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Functional Outcome of Unilateral Biportal Endoscopic Ligamentum Flavum Preserving Discectomy

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Abstract

Introduction: Low back pain affects roughly 70–80% of people at some point in their lives. Lumbar disc prolapse is one of the major reasons of low back pain that causes severe morbidity around the world, affecting primarily the working-class young population. We conducted this study to describe the unilateral biportal endoscopic (UBE) discectomy technique for lumbar herniated disc with the aim on how to perform theses procedure safely while also preserving the structures like the facet joints through the posterior interlaminar approach.

Materials and Methods: This was a retrospective study conducted between July 2019 and July 2021. The total number of patients included in the study was 41. A total of 54 levels of discectomy were done. The visual analog scale was used to assess back pain and lower leg symptoms, the Oswestry Disability Index was used to assess degrees of disability, and modified Macnab criteria were used to assess overall outcomes of treatment.

Results: Following the procedure, there was a significant improvement. The ultimate outcomes were excellent in 24 patients (58.53%), good in 15 (36.58%), fair in 2 (4.8%), and poor in 0 patients, according to the modified Macnab criteria. That is, 95.11% of patients had excellent or good results.

Conclusion: The UBE discectomy approach for lumbar disc herniation is a minimally invasive procedure that is both safe and successful. There is no soft-tissue degradation or facet joint destruction.

Keywords: Unilateral biportal endoscopy, ligamentum flavum, discectomy, visual analog scale, Oswestry Disability Index, Macnab criteria.

Introduction

With a 30% yearly point prevalence, low back discomfort is one of the most common signs of spinal abnormalities [1]. It has been identified as one of the leading causes of worker compensation and public health spending worldwide [2]. It is one of the foremost debilitating conditions. Low back pain affects roughly 70–80% of people at some point in their lives.

Lumbar disc prolapse is one of the major reasons of low back pain that causes severe morbidity around the world, affecting primarily the working-class young population. Degeneration of the intervertebral disc (IVD) is an abnormal, cell-mediated response to progressive structural failure. Disc degeneration affects the entire body. The lumbar spine is the most affected, followed by the cervical and thoracic spines. Nutritional inadequacy, mechanical load bearing, injury/trauma, and hereditary variables all play a role in disc degeneration's etiology.

Prolapse of the IVD into intervertebral foramina, particularly at the L4-L5 and L5-S1 levels, is caused by disc degeneration caused by a variety of reasons. Because the success of surgery is dependent on a number of criteria, including careful patient selection and a thorough clinical history, a physical examination accompanied by pertinent radiological studies can assist distinguish disc prolapse from other causes of low back pain and sciatica [3].

For more than 20 years, patients have been treated successfully by minimally invasive (MI) spine procedures [4, 5, 6, 7]. MI spine operations have swiftly developed from mini-open to tubular or percutaneous endoscopic techniques as surgical instruments and endoscopic technology have advanced. Aside from the potential advantages of the MI

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Figure 1: Illustration of a unilateral biportal endoscopic discectomy.

approach (less local pain, smaller wounds, less post-operative wound pain, and less duration of hospital stays), there are studies which have shown that the posterior column, including the facet joints, capsule, and interspinous ligaments, plays a major role in maintaining spinal stability [8, 9]. As a result, the most important consideration for long-term results is to avoid injury to the paraspinal muscles and posterior stabilizing structures [10].

The technique of unilateral biportal endoscopic (UBE) is a full-endoscopic method which is done percutaneously. The procedure is initiated by taking two small surgical incisions on either side of the spinous process. This procedure does not rely on the working tube or the working channel to function. Through this procedure, highly accurate decompression in a clear and magnified operative field can be done by the surgeon using continuous normal saline irrigation under high pressure and a high-definition arthroscope.

We conducted this study to describe the UBE discectomy technique for lumbar herniated disc with the aim on how to perform theses procedure safely while also preserving the structures like the facet joints through the posterior interlaminar approach. The efficacy of this technique was assessed by the clinical outcomes.

