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Review Article

PERCUTANEOUS ENDOSCOPIC LUMBAR DISCECTOMY (PELD) - A MINIMALLY INVASIVE SURGICAL PROCEDURE USED IN THE TREATMENT OF DISC HERNIATION

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ABSTRACT

Although open lumbar discectomy is a gold standard surgical technique for lumbar disc herniation (LDH), surgery-induced tissue injury may actually become a source of postsurgical pain. L4 – L5 disc herniations can be treated with percutaneous endoscopic lumbar discectomy (PELD) using a transforaminal posterolateral approach. Endoscopic discectomy is a minimally invasive surgical procedure used to remove herniated disc material that is causing pain in the lower back and legs (lumbar), mid back (thoracic), or neck and arms (cervical). The spine is visualized through a camera, smaller than a smart phone camera, through a small surgical port (tube). Large incisions are avoided. The procedure does not traumatize the spine like traditional spine surgeries do and provides better outcomes in terms of operative time, blood loss, lower complication rates and is a safe and efficacious technique to relieve symptoms of herniated discs and this improvement in back pain and leg symptoms translates to improvement in quality of life

Key words: Adjacent segment degeneration, Open lumbar discectomy, Percutaneous endoscopic lumbar discectomy, Transforaminal

INTRODUCTION

In the last century percutaneous nucleotomy (PN) was developed by Hijikata [1]. Since the skin incision was minimal and small cannula was inserted into the canal, it can be performed under local anesthesia. According to the Hijikata method, the position of the cannula was confirmed under the C-arm fluoroscopic not the endoscopic guidance; therefore, it was unable to introduce a cannula into a herniated mass in the neural canal. Following some frontiers tried to introduce the spinal endoscope with the PN technique [2-5], with single-portal endoscopic discectomy being developed around the end of the last century [4, 5]. This technique is called as the percutaneous endoscopic lumbar discectomy(PELD). This procedure was introduced by Dezawa in 2003 in Japan [6]. The PELD was initially indicated for herniated nucleus pulposus (HNP) [4-6].

Transforaminal percutaneous endoscopic lumbar discectomy (PELD) is regarded as a practical alternative to conventional open discectomy in the treatment of lumbar disc herniations, with benefits of less tissue trauma and day-surgery setting [7-13] As the concept of transforaminal PELD has been changed from intradiscal decompression to epidural selective discectomy, advanced endoscopic decompression techniques for migrated disc herniation have been developed[14-18]

Advantages of an Endoscopic Discectomy:

- Minimally Invasive
- Short recovery
- High Success rate
- Preservation of spinal mobility
- Local Anesthesia
- minimal blood loss
- Same-day surgery with no hospitalization (outpatient procedure)
- Small incision and minimal scar tissue formation

What conditions Can an Endoscopic Discectomy Surgery Treat?

Lumbar Endoscopic Discectomy

- Disc Bulge
- Herniated Disc
- Disc Tear
- Radiculitis
- Radiculopathy

How is an Endoscopic Discectomy Surgery Performed?

The surgical treatment of disc herniation constitutes a large part of orthopedic practice and it has evolved considerably in terms of surgical technique and instrumentation. Percutaneous endoscopic discectomy is a relatively new technique for removing lumbar disc herniation. It involves using an endoscope to visualize the disc removal.

Under the guidance of the x-ray fluoroscopy and direct visualization, a piece of the herniated disc is pulled out with a grasper. A small disc bulge or annular tear can be treated with a laser, which vaporizes disc material, kills pain nerves inside the disc, and hardens the disc to prevent further leakage of disc material to the surrounding nerves. Finally, the tube is removed and the incision is closed with a stitch or two.

