

Percutaneous Endoscopic Interlaminar Disectomy For Lumbar Disc: Early Experience, Outcome and Complication: a Retrospective Observational Study With a Pre–Post Design

Sabri Ibrahim

ns.greenbrain26@gmail.com

University of North Sumatra

Muhammad Deni Nasution

University of North Sumatra

Fahmi Rasyid

University of North Sumatra

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Abstract

Background

The number of patients suffering from lumbar disc herniation (LDH) continues to increase annually, largely attributed to rising work demands and life stress. In response to this growing burden, minimally invasive surgical techniques have been developed, among which percutaneous endoscopic lumbar discectomy has emerged as a favorable alternative to conventional open discectomy due to its advantages of reduced tissue trauma and faster postoperative recovery. Previous studies have reported that the recurrence rates of percutaneous endoscopic lumbar discectomy are comparable to those of open discectomy and microendoscopic discectomy. In this context, Percutaneous Endoscopic Interlaminar Lumbar Discectomy (PEID) has been increasingly utilized. Therefore, this study aims to analyse the difference in pain, measured using the Visual Analog Scale (VAS), and physical functioning, measured using the Oswestry Disability Index (ODI), before and after surgery. We included all adult patients (age > 18 years) diagnosed with lumbar herniated nucleus pulposus who underwent Percutaneous Endoscopic Interlaminar Lumbar Discectomy (PEID) at a government tertiary referral hospital in Indonesia from January 1st 2020 to December 31st 2024. Pain and functional outcomes were assessed using the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) before and after surgery. The PEID technique involves intradiscal removal of the degenerated disc material followed by radiofrequency coagulation of the remaining disc.

Results

Most of the cases were on L4/L5 level followed by L3/L4 and L5/S1. Complication were found only on 2 cases. Male dominated through all the patients with mean of age were $40,37 \pm 13,48$ and duration of operation were $56,34 \pm 10,49$. The difference of VAS and ODI score between pre and post operative groups were statistically significant ($p = 0,001$; $p = 0,001$, respectively).

Conclusions

Improvement of pain intensity and physical functioning was seen after surgery proven by decrease of VAS and ODI score of patients who underwent Percutaneous Endoscopic Interlaminar Discectomy (PEID).

INTRODUCTION

Lumbar disc herniation is a frequently encountered pathologic condition in spine clinical practice. Patients with lumbar disc herniation experience radicular symptoms or low back pain caused by compression of the nerve roots. Treatment is initially conservative, persistent limb or lumbar pain or neurologic deficits may lead to consideration of surgical interventions and removal of disc material. Open lumbar microdiscectomy has been a standard surgical technique for the treatment of lumbar disc

herniation owing to its efficacy and safety, since the late 1907s. In contrast, Percutaneous Endoscopic Interlaminar Lumbar Discectomy (PEID) has gained popularity worldwide, as a standard full-endoscopic surgical technique for the treatment of disc herniation at the L5–S1 level and as an alternative minimally invasive technique to open lumbar microdiscectomy since the mid-2000s. Recently, many previous studies have reported on the efficacy and safety of PEID. Although conventional open discectomy offers favorable clinical outcomes, damage to normal structures not only leaves surgeons with a sense of guilt but also can negatively affect clinical outcomes.^{1,2}

These minimally invasive endoscopic procedures via the interlaminar windows are regarded as effective surgical options for soft lumbar disc herniation and lead to favorable clinical results with less tissue trauma and an earlier recovery than conventional surgery. Some randomized controlled trials and meta-analyses revealed that Percutaneous Endoscopic Lumbar Discectomy is not inferior to standard open surgery in terms of global outcome, complications, and returning to work. PEID has been developed for patients in whom transforaminal endoscopic lumbar discectomy is difficult due to a high iliac crest or conjoined nerve root.^{3,4}

The number of people suffering from lumbar disc herniation increases every year due to increased work and life stress. Percutaneous endoscopic lumbar discectomy, with less trauma and fast recovery, has been a favorable alternative to open discectomy for patients of lumbar disc herniation. The indication for Percutaneous endoscopic lumbar discectomy has been expanded through improved techniques. Percutaneous endoscopic lumbar discectomy, a minimally invasive spine surgery, has been a mainstream technique for lumbar disc herniation. Some studies suggested a similar incidence of recurrence between Percutaneous endoscopic lumbar discectomy and open discectomy or microendoscopic discectomy.^{4,5,6}

METHODS

We did full endoscopy discectomy for lumbar herniated nucleus pulposus using interlaminar approach in government tertiary referral hospital in Indonesia. All patients were adults (age > 18) with diagnosis of lumbar herniated nucleus pulposus and underwent Percutaneous Endoscopic Interlaminar Lumbar Discectomy (PIED) in our centre on January 1st 2020 until December 31st 2024. The amount of patients were 41 people. Exclusion criteria were patients who diagnosed with discitis, have history of spinal fracture and radiographically proven for instability. All patients included were one level discectomy.

