



Case series

Transforaminal endoscopic lumbar discectomy for L5–S1 disc herniation: A case series

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1. Introduction

Spine surgery is traditionally done as “open surgery”. However, technological advances have allowed more back conditions to be treated with minimally invasive surgical techniques. Percutaneous endoscopic lumbar discectomy (PELD) is an example of a minimally invasive surgical technique. PELD can achieve decompression with minimal injury to surrounding soft tissue and preservation of bony structure, which benefits postoperative pain, shorter hospital stays, and early return to daily life or work. Because the surgery is done under local anaesthesia, surgeons can avoid neural injury by communicating with the patient directly during the procedure [1,2].

Though there are advantages in enhancing postoperative recovery, there are also limitations causing failure or complications of PELD. According to the anatomical findings, the transforaminal approach to the L5–S1 level may be difficult due to the high iliac crest and narrowed foraminal area caused by the large L5 transverse process or hypertrophic facet joint. There are various techniques proposed to overcome these anatomical limitations. Most studies of PELD at the level of L5–S1 have reported the interlaminar approach [3,4]. It is thought that the high iliac crest, narrow foramen, and a large facet joint are a barrier to performing transforaminal PELD (TELD). Yeung and Tsou [5] suggested that TELD can access all lumbar levels, even L5–S1. It is questionable that the decision of the endoscopic route for L5–S1 discs only depends on the surgeon's preference and anatomic relation between iliac bone and disc space.

This study aimed to evaluate the anatomical consideration, trajectory, and patient positioning during transforaminal PELD at L5–S1.

2. Materials and methods

We follow patients with a diagnosis of herniated disc at the level of

L5–S1. All patients had unilateral radiculopathy resistant to conservative treatment. The demographics and clinical outcomes of the patients were recorded prospectively. The clinical outcomes were assessed with the visual analogue scale (VAS). Statistical calculations were carried out with the IBM SPSS Statistics ver. 23.0 (IBM Co., Armonk, NY, USA). The *p*-value of less than 0.05 was considered statistically significant. This study has been reported as PROCESS 2020 criteria.

3. Surgical techniques

3.1. Patient position

The patient was in a prone position with mild anesthetic sedation condition. Antero-posterior and lateral fluoroscopy were used to visualize the appropriate level and outline of the iliac crest. After performing prepping and draping, the outline of the iliac crest is identified. The entry point is marked at the intersection of the tangent line to the iliac crest toward the base of the S1 superior articular process (SAP) in the anteroposterior fluoroscopic view, and the trajectory line toward the junction of the S1 SAP and pedicle in lateral view (Fig. 1). The mean entry point in this case series was 8.6 ± 1.43 cm from the midline.

3.2. Anaesthesia and docking the working canula

After planning the entry point and trajectory, a stab incision of 8 mm is made through the skin and fascia with a blade. The cannulated needle is placed from the entry point and along the trajectory to the base of SAP. The target of the needle placement is at the junction of the SAP and pedicle. We inserted the needle into the final working zone after docking and confirmed it with fluoroscopy (Fig. 2). After confirming the needle position, the contrast agent was omitted (Fig. 3). Contrast agent evaluated whether there was intradiscal or intradural involvement. Patient

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Fig. 1. Patient position and distance of the entry point form the midline.

reaction was also evaluated if there was any provoked pain during contrast agent injection.

A guidewire is then inserted through the cannulated needle and followed by sequential dilators to create the track for working cannula. The position of the working channel is inserted through the dilator under the visualization of the fluoroscopy.

3.3. Endoscopic discectomy

The dilator is then removed, and the endoscope of the working channel is inserted through the working channel with continuous sterile saline irrigation. After adjusting the position of the working cannula, the disc herniation can be identified. The herniated discectomy can be performed. Approximately one third of the posterior nucleus pulposus and annulus were removed before the ruptured fragment removal. All the procedures start from the disc space. Then the tip of the working tube was lifted to the direction in the epidural space. We perform double evaluation of inside out and outside in technique for the annular release.

