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Surgery for Lumbar Disc Prolapse: The Decision is More Important than the Incision

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Abstract

The common techniques of discectomy for a posterolateral lumbar disc herniation include conventional open discectomy, microlumbar discectomy, tubular microdiscectomy, and endoscopic discectomy. All these techniques involve an interlaminar fenestration for accessing the spinal canal, decompressing the neural elements, and performing the discectomy with the goal of relieving radicular leg pain and improving function. The current review aims to briefly outline the evolution of lumbar discectomy over the last century, examine the pros and cons, and compare the short-term and long-term clinical outcomes of the common techniques of lumbar discectomy. While no single approach may be universally superior to the other, surgical selection tailored to patient-specific factors and surgeons' experience with a technique helps to optimize clinical outcomes.

Keywords: Lumbar disc prolapse, microlumbar discectomy, tubular discectomy, endoscopic discectomy

Introduction

Surgery for lumbar disc herniation is one of the most common procedures performed in spine surgery. The primary goal of surgery is decompression of the neural elements to alleviate radicular leg pain and improve mobility, with minimum morbidity and complications. At present, three different procedures are popular among spine surgeons in the surgical management of this condition. These include microlumbar discectomy, microdiscectomy using tubular retractors (tubular microdiscectomy), and endoscopic discectomy. In addition, in centers where microscopes and endoscopes are unavailable, a conventional open fenestration discectomy is still preferred, and probably, is the most common discectomy procedure performed across India. The current article aims to trace the evolution of lumbar discectomy over the past 100 years and analyze the advantages and limitations of the common currently performed procedures.

Surgery for Lumbar Disc Herniation: A Brief History

Krause and Oppenheim in 1909 performed the first lumbar discectomy. They described the disc herniation as an intraspinal cordoma. Mixter and Barr in 1934, described a transdural approach through a laminectomy to approach and excise the disc herniation. They described a correlation between lumbar disc herniation and clinical syndromes associated with nerve and cauda equina compression. The advent of myelography revealed that most disc herniations were posterolateral in location, wherein a complete laminectomy may be unnecessary. Love in 1939 described a hemilaminectomy, and subsequently a fenestration procedure to approach and excise posterolateral disc herniations. The fenestration procedure involved excision of the ligamentum flavum, a small amount of the overhanging cephalad lamina, and a small shaving of the medial facet to visualize the traversing root and excise the intervertebral disc. Although the decompression was performed unilaterally, Love performed bilateral subperiosteal muscle dissection to be able to place retractors. With the development of better retractor systems such as the Caspar retractor in the 1970s and the McCulloch retractors in the 1980s, gradually fenestration discectomy began to be performed with unilateral subperiosteal muscle elevation, minimizing trauma to soft tissues thereby minimizing morbidity of the surgery.

In the early years, fenestration discectomy was performed without any visualization aids. Subsequently, some surgeons started using loupes for magnification of intraspinal structures to provide improved visualization and reduce the risk of injury to neural elements. However, the size of the incision was generally big, to allow overhead operation theater lighting to reach the depths of the wound for adequate visualization.

Yasargil, Caspar, and Williams in 1977 described the use of an operating microscope to perform a fenestration discectomy.

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Besides offering magnification up to 10×–12×, the microscope served as a coaxial light source that provided illumination in the depths of the wound. This enabled surgeons to perform unilateral fenestration discectomies through smaller incisions. This procedure was labeled as "Microlumbar discectomy" and is even today considered the gold standard surgery for lumbar disc herniation. With the advent of CT scans and subsequently MRI scans in the 1970–1980s, the nature of nerve compression and the location of the disc herniation could be precisely determined. Surgery for lumbar disc herniation could now be a precision surgery rather than an exploration to seek and find pathology.

In 1975, Hijikata described the technique of "percutaneous nucleotomy." This involved a posterolateral transforaminal approach to the intervertebral disc using a percutaneous incision under local anesthesia. Special tubes were inserted up to the posterolateral annulus under fluoroscopy. Trephines were used to perforate the annulus and internal discectomy was performed using pituitary rongeurs. The resultant reduction in intradiscal pressure provided pain relief in up to 72% of patients. The disc herniation was not excised with this procedure. This procedure is widely considered the birth of percutaneous endoscopic discectomy. In the 1980s, Parvez Kambin described the technique of endoscopic discectomy through a transforaminal approach which was revolutionary because it enabled the use of an endoscope while leaving the posterior stabilizing structures of the lumbar spine intact. They accessed the Kambin triangle which is a safe corridor to the lumbar disc between the existing nerve root and the superior facet. Discectomy was performed from within the disc out. Mayer and Brock (1993) used an endoscope with an angled lens for improved dorsal visualization. However, the early lumbar full endoscopy technique had poor acceptance due to limited indications and poor quality of optical systems in the 1980s and 1990s which failed to confer any significant advantage over microlumbar discectomy.