The PIED technique involves intradiscal removal of the unhealthy disc and radiofrequency coagulation of the healthy remaining disc. All the patients were operated on by the same surgeon and were followed up by the same spine surgical team, supervised by the same surgeon. The clinical data were retrieved from the patients' medical records. The preoperative and postoperative data were assessed using the Oswestry Disability Index (ODI) for physical functioning, visual analog scale (VAS) for back pain, and VAS for leg pain at 3 months postoperatively and complications were recorded from the medical records.

PROCEDURE

Under general anesthesia and intravenous antibiotic prophylaxis, the patient is positioned with both hips and knees in flexion. We used endoscopy with working channel 6mm, outer diameter 11mm, working length 120 mm, 12 and 25 degrees of lens angle and a 4-mm head-sized endoscopic burr (shaver) that is available through the working channel (Figure-1). An 10 mm incision is made near the midline on the operated interlaminar window via an anteroposterior fluoroscopic view. The dilator is inserted through the fascia, followed by an endoscopic working sleeve aimed over the ligamentum flavum. The paravertebral muscle is coagulated to identify the border of the interlaminar window. For L4/5 if the interlaminar window was too narrow, we did drill (shaver) on inferiomedial laminar. The ligamentum flavum is then cut in a mediolateral direction at the level of the tip of the descending facet. The working sleeve is passed through the cut ligament flavum into the epidural space, with the beveled tip placed on the remaining facet. The epidural tissue covering the lateral rim of the dural sac and exiting nerve root is gently removed using a pituitary rongeur. The working sleeve is rotated to retract the exiting nerve root medially. The posterior longitudinal ligament is cut using a micropunch in the mediolateral direction, and the free fragments are removed. A probe is to identify the annular tear and trace the sequestered disc. The border of the annular defect and intradiscal area is diminished by radiofrequency bipolar. The entire passage of the exiting nerve root is evaluated under visualization for pulsation and tightness and the subcuticular layer of the skin is then sutured.

Statistical Analysis; Patients' demographic data, clinical characteristics, and complication rates were analyzed using descriptive statistics. VAS scores were analyzed preoperatively and 1 week postoperatively using Student's Wilcoxon test. VAS and ODI scores were analyzed pre- operatively and 3 months postoperatively using Student's Wilcoxon test. Improvement was analyzed with the VAS scores 3 months postoperatively. The VAS and ODI scores across ethnicities were analyzed using 1-way analysis of variance.

RESULTS

Table 1
Characteristics data

Characteristics	n (%)
Level	
L3/L4	13 (31,7)
L4/L5	15 (36,6)
L5/S1	13 (31,7)
Complication	
Absent	39 (95,1)
Durotomy	2 (4,9)
Gender	
Male	21 (51,2)
Female	20 (48,8)
Age (Mean $\pm$ SD)	40,37 $\pm$ 13,48
Operation time (Mean $\pm$ SD)	56,34 $\pm$ 10,49

From Table 1, it can be concluded most of the cases were on L4/L5 level followed by L3/L4 and L5/S1. Complication were found only on 2 cases. Male dominated through all the patients with mean of age were 40,37 $\pm$ 13,48 and duration of operation were 56,34 $\pm$ 10,49.

Table 2
Comparison of Visual Analog Score (VAS) pre and post operative group

Groups	VAS				p
	Mean	SD	Median	Min - Max	
Pre-operative	7,68	0,96	8	6–9	0,001 ^{a*}
Post-operative	5,34	0,938	5	4–8	
*Statistically significant p < 0,05					
^a Analysed using Wilcoxon test					

Visual Analog Score or VAS was observed in this study (Table 2). Higher VAS was seen on pre-operative group and lower on post operative group. The difference between each groups was statistically significant (p = 0,001).

Table 3
Comparison of Oswestry Disability Index (ODI) Score pre and post
operative group

Groups	ODI Score				p
	Mean	SD	Median	Min - Max	
Pre-operative	57,07	15,85	60	20–60	0,001 ^{a*}
Post-operative	21,95	8,723	20	45–90	
*Statistically significant with p < 0,05					
^a Analysed using Wilcoxon test					

ODI score was also observed in this study. Significant difference of ODI score between each groups was also found on Table 3 ($p = 0,001$).

