Original Article

The role of transforaminal percutaneous endoscopic discectomy in lumbar disc herniations

ABSTRACT

Objectives: To study 1)the efficacy of transforaminal percutaneous endoscopic lumbar discectomy in lumbar disc herniations.2) limitations and advantages of the surgical procedure. 3)morbidity and complications associated with the procedure.

Materials and Methods: This study was carried out on 120 patients who had single level herniated disc Pre-operative assessment of VAS and MSS scoring systems were documented one day prior to surgery. Post operative results were determined by MacNab criteria and by modified Suezawa and Schreiber clinical scoring system (MSS score).

Results: Maximum patients were in the age group of 31 to 40 years and 83.43% of the patients were males. 80% patients had lumbar disc herniation at L4-L5 level, The mean operative time of endoscopic discectomy was 52.28 minutes and the mean hospital stay was 2.1days .8 cases of L5-S I were abandoned due to high iliac bone and hence their disc could not be accessed.Out of 112 patients who underwent operation, 2 patients developed discitis and 1 was found to have dysesthesia. Also recurrent prolapsed intervertebral disc was seen in 6 cases The mean preoperative and 6 months follow up VAS score was 8.4 and 1.89 respectively. Mean preoperative and 6 months follow up Modified Suezawa And Schreiber Clinical Scoring System(MSS Score) was 3.47 and 7.92 respectively.MSS score showed excellent and good outcome in 82.12% patients and Modified Macnab Criteria showed excellent and good outcome in 89.3% patients at 6months follow up.

Conclusion: TPELD can be a reasonable alternative to conventional microscopic discectomy for the treatment of patients with LDH. We also conclude that TPELD is not an effective procedure for L5 -S 1 disc and an open procedure should be opted for better outcomes.

Key words: Lumbar disc herniation; minimally invasive spine surgeries; percutaneous endoscopic transforaminal lumbar discectomy.

Introduction

Lumbar disc herniation (LDH) is one of the most common causes of low back pain and sciatica. The number of patients with LDH is increasing not only with the aging population but also in the young due to the lack of physical activity and sedentary lifestyle.[1] Surgical intervention should be considered in patients of LDH who do not achieve satisfactory recovery following conservative treatment.

Migrated or sequestered disc herniations need extensive resection of the lamina, especially in the region of pars intraarticularis and facets when approached by conventional posterior laminectomy. This causes extensive damage to the normal anatomical structures posteriorly and may destabilize

Sarang Gotecha, Deepak Ranade, Sujay Vikhe Patil, Ashish Chugh, Megha Kotecha[1], Shrikant Sharma, Prashant Punia

Departments of Neurosurgery and [1]Ophthalmology, Dr. D. Y. Patil Medical College, Pune, Maharashtra, India

Address for correspondence: Dr. Sarang Gotecha, Department of Neurosurgery, Dr. D. Y. Patil Medical College, Sant Tukaram Nagar, Pimpri, Pune - 411 018, Maharashtra, India.
E-mail: dr.sarangsgotecha@gmail.com

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the motion segment aggravating back pain and increasing postoperative morbidity.[2]

Minimally invasive techniques for the treatment of lumbar spine pathologies have found their way into mainstream spinal surgery. Advantages of minimally invasive procedures include faster recovery and rehabilitation, reduced hospital stay and return to work, and lesser risk of spinal instability.[3-6]

Since the introduction of the concept of percutaneous posterolateral nucleotomy by Kambin in the year 1973, the technique of percutaneous endoscopic transforaminal lumbar discectomy (PELD) has eveloved over the years and is increasingly becoming treatment of choice for the management of LDH.[2]

PELD, by transforaminal approach, offers several advantages over open methods such as preservation of normal anatomy by preventing iatrogenic injury of the paraspinal muscles, lesser postoperative instability, facet arthropathy, and disc space narrowing. In addition, there is no interference of the epidural venous system that may lead to chronic neural edema and fibrosis. Epidural scarring after open discectomy which leads to clinical symptoms in more than 10% of patients, is not observed in PELD.[7,8]

This study was conducted as not many studies have been done in India with respect to the transforaminal percutaneous approach to the lumbar disc pathology and also to evaluate the efficacy of the procedure with respect to the outcome of the same.

Aims and objectives

To study the efficacy of transforaminal percutaneous endoscopic lumbar discectomy in LDHs with respect to advantages, complications, and limitations associated with the procedure.