In 1997, Foley and Smith described the technique of tubular microdiscectomy. Through a 16–20 mm paraspinal incision using an approach that splits fibers of the multifidus muscle, tubular retractors are introduced and docked onto the interlaminar region. Using a microscope as a visualization aid, a standard interlaminar discectomy was then performed. It was postulated that since the multifidus muscle was not cut nor elevated, post-operative pain and scarring were significantly minimized.

In the late 1990s, Anthony Yeung revolutionized lumbar endoscopic discectomy by performing the procedure "underwater" with continuous suction and irrigation. This was in contrast to the earlier era of dry endoscopic procedures performed purely through a transforaminal route by Kambin and others. Underwater endoscopy reduced intra- and post-operative bleeding, enabled better identification of microanatomy, and permitted separation of tissue layers by irrigation. In the early 2000s, Sebastian Rutten applied these principles through the interlaminar endoscopic approach for lumbar discectomy, thereby enhancing the spectrum of full endoscopic lumbar discectomy.

Comparison of the Different Techniques of Discectomy for Posterolateral Lumbar Disc Prolapse

Aside from transforaminal endoscopic discectomy, all other procedures involve an interlaminar fenestration to access the spinal canal, retract the traversing nerve root, and excise the herniated disc.

Conventional lumbar discectomy

- Open discectomy performed without visual aids or using loupes
- Fenestration discectomy with unilateral exposure, muscle stripping approach
- Slightly larger incision, more muscle dissection.

Limitations

1. Poor visualization in the depth of the wound, especially in obese patients
2. Longer incision with more muscle dissection.

Microlumbar discectomy

- Open discectomy was performed using a microscope
- Fenestration discectomy with unilateral exposure, muscle stripping approach
- Smaller incision, approximately 3 cm in length
- Improved visualization due to better illumination in the depth of the wound
- Especially useful in obese patients
- Magnification provides better visualization of neural structures reducing the risk of injury
- Better control of epidural bleeding. Especially useful in revision situations.

Limitations

1. Availability of microscope
2. Learning curve
3. Muscle stripping.

Tubular microdiscectomy

- Open discectomy performed using a microscope/endoscope
- Fenestration discectomy with unilateral exposure, muscle splitting approach
- Incision 2–2.5 cm in size
- Excellent visualization in the depth of the wound, even in

obese patients
• Ability to tilt the tubes and perform ipsilateral and contralateral decompression at 1–2 levels through a single incision.

Limitations
1. Special equipment required
2. Long learning curve
3. Higher radiation exposure
4. Difficult to control bleeding and suture dural tears.

Interlaminar endoscopy

• Percutaneous procedure using an endoscope
• Fenestration discectomy
• Excellent illumination and magnification offer excellent visualization
• Continuous irrigation minimizes intraoperative and post-operative blood loss
• Irrigation aids dissection of tissue planes
• Lower infection rate.

Limitations
1. Special equipment required
2. Long learning curve
3. Time-consuming
4. Higher radiation exposure.

Transforaminal endoscopy

• Percutaneous procedure using an endoscope
• Discectomy performed from within out
• Excellent illumination and magnification offer excellent visualization
• Limited epidural scarring makes revision surgery easier.

Limitations
1. Special equipment required
2. Long learning curve
3. Higher radiation exposure
4. Nerve root injury
5. Difficulty in excising migrated disc herniations
6. Inability to deal with associated lateral recess stenosis

A basic tenet of surgery is to effectively treat pathology with minimal disturbance of normal anatomy. The primary goal of surgery for lumbar disc herniation is to relieve the patient's radicular leg pain and improve mobility and function. Studies have shown that irrespective of the surgical procedure performed, the success of the primary surgery in relieving leg pain is between 90 and 95%. Poor results stem from poor patient selection and poor surgical technique, that is, inadequate removal of the herniated disc or incomplete decompression of the traversing nerve root. Iatrogenic damage to soft tissues and stabilizing structures has also been linked to poor results.