DISCUSSION

LDH is a prevalent cause of both low back pain and sciatica, significantly impacting the daily lives of patients.⁷ Therefore, there is an urgent need to alleviate the pain and enhance the quality of life for these patients.⁸ Minimally invasive surgery is often preferred by patients due to their potential for quicker postoperative recovery.⁹

Prof. Ruetten proposed percutaneous endoscopic interlaminar discectomy (PEID) in 2006 as a complementary procedure to percutaneous endoscopic transforaminal discectomy (PETD), which is more advantageous in treating Lumbar Disc Herniation (LDH) with high ilium and hypertrophic transverse process in the L5-S1 segment.¹⁰

Table 2 in our study, improvement in pain intensity was noted. Higher score of VAS pre operative and the decline of VAS remarking there was significant differences on pain intensity after the surgey. Physical function was also analysed using ODI score. We compared the score before and after the operation and it was found there was a decline too and statistically significant.

A study by Shi et al was compared VAS back pre and post operative who underwent PEID and the difference was statistically significant but the opposite results was showed when comparing VAS leg pre and post operative. ODI score was also observed in this study and it also showed similar results with our study which we can conclude there was an improvement of low back pain and lumbar spine function after PEID.¹¹

Wei et al also compares VAS and ODI score the patients who underwent PEID with Unilateral Biportal Endoscopic Discectomy (UBED). VAS back and sciatica and ODI score were checked 1 day, 1 month, 3 months, 6 months and 12 months after operation. The VAS and ODI scores at each observation point after the operation were significantly decreased compared with before the operation in both groups ($P <$

0.05) but there was no statistical difference in VAS of low back pain and sciatica and ODI score of patients who underwent PEID and UBED in each observation point. We can conclude there was no superior-inferiority between each methods and both method have demonstrated comparable efficacy in alleviating pain and improving functional ability in patients with LDH.¹²

PEID, as one of the major minimally invasive techniques, resembles the view of traditional open surgery as well as more direct intra-spinal decompression, minimizing damage to paraspinal muscle stripping and small joints to maintain spinal stability, and has now been proved to have excellent postoperative results and surgical safety.¹³

With the development of spinal endoscopic instruments and the improvement of surgical techniques, PEID is not limited to the treatment of L5-S1 segments, and the indications have also expanded from a single LDH to lumbar spinal stenosis, lumbar vertebral metastases, lumbar disc cysts and reparation of recurrent LDH.^{14,15}

In our study, mean of the operation time was $56,34 \pm 10,49$. A study by Shi et al showed operation time in this study is longer than ours. Compared to UBED, PEID was have shorter operation time remarking that PEID did not take long operation time but still showed significant efficacy in treating lumbar disc herniation (LDH) and it could be an option for LDH treatment.

Choi et al found that characteristics of the disc herniation, which are location, type, degree of migration, and recurrent disc should be considered for an endoscopic trajectory, considering the anatomy of the L5-S1 disc space, iliac bone, and interlaminar window.¹⁶

Percutaneous endoscopic discectomy, which includes IELD and TELD, has been considered as a minimally invasive alternative to conventional open discectomy for LDH.¹⁷ There were no major differences in hospitalization time, VAS scores, and ODI scores between the Interlaminar Endoscopic Lumbar Discectomy (IELD) and Transforaminal Endoscopic Lumbar Discectomy (TELD) groups. This suggests that both IELD and TELD offer similarly satisfactory clinical outcomes for L4-L5 highly down-migrated LDH.¹⁸

Despite these promising findings, several limitations should be considered. First, this study employed a retrospective design, which may introduce selection bias and limit the ability to control for confounding variables. Second, the study was conducted in a single center with a relatively small sample size, potentially limiting the generalizability of the results. Third, the absence of a control group restricts direct comparison with other surgical techniques, such as open discectomy or alternative endoscopic approaches. Finally, the follow-up period was relatively short, and long-term outcomes, including recurrence rates and sustained functional improvement, were not evaluated.

Future studies with prospective designs, larger sample sizes, multicenter settings, and longer follow-up periods are warranted to further validate the effectiveness and safety of PEID and to establish stronger evidence for its clinical application.

CONCLUSION

Improvement of pain intensity and physical functioning was seen after surgery by a decline of VAS and ODI score before and after operation and both were statistically significant. PEID can be an option in treating LDH.

Declarations

Written informed consent was obtained from all participants prior to their participation in the study.

ETHICAL APPROVAL

This study was approved by an institutional ethics committee

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Author Contribution

SI conceived and designed the study. SI and MDN collected the data. FR performed the statistical analysis. SI and MDN drafted the manuscript. FR critically revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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The authors would like to thank all nurses, doctors, and residents who contributed to patient care and data collection in this study.