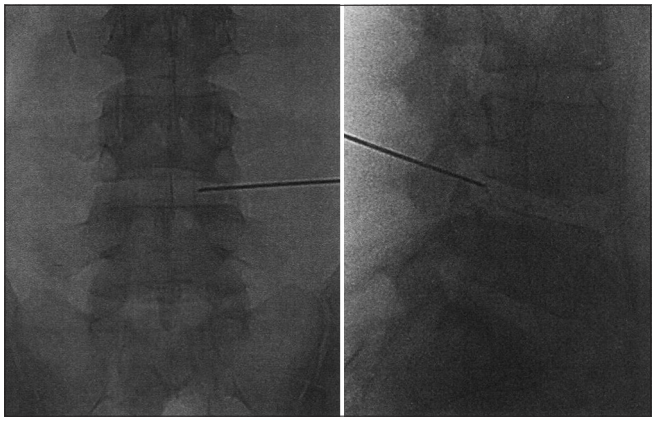

Figure 1: Needle insertion technique: (At the medial pedicular line in the anteroposterior view and the posterior vertebral line in the lateral view on fluoroscopy)

Materials and Methods

This prospective study was carried out at Dr. D. Y. Patil Hospital, Pune from August 2012 to December 2014 on 120 patients. Patients included were those who had single-level herniated disc with neurological signs with demonstrable nerve root compression seen on magnetic resonance imaging, patients with unsuccessful conservative treatment for atleast 4 weeks and patients with comorbid conditions such as obesity and age-related complications. Patients with spinal instability, central canal stenosis or lateral recess stenosis, calcified centrally located disc or herniations occupying more than 50% of the spinal canal, and multiple level disc herniations and cranially or caudally migrated disc fragments were excluded from the study. The patients were examined thoroughly, and the diagnosis was made by assessing thorough medical history, complete physical examination, and appropriate investigations. Preoperative assessment of visual analog scale (VAS) and Modified Suezawa and Schreiber (MSS) scoring systems [Table 1] were documented 1 day before surgery. All the patients were operated under local anesthesia with nil by mouth status overnight (precautionary). Postoperative results were determined to be excellent, good, fair, or poor according to MacNab criteria [Table 2] and also evaluated by MSS clinical scoring system on postoperative day 7 and after 6 months.

Technique

The procedure was performed under local anesthesia with the patient in the prone position under guidance of C-arm fluoroscopy. Continuous feedback from the patient is necessary to avoid causing damage to the exiting and the traversing nerve roots. This is facilitated by local anesthesia, where the patient's foot and toe movements are continuously monitored.

The skin entry point was about 12–14 cm from the midline, and the needle insertion was done. The needle is navigated into the disc space through the Kambin's triangle using the C-arm [Figure 1].

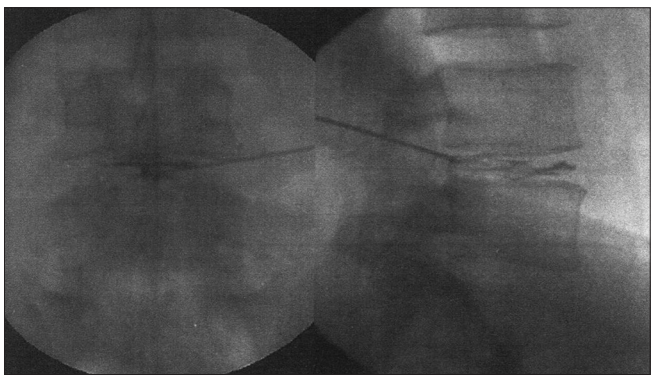

Figure 2: Discography: Done by injecting radio opaque dye in the disc space

Liberal use of local anesthetic at the site of the skin entry as well as the tract of the intended trajectory is done. A volume of 6–8 ml of the local anesthetic is injected at the annulus. 1–2 ml of a radioopaque dye is injected to define the exiting nerve root and the dural sac in the fluoroscopy. Discography was performed by injecting 2–3 mL of a mixture of radiopaque dye (urografin dye) and normal saline mixed in equal ratios. The dye leak was seen through the tear in the annulus into the epidural space with the direction being concordant with the anatomical location of the ruptured fragment [Figure 2].