Materials and Methods

Type of study

This was a retrospective study.

Study period

The study period was from July 2019 to July 2021.

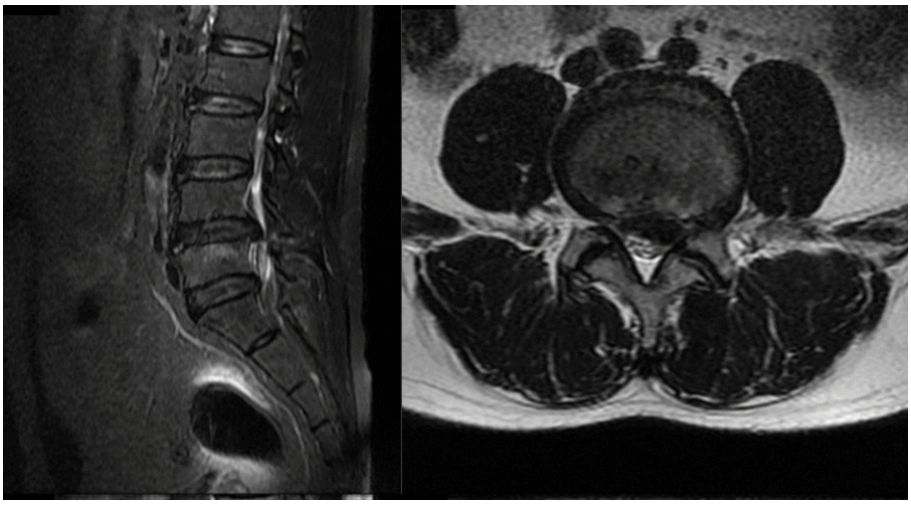

Figure 2: Pre-operative sagittal and axial magnetic resonance images in a 34-year-old male patient complaining of the left radicular leg pain, showing L4–L5 disc herniation on the left side.

No. of patients

Forty-one.

Patients were included in the study according to inclusion and exclusion criteria.

Inclusion criteria

Lower back pain with neurological impairment and persistent radicular leg pain that has been resistant to conservative treatment for at least 6 months due to a moderate-to-severe prolapsed disc as evidenced by an magnetic resonance imaging (MRI) were included in the study.

Exclusion criteria

The following criteria were excluded from the study:

1. Spondylolisthesis or degenerative scoliosis
2. Lumbar stenosis
3. Instability of the spinal segment, which was defined as lateral bending on upright anteroposterior radiographs or translation of more than 4 mm or 10° of angular motion between flexion and extension on upright lateral radiographs
4. Previous lumbar spine surgery history.

There were 22 females and 19 males with an average age of 65 (range – 39–92). A total of 54 levels of discectomy were done. One-level discectomy was done in 30 patients while two-level discectomy was done in 12 patients.

Surgical Technique

The patient was put prone with the abdomen free over the radiolucent surgical table after general anesthesia had been administered. The surgery field and the skin were prepared. Under continuous normal saline irrigation, UBE surgery was conducted. It is vital to make sure the last layer of drape is waterproof and that the saline outflow drainage system was properly set up. The patient could be saturated by the cold normal saline and get hypothermia if these precautions are not taken.

The fluoroscope should be tilted parallel

Table 1: Summary of clinical results

Measurement	Pre-operative	Post-operative	*P*-value
VAS for leg pain	7.2±2.1	0.8±0.4	<0.005
VAS for back pain	4.2±3.0	1.1±0.9	0.013
ODI	54.5±16.8	14.5±12.5	0.005
Macnab criteria			
Excellent		24 patients (58.53%)	
Good		15 (36.58%)	
Fair		2 (4.8%)	
Poor		0	

VAS: Visual analog scale, ODI: Oswestry Disability Index

to the disc space (Ferguson view) to obtain a proper anterior-posterior view. The biplanar fluoroscope was used to determine the spinal levels of interest, which are then marked by the surgeon on the skin. UBE technique requires two small incisions which are taken through deep fascia: One which is about 8–10 mm for the outflow of normal saline, which serves as the instrument portal and another one which is 5–6 mm for continuous normal saline irrigation and the arthroscope. A 0° or 30° scope is essential for this surgery.