The surgical procedure can be categorized into 3 stages: (1) direction-oriented transforaminal approach, (2) release of periannular anchorage, and (3) epiduroscopic fragmentectomy using navigable instruments.[12]

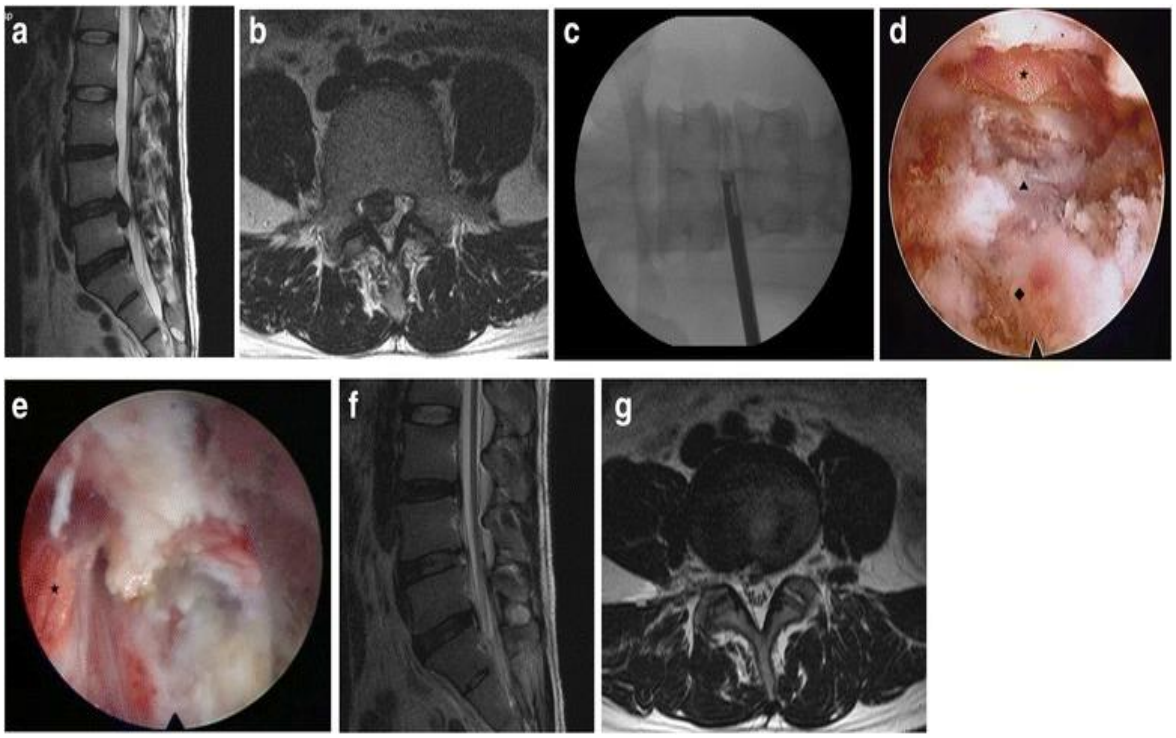

Figure: T2-weighted parasagittal magnetic resonance (MR) images showing down-migrated disc herniation at the L4–5 (**a** and **b**); after first PELD (**c**). After removing the nucleus pulposus (◆) and cutting the annulus (▲), the epidural space (★) is found to decompress (**d**). Pulling out the working cannula, the exiting nerve root (★) is found (**e**). MR images demonstrating complete removal of herniated disc (**f** and **g**)