A guide wire is introduced through the needle, and the passage is dilated with the obturator that is threaded onto the guide wire till it reaches the annulus [Figure 3]. The next step was annular fenestration, in which the blunt-tapered obturator was advanced manually or with a mallet (patient is sedated before thrusting the obtuator past the annulus) [Figure 4]. A beveled working cannula is guided over the dilator to position it into the disc [Figure 5]. The next step is fragmentectomy where the decompression is done from medial to lateral aspect of the disc using rongeurs of various sizes under direct vision [Figure 6]. After decompressing the dural sac laterally to the spinous process in the AP view guided by the C-arm, the working cannula was retracted until it reached the medial pedicular line and the foramen. The decision of adequate decompression was accomplished by visual inspection of mobility of a free-floating dural sac and epidural space [Figure 7].

The entire procedure was performed under constant irrigation with antibiotic instilled cold normal saline solution to maintain a clear field preventing clouding of the lens and also flushes any minor oozing. The patient's pain relief was assessed intraoperative after the removal of the disc fragment and was considered as the end-point of the procedure. In the postoperative period, injectable broad-spectrum antibiotic was given to all the patients for 3 days. The patient was ambulated on day 1 and discharged on the 2nd postoperative day and was called for follow-up and suture removal on the 7th postoperative day. Regular follow-up was done on day 15, 2 months, and 6 months for all patients. Various assessment scores (VAS, MacNab, and MSS) were documented on

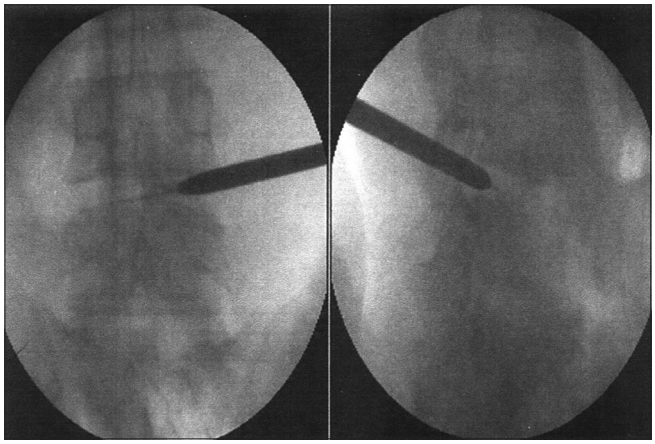

Figure 3: Inserted guide wire in the disc space over which obturator is being inserted