The two skin incisions are normally separated by 2–3 cm along the medial pedicle line. We then dilate the paraspinal muscles till fascial depth, between the fascicles of the multifidus muscle, enlarge the instrument portal, and gradually strip the soft areolar tissues from the lamina and interlaminar space with serial dilators up to 10 mm. The lifting of the muscles from the lamina creates a tiny space with the inflow of normal saline, forming the initial working chamber. The entire surgical operation can be performed in a clear and magnified surgical field with rigorous hemostasis. By adjusting the inflow hydrostatic pressure and controlling the outflow, hemostasis can be achieved for oozing from bones and bleeding from small epidural veins. The radiofrequency probe was used to cauterize bleeding from soft tissues and larger epidural veins. The more severe bleeding from the cancellous bone was stopped using bone wax.

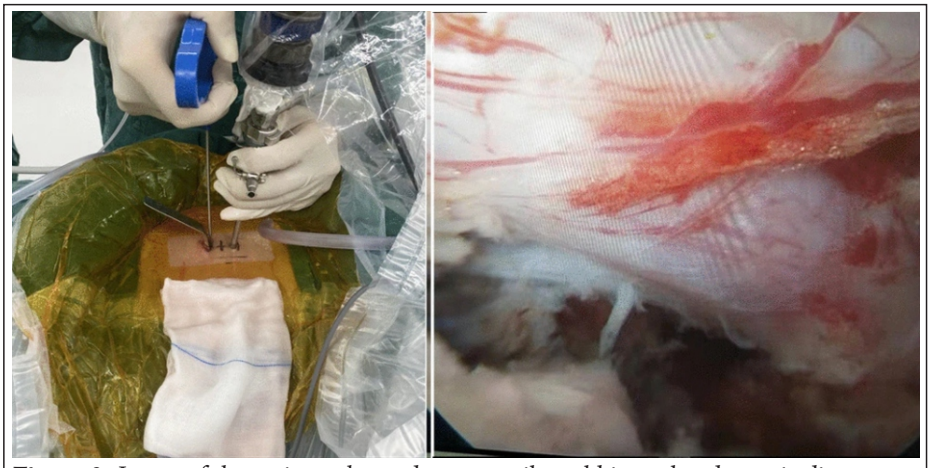

Figure 3: Image of the patient who underwent unilateral biportal endoscopic discectomy (left). Endoscopic image showing the relaxation of L5 nerve root after decompression (right).

Using an electric high-speed diamond bur with a diameter of 3 or 4 mm, we always begin the discectomy at the spinolaminar junction. The discectomy surgeries were carried out in the order listed below (Fig. 1):

1. The ipsilateral lamina is burred from the lower margin cranially until the underlying epidural fat and origin of the ligamentum flavum is exposed
2. Ipsilateral ligamentum flavum is separated using a blunt neural dissector from the undersurface of ipsilateral lamina sweeping toward the facet
3. Separation of the flavum from under surface of lamina occurs and epidural fat is excised, also burring of spinous process exposes the midline cleft of the two wings of the flavum
4. Burr the IAP partially in step ladder manner to expose the SAP and the lateral recess is opened
5. In a L-shaped manner detach the lateral attachment of the flavum ipsilaterally
6. It should be noted that preservation of the ligamentum flavum is a must as it protects the underlying neural tissue. Using a semi-tubular retractor, medially displace gently the neural elements depending on the position of herniation (axillary or lateral). Approach the herniated disc
7. Epidural fat, axillary vessels may require plasma probe application to control bleeder, exposing the disc. Using an Indian knife (Stab knife) specifically designed for UBE surgery enter the IVD
8. Start with sub-ligamentous resection of herniated fragment before processing of deeper fragment extraction if loose fragment is seen on scan
9. Proceed as normal discectomy
10. Reposition the stripped flavum
11. Insert a small caliber suction drain tube after hemostasis without negative

suction pressure to make sure that there is no epidural hematoma.