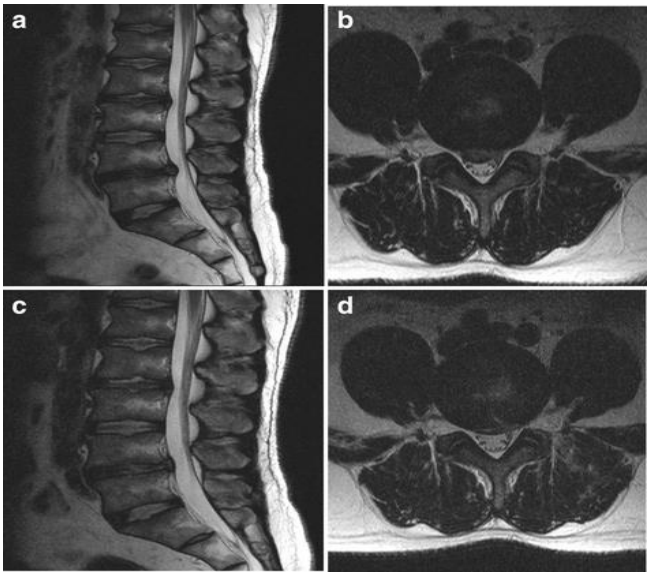

Figure: MR images showing broad based central disc extrusion at the L4–5 (**a** and **b**). After the PELD, MR images showing sound decompression (**c** and **d**)

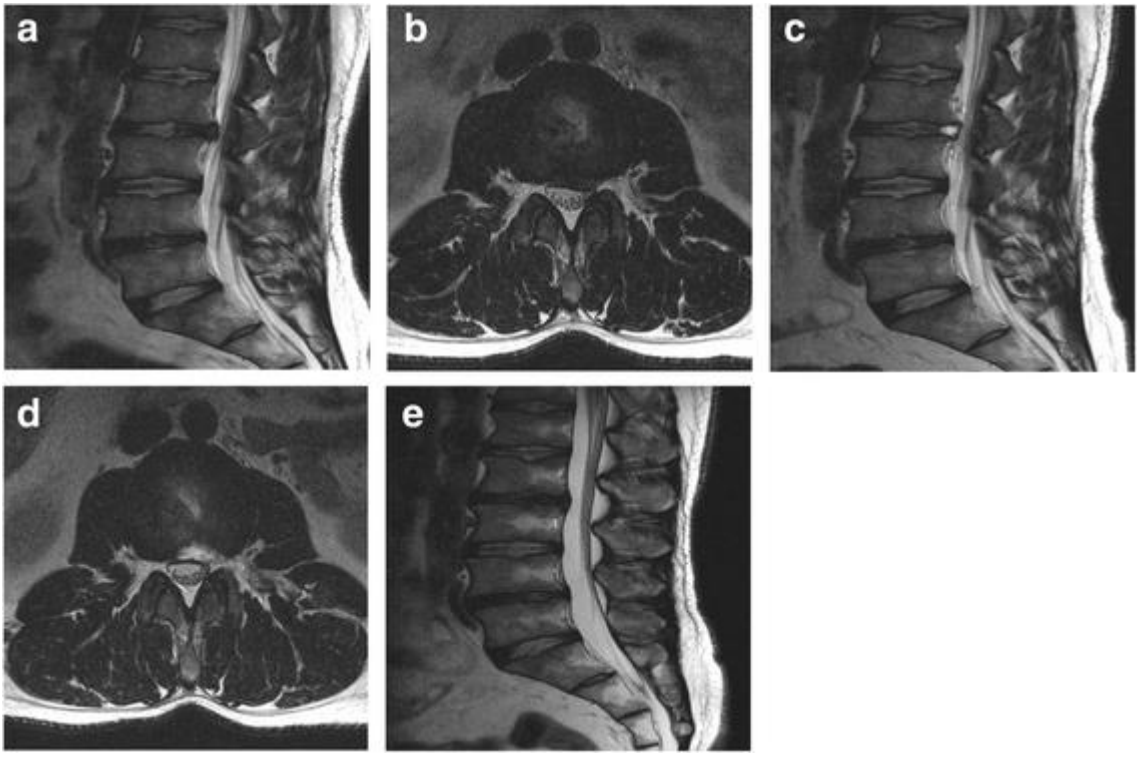

Figure: One year later, MR images showing left paramedian disc herniation at the L2–3 (**a** and **b**). After the PELD, MR images showing complete removal of the disc (**c** and **d**). Eighteen months later after second PELD, MR image (**e**) showing no significant changes of the disc height or any disc degeneration aggravation in comparison with initial MR images