3.4. Final check point

We stop over discectomy after negative visual disc degeneration at 9, 12, and 3 o'clock. After discectomy, we would check the bleeding, possible residual pathology, and gross appearance of nerve roots with good pulsation. The endoscope can then be retracted to examine the extraforaminal space and the exiting root. Meticulous haemostasis was performed using a bipolar coagulator (Trigger-Flex probe, Elliquence, Baldwin, NY, USA), and the wound was closed with a single skin suture.

4. Result

Six cases underwent PELD at the L5–S1 level in our case series as seen in Table 1. The mean age of the patients was 44.83 years old (range,

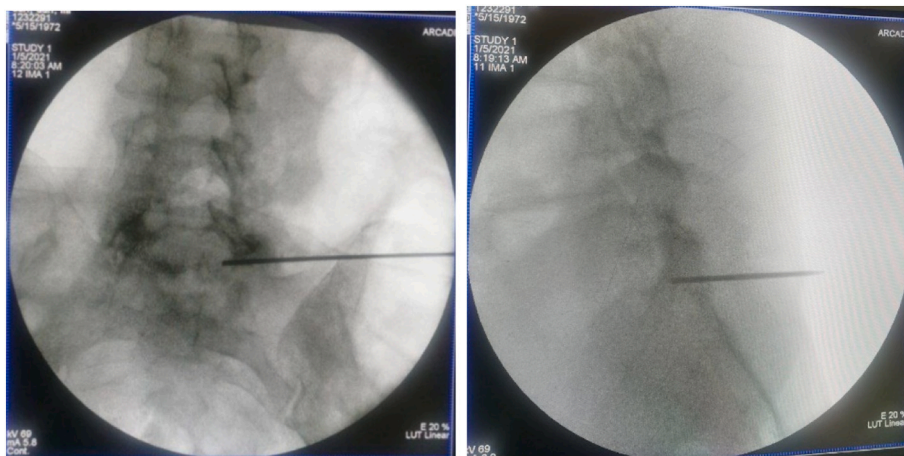


Fig. 2. The docking position of the patient in the fluoroscopy in the Antero posterior and lateral view.

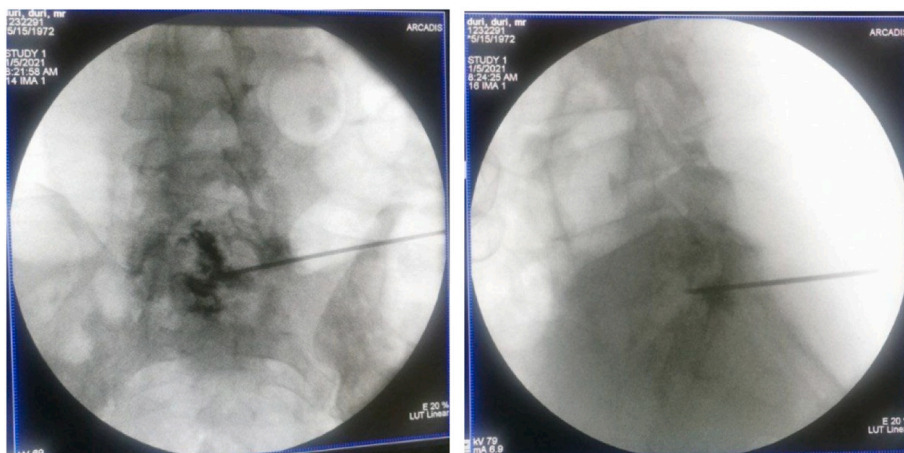


Fig. 3. Contrast agent injection after final working zone was confirmed.

Table 1
Patient's detail.