To assess segmental instability, pre-operative and post-operative radiographs were analyzed which included anteroposterior and lateral static and dynamic images. Before surgery, MRI examinations were performed of the lumbar spine. (Figs. 2 & 3).

The visual analog scale (VAS) was used to assess back pain and lower leg symptoms, the Oswestry Disability Index (ODI) was used to assess degrees of disability, and modified Macnab criteria were used to assess overall outcomes of treatment. Patients were examined by this functional evaluation before surgery and at the end of the treatment. The medical records were thoroughly examined to determine if there were any complications.

In our study, the patient is mobilized and discharged on same day. Only one dose of intravenous antibiotic is administered for most of the patients followed by oral antibiotic for 5 days. In our study, we used cefuroxime, paracetamol, and pantoprazole as the only medications for most of our patients.

Results

The duration of the follow-up in our study was 6 months. Per level of decompression, the operation took 89 ± 56.9 min (range: 50–190 min). The amount of blood lost during the procedure was minimal. On the same post-operative day, most of the patients were ambulated and discharged using a brace.

Following the procedure, there was a significant improvement. At the final follow-up, leg pain VAS score improved from 7.2 ± 2.1 to 0.8 ± 0.4 ($P < 0.005$, paired t-test); back pain VAS score improved from 4.2 ± 3.0 to 1.1 ± 0.9 ($P = 0.013$, paired t-test). The ODI went from 54.5± 16.8 to 14.5 ± 12.5 (paired t-test, $P = 0.005$). The ultimate outcomes were excellent in 24 patients (58.53%), good in 15 (36.58%), fair in 2 (4.8%), and poor in 0 patients, according to the modified Macnab criteria. That is, 95.11% of patients had excellent or good results (Table 1).

Post-discectomy segmental instability or progression of pre-existing spondylolisthesis occurred in none of the patients. There were a few surgical complications that were noted. Transient motor weakness due to epidural hematoma in one patient, which healed in 3 months with Oxy-carbamazepine and nefopam hydrochloride, and dural tear in one patient due to lateral Hofmann band were among the consequences. Prolene 6.0 was used for endoscopic suture repair. There were no wound-related complications or infections in our study.

Discussion

The most important determining factor in the surgical treatment of lumbar disc herniation is adequate discectomy. Micro-MI intervention unilateral laminotomy was the most commonly used procedure to avoid destruction of the posterior stabilizing structures. This procedure demonstrated total spine mobility in a biomechanical cadaver research, and it helps preserve the facet joints and associated components better than other methods. Various MI techniques (microscopic, open, microendoscopic, tubular retractor assisted, endoscopic assisted, or full endoscopic) have been proposed to further limit harm to the paraspinal muscle and surgical wounds so as to improve recovery following surgery [10, 11, 12, 13]. The benefits of minimally invasiveness must, however, be balanced against the disadvantages of a small working field, narrow vision field, radiation exposure, a steep learning curve, poor treatment results, cost, and complications.

The UBE decompression technique has been offered as a MI surgical procedure for lumbar disc herniation treatment since 2003. However, due to a lack of useful instruments such as power motor drills for efficient removal of bony pathologies and radiofrequency probes for hemostasis, there was a lack of development. UBE procedures have been successfully applied on many disorders involving the cervical, thoracic, and lumbar spines in recent years, thank to advancements in endoscopic technology and surgical equipment [14]. We can handle the instruments almost as well as we can in open procedures because no tubular retractor is used to maintain the access portals [15]. The surgical field is nearly bloodless thanks to rigorous hemostasis and proper management of hydrostatic pressure of normal saline. Because the endoscope's diameter is only 4 mm, we may get an extremely close visualization of the pathology which could give a more accurate procedure and helps in careful manipulation of the neural tissue.