Preoperative evaluation from MRI and CT scan is essential to determine the shape of the migrated disc and the adequate landing point with approach angle. The procedure is usually performed under local anesthesia with conscious sedation. The patients are injected with midazolam (0.05 mg/kg) intramuscularly and fentanyl (0.8 μg/kg) intravenously before surgery. Thereafter, the amount of sedatives can be adjusted according to the patient's condition and the surgeon's need. The patient is placed in the prone positioned on a radiolucent table. A typical skin entry point is 10–15 cm lateral to the midline according to the patient's body size. For the proper transforaminal epiduroscopic approach, skin entry can be determined using the lateral fluoroscopic view, which should be at the skin point between the tip of the spinous process and the posterior surface of the facet joint on the lateral fluoroscopic view. For a shallower approach, the point should be determined anteriorly, while for a steeper approach, the point should be determined posteriorly on the lateral fluoroscopic view. The disc landing and approach angle is determined depending on the zone and direction of disc migration (direction-oriented transforaminal approach). The landing point on the disc should be as close as possible to the annular tear point. For a cranially migrated disc, a caudal-to-cranial approach angle is recommended, whereas for a caudally migrated disc, a cranial-to-caudal approach angle is recommended An 18-gauge spinal needle is inserted into the disc along the planned trajectory line through the foraminal window. Preemptive epidurogram and epidural block before disc penetration may help determine the shape of the disc herniation and reduce approach-related pain. Once the needle is inserted into the disc, discography with indigo carmine is performed to stain the disc material and determine the leakage pattern through the annular fissure. Then, a staged dilation technique from the guide wire, obturator, and final working sheath is performed. The bevel-ended working sheath is typically placed on the disc to see both the intradiscal and the epidural space (half-and-half configuration). Thereafter, a working channel endoscope is inserted and a delicate endoscopic exploration can begin.

Intradiscal and annular release:

The release of annular anchorage should be performed around the annular fissure. Initial endoscopic exploration can confirm the anatomical layer of the periannular structures: the intradiscal layer with the nucleus, the outer layer with the annulus-posterior longitudinal ligament (PLL) complex, and the epidural layer with perineural fat and dural sac. Thereafter, intradiscal subannular debulking is performed until the border of the annular fissure is exposed. Intradiscal release can be performed using grasping forceps, radiofrequency bipolar ablator, and side-firing laser. The outer layer of the annulus and the PLL can be cut using annulus scissors. Then, the epidural layer can be released after confirming the epidural space and the migrated disc fragment. Before the adequate releasing step, the epidural space is hardly opened because of the tight adhesion between the disc and the fibrous anchoring tissues. Once the intradiscal and epidural release is completed, the herniated mass can be defined, and the epidural working space for instruments can be obtained.

Epiduroscopic fragmentectomy using navigable instruments:

The use of navigable instruments such as semiflexible forceps, articulating forceps, and flexible curved probe is effective for complete removal of very high-grade migrated disc. Before inserting a grasping forceps, the shoulder osteophyte can be cut by endoscopic cutters. This ventral decompression can create a further working space to approach the migrated disc in a cranial or caudal direction. Then, articulating forceps or semi-flexible forceps are applied toward the tip of the migrated disc under endoscopic and fluoroscopic guidance. A flexible curved probe can track the trajectory of disc migration and dissect the fragment. The use of navigable instruments can avoid the need for time-consuming bony resection. The migrated disc can be gently removed in one piece or in multiple pieces. Complete herniotomy can be performed by removing the whole herniation mass including the intradiscal fragment, periannular fragment, and far-migrated remote site fragment. Supplementary use of radiofrequency coagulator and side-firing laser is useful for hemostasis and delicate decompression. After complete herniotomy, the decompressed dural sac and nerve root become freely movable. The end point of the procedure is a strong pulsation of the dural sac and nerve root with respiration, coughing, or Valsalva maneuver. Finally, careful endoscopic examination is performed if there is any adverse event such as dural damage or epidural bleeding. After adequate hemostasis, the endoscope is taken out, and a sterile dressing is applied on the surgical wound.