Subject	Diagnosis	Back pain		Leg pain		BMI	Entry point from midline (cm)
		VAS Pre-operative	VAS Post-operative	VAS Pre-operative	VAS Post-operative		
Patient 1	Disc herniation of the 5th lumbar - 1st sacral spine (Protrusion type, paracentral type, sagittal disc level) without neurologic deficit	6	4	6	2	25.2	8
Patient 2	Disc herniation of the 5th lumbar - 1st sacral spine (Extrusion type, paracentral type, sagittal disc level) without neurologic deficit	6	4	6	3	19.4	6
Patient 3	Disc herniation of the 5th lumbar - 1st sacral spine (Protrusion type, paracentral type, sagittal disc level) without neurologic deficit	7	4	7	2	24.5	10
Patient 4	Disc herniation of the 5th lumbar - 1st sacral spine (Protrusion type, paracentral type, sagittal disc level) without neurologic deficit	5	2	5	1	27.1	9
Patient 5	Disc herniation of the 5th lumbar - 1st sacral spine (Extrusion type, central type, sagittal disc level) without neurologic deficit	7	3	7	2	20.03	8
Patient 6	Disc herniation of the 5th lumbar - 1st sacral spine (Extrusion type, central type, sagittal disc level) without neurologic deficit	6	2	6	2	21.45	10

Table 2
Patient's demographic.

Variable	Value
Age (Year)	44.83 ± 22.50
BMI	
<18.5	0 (0)
18.5–25	5 (83.3)
>25	1 (16.7)
Sex	
Male	2 (33.3)
Female	4 (66.7)

Table 3
Patient's outcome.

Variable	Value	p-Value
VAS for back pain		
Pre-operative	4.05 ± 0.95	
Post-operative	3.16 ± 0.98	0.00
VAS for leg pain		
Pre-operative	6.16 ± 0.75	
Post-operative	2.00 ± 0.63	0.00

22–78 years). 2 (33.3%) patients were male, and 4 (66.7%) patients were female. 5 (83.3%) patients had normal BMI, while 1 (16.7%) patient was overweight (Table 2).

The preoperative mean VAS scores for leg pain significantly decreased from 6.16 ± 0.75 to 2.00 ± 0.63 at the last follow-up ($p < 0.05$) (Table 3). There was significant difference in VAS scores for back pain (4.05 ± 0.95 preoperatively vs. 3.16 ± 0.98 at the last follow-up).

There were no immediate postoperative complications, such as epidural hematoma or dysesthesia found in these case series.

5. Discussion

Transforaminal Endoscopic Lumbar discectomy (TELD) at the level of L5-S1 is challenging due to anatomical obstacles. The surgeon should assess the iliac crest height and the inclination of the disc at the L5-S1 level because these factors might cause a steeper trajectory angle and failure to reach the herniated disc.

The result of this study showed that 5 patients had normal body mass index and 1 patient had an overweight body mass index. In a study by Kim et al, the mean BMI of patients with recurrent disc herniation after lumbar microdiscectomy was significantly increased compared with patients without recurrent disc herniation. Overloading the intervertebral disc, whether by traumatic event or repetitive loading, could

contribute to recurrent herniation.

Prone position is a terminology that indicates a face-down body position, which is often used during lumbar surgeries. Many spine surgeons prefer knee-chest or modified knee-chest position in performing lumbar spine surgery instead of the usual prone position. The classic knee-chest position with 90° of hip flexion may slow the velocity of blood flow down and lead to complications. While in a modified knee-chest position with 45° hip flexion and 30° knee flexion, the femur and knee angle are greater than in the classic knee-chest position. The knee-chest position was found to have shorter puncture time compared to the prone position, while in the modified knee-chest position the foramen height will be widened compared to the classic prone position. Increasing the height of the foramen magnum may reduce the risk of neurologic complications. Thus, there were more advantages in L5-S1 PELD using a modified knee-chest position than the prone position during PELD procedure [16].

The skin entry point was approximately 8 to 11 cm from midline. Yeung and Tsou described a method for treating all types of disc herniations by inserting a working channel endoscope through the transforaminal route. The skin entry point described by them lies 12 ± 2 cm away from the midline [5].