With UBE decompression procedures, adequate discectomy can be obtained. Clinical data from our study revealed significant benefits following the operation. The most notable improvement was in the VAS for leg pain, which went from 7.2 to 0.8. The patients' neurological symptoms as well as their impairment status improved significantly, as evidenced by an increase in the ODI. Furthermore, according to the modified Macnab criteria, more than 95% of patients had excellent or good results.

Among the posterior stabilizing components, the facet joints complex (which includes the synovial facet joint and the joint capsule) is the most essential. Facet joint damage can result in segmental instability in more than half of cases, according to biomechanical testing [16]. All the MI procedures attempt to achieve appropriate decompression while preserving the facet joint complex's integrity. The surgeon's viewing point can be advanced inside the lamina or into the contralateral lateral recess and contralateral foramen using an

endoscopic method, particularly UBE. This capability allows for a precise examination of the problematic pathological structures without visual limitations. With partial laminectomy and preserving sufficient pars, a high upward migrated disc and by cutting lower lamina inferior prolapsed disc can be easily extruded through this procedure. Furthermore, patients who have undergone previous procedures like epidural steroid injections and local transforaminal nerve root blocks have been observed to have more number of adhesions due to fibrosis and local inflammatory reactions, UBE here gives an advantage over other procedure because of the targeted use of radiofrequency ablation probe as identification of bleeders is much better. In comparison to open surgery, identification of structures is good since it has excellent visualization of the structures because of blood free field and magnification of structures. It does not have restrictive field of vision and immobility of instruments having tubular retractors (easy go/metric system). The vision field would be significantly wider if a 30° endoscope was used.

The discectomy in our study was satisfactory, and the facet joints were nicely preserved. Because decompression did not proceed ipsilaterally beyond the medial pedicular line, facet joint preservation was 100% on both sides. On post-operative radiograph, proximal laminar burring routinely did not exceed more than 5 mm of bone. Hook curette was used for detachment of flavum from the undersurface of lamina.

After decompression, the more facet joints that are intact, the lower the risk of instability. Because the risk of post-decompression segmental instability is reduced compared to open laminectomy, we believe that this method can be adapted for patients with low-grade degenerative spondylolisthesis. For the same, more work is required. During the very short follow-up period in our investigation, no iatrogenic spondylolisthesis or development of pre-existing spondylolisthesis was seen.

When compared to other MI techniques, such as microendoscopic technique, which has a learning curve of roughly 100 cases, UBE techniques have a comparatively low learning curve [16, 17, 18]. It is a micro-MI procedure that involves dilatation of the multifidus muscle and removal of loose lamina areolar tissue. The learning curve for UBE decompression is roughly 30 cases for a surgeon who is familiar with open surgery but not with endoscopic techniques. The learning curve can be lowered to 10 or 15 cases for a surgeon who is familiar with micro endoscopic or percutaneous endoscopic operations.

The most important aspects of UBE are familiarity with hydrostatic pressure control and hemostasis skills in a limited space using continuous normal saline irrigation. In UBE, the rate of infection is much lower than in open surgery. Because of continuous irrigation, little soft-tissue dissection, and smaller incision, there are fewer risks of wound infection. Although a dura tear can occur, as it did in our study with one patient, most tears are small and conservative treatment is sufficient, or suturing repair with can be done. It is feasible to repair the dura under the endoscope [19]. As compared to open surgeries, using blunt neural dissectors and high-speed diamond bur are much safer than using sharp curettes and osteotomes. Most importantly, repositioning the ligamentum flavum serves as an excellent protection for the underlying neural tissue and subsequent re-exploration if needed is not associated with the risk of scar tissue formation.

Conclusion

The UBE discectomy approach for lumbar disc herniation is a MI procedure that is both safe and successful. There is no soft-tissue degradation or facet joint destruction. As a result, it is possible to avoid spinal fusion while maintaining segmental mobility and stability. Furthermore, compared to other MI decompression approaches, the learning curve is less steep.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

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