A systematic review was to identify the effectiveness of percutaneous endoscopic lumbar discectomy (PELD) in the treatment of recurrent lumbar disc herniation (rLDH) and to present its indications and techniques. We conducted a comprehensive search in MEDLINE, EMBASE, PubMed, Web of Science and Cochrane databases, searching for relevant studies of managing rLDH with PELD up to July 2015. Only papers published in English were included. Two review authors independently selected the studies, extracted relevant data and assessed their methodological quality. The Cochrane Collaboration's Revman 5.3 software was used for data analyses among the controlled studies. At last, one randomized controlled trial (RCT), two non-randomized control studies and five observational studies including a total of 579 cases were selected for this system review. The methodological quality of these studies was low to modern. The mean overall improvement of leg pain (visual analogue scale) was 66.92% (50.6%-89.87%), back pain (visual analogue scale) 54.91% (29%-67.95%), Oswestry Disability Index 60.9% (40.7%-75%), global perceived effect (MacNab/other) 75.77% (60%-95%). The mean overall of complication rate was 4.89% (0%-9.76%), dural tear rate 0.1% (0%-4.9%), recurrence rate 6.3% (4%-10%), re-operation rate 3.66% (2.33%-4.8%). We conducted a meta-analysis among the control trials. Compared with Open discectomy (OD), PELD resulted in better outcomes in terms of operative time, blood loss, lower complication rates, but with no significance differences regarding hospital stay, second recurrence rate, Macnab criteria and pain reduction. In conclusion, according to the current evidence, PELD is an effective procedure for the treatment of rLDH in terms of reducing complication and

shorting hospital course, comparing with OD. Therefore, we suggest that PELD as a feasible alternative to OD in the treatment of the rLDH in the condition of proper indication[19]

Adverse events:

Although endoscopic spine surgeries are relatively low-risk procedures, and performing most of these procedures under local anesthesia further reduces the risk, some complications typical to keyhole procedures can still arise.[20-25]

Complications of percutaneous endoscopic spinal surgeries can be divided into categories of immediate, early, and delayed, based on the time of onset.

Immediate complications:

- Intraoperative injury to neural and vascular structures
- Perforation of the peritoneal sac and abdominal contents
- Missed fragments/failure of surgery
- Exploration of the wrong level or wrong side
- Instrument breakage

Early complications:

- Psoas hematoma
- Postoperative hematoma formation
- Postoperative dysesthesia
- Cyst formation
- Postoperative infection, abscess formation, and so forth

Delayed complications:

- Recurrence of disk herniations
- Any possible instability

The advantage of percutaneous endoscopic discectomy is that the disc is approached thus preserving spinal stability. [26, 27], There is less damage to muscular and ligamentous structures allowing for faster rehabilitation, shorter hospital stay and earlier return to function. Although many studies [23, 26-30] have shown the efficacy of percutaneous endoscopic discectomy with good clinical outcomes, there are very limited reports of how this translates to quality of life improvement and ability to return to work. PELD has some

distinct advantages over conventional open discectomy, inadequate decompression is a major cause of failure of the procedure, especially with high-grade migrations[31] , also Epidural fluid collection usually occurs after percutaneous endoscopic discectomy, which is mainly due to saline accumulation and typically resolves with time, without treatment or complications.[32]

CONCLUSION

Percutaneous endoscopic lumbar discectomy resulted in better outcomes in terms of operative time, blood loss, lower complication rates and is a safe and efficacious technique to relieve symptoms of herniated discs and this improvement in back pain and leg symptoms translates to improvement in quality of life. It has the advantage that it can be performed on a day case basis with short length of hospitalization and early return to work thus improving quality of life earlier.

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