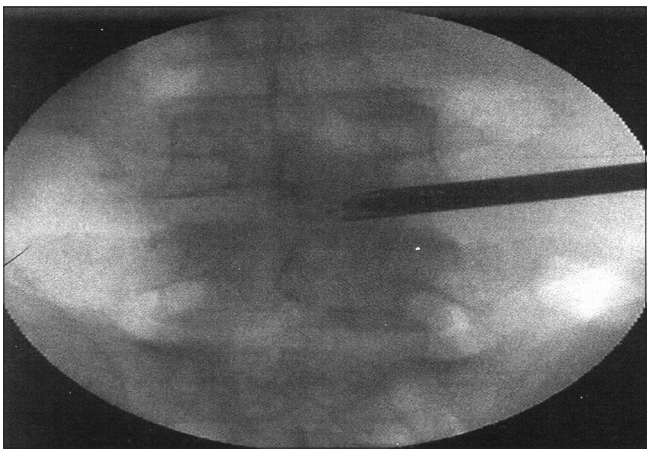

Figure 5: Working sleeve inserted over obturator

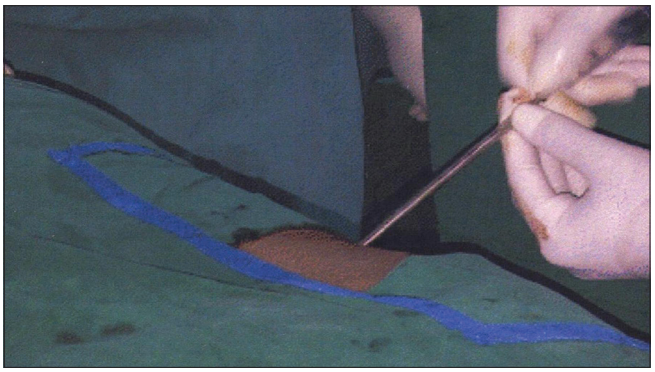

Figure 4: Annular fenestration being done by advancing the obturator

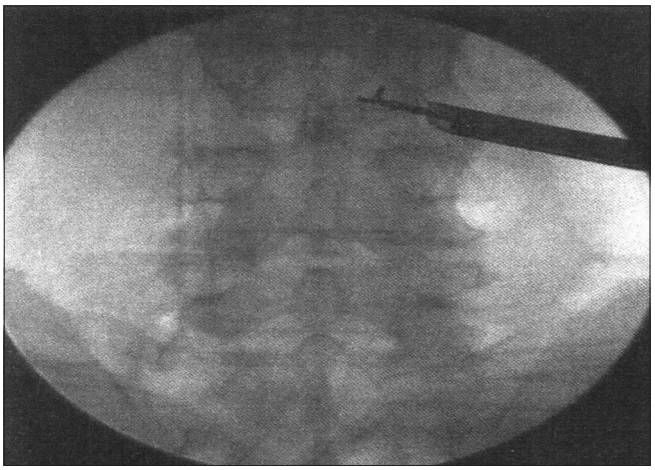

Figure 6: Rongeurs inserted into the disc space through the working cannula as seen on C-arm

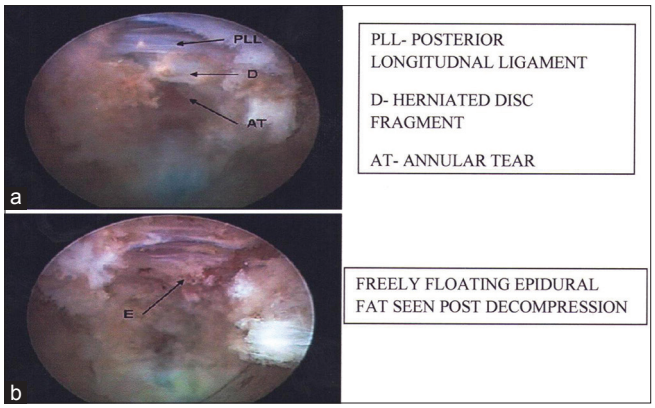

Figure 7: (a and b) Endoscopic visualization of the disc space. PLL: Posterior longitudinal ligament, D: Herniated disc fragment, AT: Annular tear, E: Freely floating epidural fat seen post decompression

postoperative day 7 and after 6 months of follow-up to evaluate the surgical outcome.

A MSS clinical scoring system[12] was used to evaluate pre- and post-operative results. The total score is calculated by adding the score from each symptom for a maximum of 10 and a minimum of 0. A total score of 9–10 indicates excellent condition, 7–8 good, 6–5 moderate, 4, or less poor.

Postoperative evaluation was also done by MacNab criteria, which was evaluated as excellent, good, fair, and poor.[13]

Observation and Results

Out of the 120 patients in our study, 100 patients were males and 20 patients were females and maximum patients were in the age group of 31–40 years. 96 patients had disc herniation at L4-L5 level, 8 patients at L3-L4 level, and 16 patients at L5-S1 level. The mean operative time of endoscopic discectomy was 52.28 min with a range of 35–70 min, and the mean hospital stay of the patients was 2.1 days. In our study, 8 cases of L5-SI were abandoned due to high iliac bone and hence their disc could not be accessed. Since these 8 cases were abandoned, they were not included in any further evaluation of the results and postoperative calculations were taken for the remaining 112 patients. Out of 112 patients who underwent operation for LDH in our study, 3 cases (2.6%) developed postoperative complications out of which 2 developed discitis and 1 was found to have dysesthesia. Out of the 2 patients of discitis, one was at L4-L5 level and the other was at L5-S1 level. In addition, recurrent prolapsed intervertebral disc was seen in 6 cases, out of which 1 case had disc prolapsed at L3-L4 level, 3 cases at L4-L5 level, and 2 cases at L5-S1 level. All the patients of recurrence had a symptom-free period of 3–6 months.

VAS: the mean preoperative VAS score was 8.4 and the mean postoperative VAS score at postoperative day 7 and at 6 months was 2.36 and 1.89. Out of 112 cases, 2 cases of discitis and 1 case of discogenic low back pain did not show much improvement in their VAS on postoperative day 7 but showed symptomatic improvement on conservative treatment on 6 months follow-up. The 6 cases of recurrence had postoperative improvement in their VAS score at 7th postoperative day and had recurrence of symptoms later.

