was introduced. Unfortunately, the unavailability of convenient tools such power motor drills for effective removal of bony pathologies and radiofrequency wands for hemostasis hindered its growth [27]. Since access portals are not maintained by a tubular retractor, the equipment utilized in these procedures can be handled similarly to those used in open surgeries. The surgical field is nearly bloodless when hemostasis is done carefully and the hydrostatic pressure of normal saline is properly controlled [28]. Because of its small 4 mm diameter, the endoscope can manipulate brain tissue with greater delicacy and precision [29].

Our study showed greater improvement in clinical outcomes as evident by improvement in VAS and ODI scores. At the final follow-up, the mean VAS for back pain improved from 4.4 ± 0.8 to 2.9 ± 0.2 (35% improvement) and the mean VAS for leg pain improved from 7.3 ± 1.1 to 0.3 ± 0.2 (85% improvement). Disability as measured by ODI for back also improved from 25.4 ± 4.3 to 4.8 ± 0.8 (81% improvement) at the final follow up. The clinical outcomes in our series were consistent with previously published literature [30-32].

Regarding the surgical time, average time for UBE for LDH was 53.3 ± 2.4 mins and for DLCS was 65.6 ± 10.9 mins. Similar results were derived from a recent study by Ito., *et al*. comparing UBE with microendoscopic decompression for single level decompression, which showed less surgical time for UBE as compared to microendoscopic decompression [33]. Their study did not showed any difference in the clinical outcomes between the two groups. However, their study reported that microendoscopic decompression resulted in greater numbers of complications, including 5 cases of hematoma paralysis, 8 cases of dura injury, 2 cases of reoperation, as opposed to zero cases of hematoma paralysis and only 2 cases of dura injury resulting from UBE.

Owing to minimally invasive nature of the surgery along with shorter duration of general anesthesia, the average length of hospital stay was 1.5 ± 0.5 days. A randomized control study by Park., *et al*. [34] comparing UBE with microendoscopic decompression for single level decompression showed reduced length of hospital stay and surgery time for UBE as compared to microendoscopic decompression. Their study showed seven complications, three (2 dural tear and 1 hematoma requiring revision surgery) for UBE and four (2 dural tears and 2 hematomas requiring revision surgery) for microendoscopic decompression.

Our cohort had two complications in the form of dural tears. Both times, a dural rip occurred during the removal of ligament flavum that was attached to the dorsal dural surface. It was detected during surgery and treated with a dural patch and *in situ* drain was kept for 2 days with strict bed rest in post op period. The patients were mobilized after 48 hours and did not have any further sequelae. The most common consequence following UBE decompression procedures is a dural tear, which occurs between 3.9% and 4.1% of the time [35]. However, in the majority of cases, conservative treatment is sufficient because the dural tear is relatively small. However, it is advised to use a clipping suture in addition to patch compression for bigger tears that are larger than 1 cm.

Limitations of the Study

There are several limitations to this study. First, we did not assess the dual cross-sectional area since we assume that clinical efficacy is attributable to its expansion. Furthermore, the study was retrospective, had a small sample size, and a brief follow-up period, making it unable to establish long-term results. Future research should carry out a bigger multicenter prospective analysis using laboratory and radiological imaging data to solve these limitations.

Conclusion

We conclude that the UBE decompression approach is a minimally invasive (MI) procedure that is both safe and effective for treating DLCS and LDH. This minimally invasive method may lead to improved clinical outcomes, including lower opioid usage, improved VAS and ODI scores, and shortened hospital stays. It also minimizes soft tissue and facet joint destruction preserving segmental mobility and stability and avoiding spinal fusion.

Conflict of Interest

The authors do not have anything to disclose. No financial aid received for the study.

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