Studies have also shown that long-term outcomes in terms of back and leg pain, patient function, and patient satisfaction are comparable across procedures. Dohrmann and Mansour [1], analyzed 39,048 cases of lumbar discectomy reported in world literature. At a mean follow-up of 6.1 years, 78.9% of patients reported good to excellent results; 84.3% in the microdiscectomy group, 79.5% in the endoscopic discectomy group, and 78.3% in the conventional surgery group. Similarly, Gotfryd and Avanzi [2] reported that all the posterior lumbar discectomy procedures had comparable effectiveness in terms of pain relief, improvement in motor and sensory function, and patient satisfaction. Good post-operative outcomes tend to deteriorate over time because of continued wear and tear which is unrelated to the disc surgery.

Proponents of minimally invasive surgery argue that outcomes of microdiscectomy, tubular microdiscectomy, and endoscopic discectomy are superior in the short term because of limited damage to normal tissues during surgery. Reduced muscle dissection results in reduced intraoperative blood loss and lesser operative time. Postoperatively, there is less pain, enabling faster mobilization, early discharge from the hospital, and eventually early return to activities of daily living. He et al. [3], based on a meta-analysis comparing tubular microendoscopic discectomy with conventional open discectomy, reported that although the post-operative pain relief and complications were comparable between procedures, microendoscopic discectomy was associated with lesser intraoperative blood loss and shorter hospital stay. Similarly, Brock et al. [4], compared post-operative outcomes following lumbar microdiscectomy performed either with a subperiosteal approach or a muscle-splitting approach using tubular retractors. They found comparable improvement in back and leg pain between procedures but reported significantly less analgesic consumption within the muscle-splitting group. Teles et al. [5] reported no significant difference in any parameter in the immediate post-operative, short-term, and 1-year follow-up when comparing percutaneous lumbar discectomy with tubular microdiscectomy. Liu et al. [6] compared the outcomes in 192 patients with symptomatic lumbar disc herniation who were treated with microdiscectomy, tubular microdiscectomy, and endoscopic transforaminal discectomy. They reported no difference in outcomes between surgical techniques in the long term. However, the endoscopic technique did offer a smaller incision, lesser blood loss, and shorter hospital stay. However, the differences with the other techniques were not statistically significant. The Spine Committee of the World Federation of Neurological Surgeons has concluded that minimally invasive techniques have short-term advantages over open procedures, but there is insufficient evidence to make a recommendation for or against the choice of a specific surgical procedure.

The other absolute indication for surgical management of lumbar disc herniations is the presence of a significant neurological deficit. These situations merit early surgical intervention. Post-operative neurological recovery is affected by the duration and severity of pre-operative weakness but not by the choice of discectomy technique [7-12]. However certain surgical approaches may be more suited to a specific pathology, (e.g., transforaminal endoscopic approach in foraminal or extraforaminal disc herniations.)

Both tubular microdiscectomy and endoscopic discectomy techniques offer a significant advantage in obese patients in terms of smaller incision size, less muscle dissection, and lesser risk of post-operative wound infection. Endoscopic discectomy techniques are associated with a reduced risk of post-operative wound infections because of continuous irrigation used during surgery. In addition, a number of surgeons prefer to perform endoscopic discectomy under epidural anesthesia, thereby reducing the risks of general anesthesia as well.

A review of the literature as a whole has failed to establish the superiority of one technique of discectomy over another. The surgical technique does not affect long-term clinical outcomes significantly. However, minimally invasive surgery may have improved pain relief which facilitates early mobilization and shorter hospital stay. Irrespective of the technique, reduced nerve root retraction, and avoiding aggressive exploration of disc space helps in producing good functional outcomes.

Conclusion

The techniques for performing a lumbar discectomy have considerably evolved over the past 100 years. The ability to precisely localize the disc herniation has enabled surgeons to perform more precise surgery with minimum damage to adjacent, uninvolved structures. This has enabled surgery to be performed with less muscle dissection, less blood loss, and minimal perioperative pain. As a consequence, patients are allowed out of bed mobilization within a few hours of surgery, and discharged home earlier. Return to work and activities of daily living are also permitted earlier than before.

Despite all the progress in surgical techniques, the surgical outcomes in the long term and to a large extent in the short term too, remain the same across procedures. The initial success of surgery, as measured by relief in radicular pain continues to hover around 90–95%. The two important factors that have been shown to determine the surgical outcome are patient selection and surgeon experience with a surgical procedure, rather than what precise procedure is being performed. "The decision is far more important than the incision."

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.

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