MSS clinical scoring system for lumbar disc disease: the mean preoperative MSS score was 3.47 the MSS score at postoperative day 7 and at 6 months was 7.14 and 7.92, respectively. According to MSS scoring at 6 months, 25 patients (22.32%) and 67 patients (59.8%) had excellent and good outcome while 12 patients (10.7%) and 8 patients (7%) had moderate and poor outcome, respectively.

There were 22.32% cases having excellent and 59.8% cases having good MSS score at 6 months follow-up. The 2 cases of discitis and 1 case of discogenic low back pain showed poor MSS on postoperative day 7 but showed improvement in their MSS score after 6 months of conservative therapy.

According to the Modified Macnab Criteria, 28 patients (25%) and 68 patients (60.7%) had excellent and good results, respectively at postoperative day 7 which improved to 48 patients (42.9%) and 52 patients (43%) at 6 months follow-up whereas 8 patients (7.1%) had fair and poor outcomes each at postoperative day 7 which improved to 4 patients (3.6%) and 8 patients (7.1%), respectively at 6 months follow-up.

In our study, 42.9% cases showed excellent result in their MacNab scoring system at 6 months follow-up whereas 43% showed good results. The 2 cases of discitis and 1 case of discogenic low back pain which did not show immediate postoperative improvement in their VAS and MSS score, had a poor MacNab score even on 7th postoperative day but showed improvement in MacNab score on 6 months follow-up after conservative treatment.

Out of 112 cases who were operated endoscopically in our study, 6 cases with recurrence underwent open surgical intervention (microscopic discectomy) for LDH eventually. The overall successful outcome of the endoscopic discectomy in our study was evaluated after 6 months of follow-up on the basis of (a) VAS improvement percentage = 79.1% (b) MSS scoring percentage (overall excellent and good cases at 6 months follow-up) = 82.12% (c) MacNab SCORING percentage (overall excellent and good cases at 6 months follow-up) = 86%.

Table 1: Modified Suezawa and Schreiber clinical scoring system for lumbar disc disease

Symptoms	Score 2	Score 1	Score 0
Low back pain	None	Activity related	At rest
Sciatica	None	With SLRT	At rest
Sensory deficit	None	Dysesthesia paresthesia	Hypesthesia anesthesia
Motor weakness	None	Full function with slight resistance	Two reflexes impaired
Reflex changes	None	One reflex impaired	Two reflexes impaired

SLRT - Straight leg raising test

Table 2: MacNab criteria

Grade	Criteria
Excellent	No pain; no restriction of activity
Good	Occasional back or leg pain of sufficient severity to interfere with the patient's ability to do his normal work
Fair	Improved functional capacity, but handicapped by intermittent pain of sufficient severity to curtail or modify work or leisure activities
Poor	No improvement or insufficient improvement to enable increase in activities; further operative intervention required

Discussion

Is minimally invasive spine surgery the answer to all the lumbar disc diseases? Various advantages of endoscopic discectomy have been described in literature.[7,8] With increasing awareness among patients about endoscopic procedures, there is an increasing demand of this surgery due to better esthetic results.[7,14,15]

In 1934, Mixter and Barr were the first authors who treated LDHs by open laminectomy and discectomy.[14] In 1950, Hult described the anterior transperitoneal approach.[16] Kambin and Gellman in 1973[17] in the USA and Hijikata in Japan in 1975[18] independently performed a nonvisualized, percutaneous central nucleotomy for the resection and evacuation of nuclear tissue through a posterolateral approach. In 1989 and 1991, percutaneous discoscopy was described by Schreiber *et al.,* which is a biportal endoscopic posterolateral technique with modified instruments for direct view.

In transforaminalpercutaneous endoscopic lumbar discectomy (TPELD), the posterolateral approach can be used to avoid the disadvantages of posterior open discectomy that are associated with its surgical route. This anatomical triangular working zone for accessing the intradiscal space has been described by various authors.[9,19,20]

In our study, the mean age group was 40.5 years with a maximum number of patients seen in the age group of 31–40 years, which is considered to be the productive age group and majority of the cases (100 cases) were male. It is in correlation with almost all the studies indicating that this disease has a male preponderance and increased incidence in the productive age group.[1,8,11]

There are 80% cases of L4-L5 LDH in our study followed by L5-S1 (13%) and L3-L4 (7%). Jang *et al*. in their study had maximum number (57%) of cases of LDH at L4-L5 level followed by 28% of cases of L3-L4. A study carried out by Kim *et al.*[21] and Tzaan[1] also showed comparable findings. Hence, we conclude that the incidence of LDH is more common at L4-L5 level as compared to other level LDH.