The important factors in successful TELD are the location and inclination of the working cannula toward the pathologic disc. The entry point and the target can usually determine the trajectory of the cannula. There are 2 choices reported in the literature for the entry point, such as transiliac and supra-iliac entry. The transiliac entry point is aimed at gaining a direct route toward the pathologic disc by drilling a hole through the ilium [6]. The hole diameter on the ilium determines the possible mobility of the working cannula. This transiliac entry is technically difficult and has only been described in a few case reports. On the other hand, the supra-iliac entry at L5-S1 TELD, high iliac crest might be a significant concern in the procedure. The situation of the high iliac crest leads to the increased inclination of the trajectory, which makes the cannula toward a more ventral aspect and away from the centrally herniated disc [7].

A series of the L5-S1 TELD in 100 patients and simplified the relation of iliac crest height and L5-S1 disc level with 2-dimensional radiography was reported by Choi and Park [8]. Using supra-iliac entry point, TELD at L5-S1 can achieve a good outcome. In high iliac crest patients, foraminoplasty was considered for transforaminal access of L5-S1 disc herniation.

Initially, the aim of foraminoplasty was to expand the foramen during TELD in order to reach a migrated disk [9]. Transforaminal endoscopic access to the epidural space in the spinal canal is hampered by the Superior articulating process (SAP). The working zone can be extended after the ventral portion is undercut, and the endoscopic

trajectory can directly target the herniated disk [10]. TELD could be used not only for migrated discs but also for L5–S1 herniated discs with a high iliac crest using foraminoplasty [11]. Bone trephines, an endoscopic burr, or a side-firing Ho: YAG laser can all be used to conduct foraminoplasty. There is yet to be a comparative analysis to demonstrate which tool is superior. As a result, foraminoplasty is dependent on the surgeon's choice, expertise, and availability of instruments [12].

Interlaminar endoscopic lumbar discectomy (IELD) has recently become common for treating herniated discs in the L5–S1 region. IELD has been shown to be a safe and effective treatment for disc herniation at the L5–S1 stage. The interlaminar window is wider at the L5–S1 level from an anatomical perspective [14]. According to a recent report, TELD and IELD have similar clinical effectiveness and protection. Additionally, IELD outperforms TELD in terms of operative time and radiation exposure. During service, however, IELD can cause root irritation.

Because neural structures are usually visible after decompression in TELD, the anesthetic risk was lower than in IELD. As a result, local anaesthesia may be used. Patients who are elderly or have multiple comorbidities may benefit from this condition. In TELD, the risk of postoperative dysesthesia is also lower. The surgical route may be determined by the position of the herniated disc and the degree of migration. According to a retrospective study conducted in Korea, TELD is preferred for shoulder type, centrally located, and recurrent disc herniation, while IELD is preferred for axillary type and migrated disc herniation, especially those with a high-grade migration [15].

In this case series, there are limitations. In the first place, the samples were retrospective and small. There was also short-term follow-up time for patients.

6. Conclusion

TELD can be performed successfully for herniated discs at the L5–S1 level, which were previously thought to have anatomical barriers, with better anatomical evaluation, good trajectory, and positioning.

CRedit authorship contribution statement

Yudha Mathan Sakti: Conceptualization, Methodology, Validation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration, Funding acquisition. **Rosyad Nur Khadafi:** Formal analysis, Investigation, Resources, Data curation, Writing – review & editing, Project administration. **Andi Karsapin Tarsan:** Investigation, Resources, Data curation. **Aristida Cahyono Putro:** Investigation, Resources, Data curation. **Galih Prasetya Saka-dewa:** Software, Formal analysis, Investigation, Resources, Data curation, Writing – review & editing, Project administration. **Dwi Budhi Susanto:** Investigation, Resources, Data curation. **Karisa Kartika**

Sukotjo: Investigation, Resources, Data curation, Project administration.

Declaration of competing interest

No potential conflict of interest relevant to this article was reported.

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