The mean operative time in our study is 52.28 min with a range of 35–70 min. Many studies have concluded has a steep learning curve and with time and experience, the operative time reduces further with better outcomes. A study carried out by Peng *et al*. showed a comparable mean operative time of 55.8 min.[8]

The mean hospital stay of the patients which were included in our study was 2.1 days. This is very beneficial for the patient as well as the surgeon. The mean hospital stay according to a Chen *et al*. in their study was 1.89 days.[4]

One of the major obstacles in operating patients with L5-S1 LDH is the iliac crest. The trajectory angle of TPELD is generally too acute to reach the posterior part of the intervertebral disc of intracanal epidural space to achieve more direct targeted fragmentectomy of the subarticular or central L5-S1 LDH. Thus, the success rate of TPELD in L5-S1 LDH is lower than LDH at other levels.[1] In our study, 8 cases of L5-S1 LDH were abandoned as the disc space at this level could not be accessed as a result of proximity to the iliac crest. Jang *et al*. in their study stated that limitation of TPELD is its inability to successfully treat foraminal or extraforaminal nerve root compression at L5-S1 level as it may pose technical difficulties because of proximity of the iliac crest or prominent ala sacralis which make it impossible to obtain oblique view into the depth of lateral interpedicular compartment.[22] Hence, we conclude that TPELD is not an effective procedure for L5-S1 disc and an open procedure should be opted for better outcomes.

According to literature and our experience, the advantages of transforaminal endoscopic surgery are a lower complication

rate. Various complications mentioned in literature are infections such as discitis, late recurrence, root damage, dysesthesias, dural tear, vascular injury, and death.[1,4,21] There were complications observed in 3 of our cases (2.5%). 2 cases had discitis, and 1 had dysesthesia. The 2 cases which developed discitis suffered from severe back pain seen around a week after the operation. These cases were managed conservatively with intravenous antibiotic cover for 1 month with strict immobilization. They recovered slowly and showed good results on follow-up after 6 months. One with dysesthesia also recovered with conservative line of management and no further intervention was needed. David A. Ditsworth *et al*. in their study mentioned a complication rate of 8.2% and had similar complications such as discitis and dysesthesia. 6 cases (5%) of recurrence were also seen in our study which was comparable to a study carried out by Kim *et al*. where TPELD was done in 295 patients, and the recurrence rate was 6.44%.

VAS was used as a parameter to study the preoperative, postoperative (7 days), and follow-up (6 months) outcomes of the surgery. Mean VAS preoperative, postoperative, and follow-up were 8.4, 2.3, and 1.89, respectively. Sasani *et al.*[23] in their study showed a similar result with preoperative, postoperative, and follow-up showing mean VAS of 8.2, 4.2, and 1.4, respectively. Similar results were also seen in a study carried out by Ahn *et al.*[24]

MSS score was used preoperative and postoperative to assess the successful outcome of our procedure. Results that were excellent and good were considered to be as successful outcome. In our study, 25 (22.32%) patients had excellent, and 67 patients (59.8%) had good outcome on 6 months follow-up whereas 12 had moderate and 8 had poor outcome. The mean clinical score calculated from the scoring system was 3.47 in the preoperative period and 7.92 on 6 months follow-up. Successful outcome is 82.14%. In the study carried out by Kafadar *et al.*,[25] the clinical score calculated from the scoring system averaged 5.17 ± 0.82 in the preoperative period, and the mean postoperative score was 7.58 ± 1.77, and the overall success rate was 77%.

MacNab score was used to assess the outcome of the procedure. In our study, 42.9% showed excellent and 43% had good outcome with a successful outcome of 85.9%. Fair outcome was seen in 3.6% and 7.1% had poor outcome after 6 months follow- up period. Jorn Nellensteijn *et al*. in their systematic review of literature calculated the successful outcome of the procedure by MacNabs criteria to be 85% (72%–94%).

Conclusion

We conclude that TPELD is a reasonable alternative to conventional microscopic discectomy for the treatment of patients with LDH. We also conclude that TPELD is not an effective procedure for L5-S1 disc, and an open procedure should be opted for better outcomes.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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