Data Availability

The datasets generated and/or analyzed during the current study are not publicly available due to patient confidentiality but are available from the corresponding author on reasonable request.

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Figures



Figure 1

Endoscopy Instrument i.e working sleeve (F)

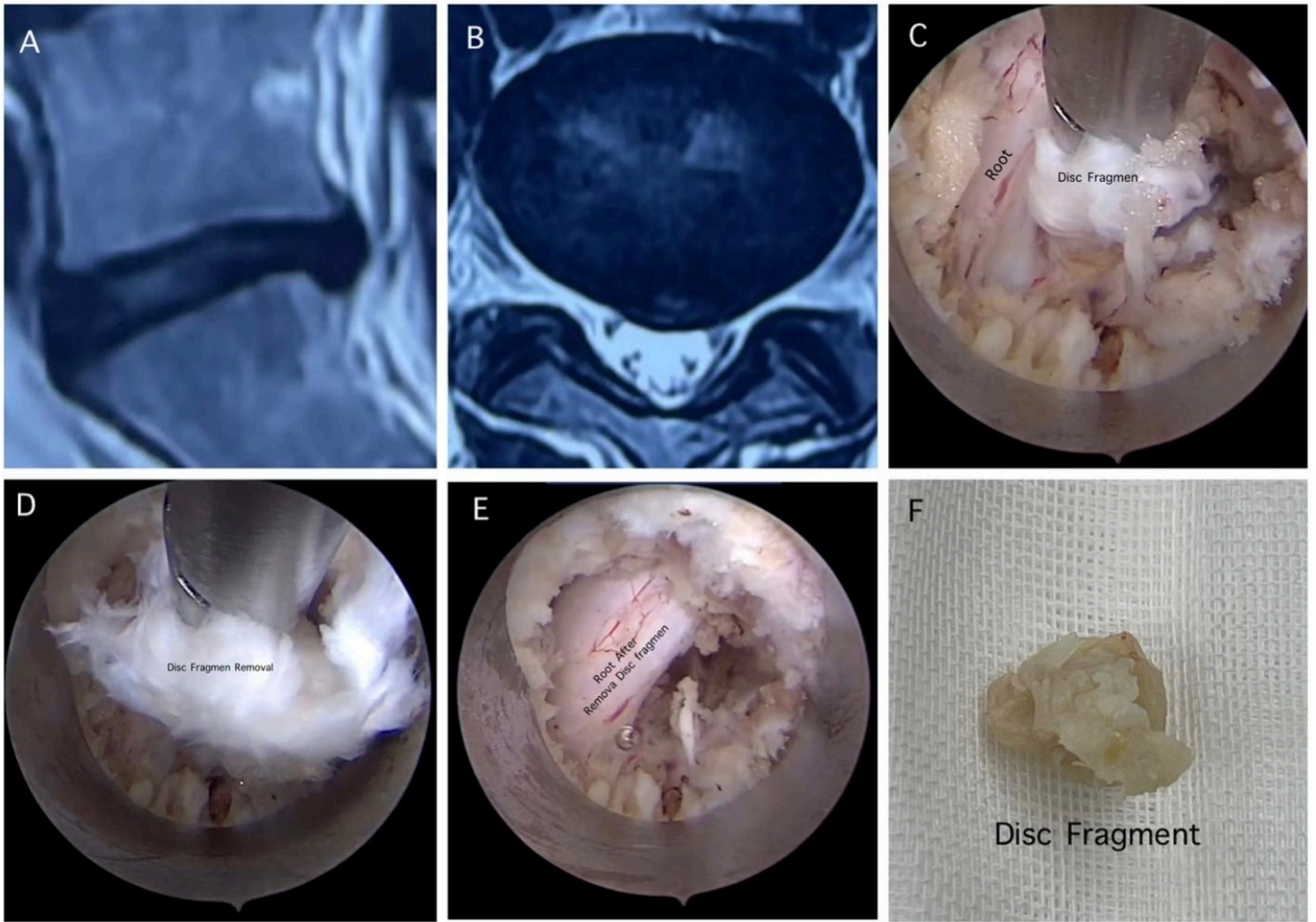


Figure 2

Sample case, (A) MRI, sagittal plane. Herniated disc was seen on L5/S1, (B) MRI, coronal plane. Herniated central disc was seen, (C,D,E) Extraction of herniated disc fragments, (F) After the disc fragments are retrieved, the radix was free, (F) Disc Fragment

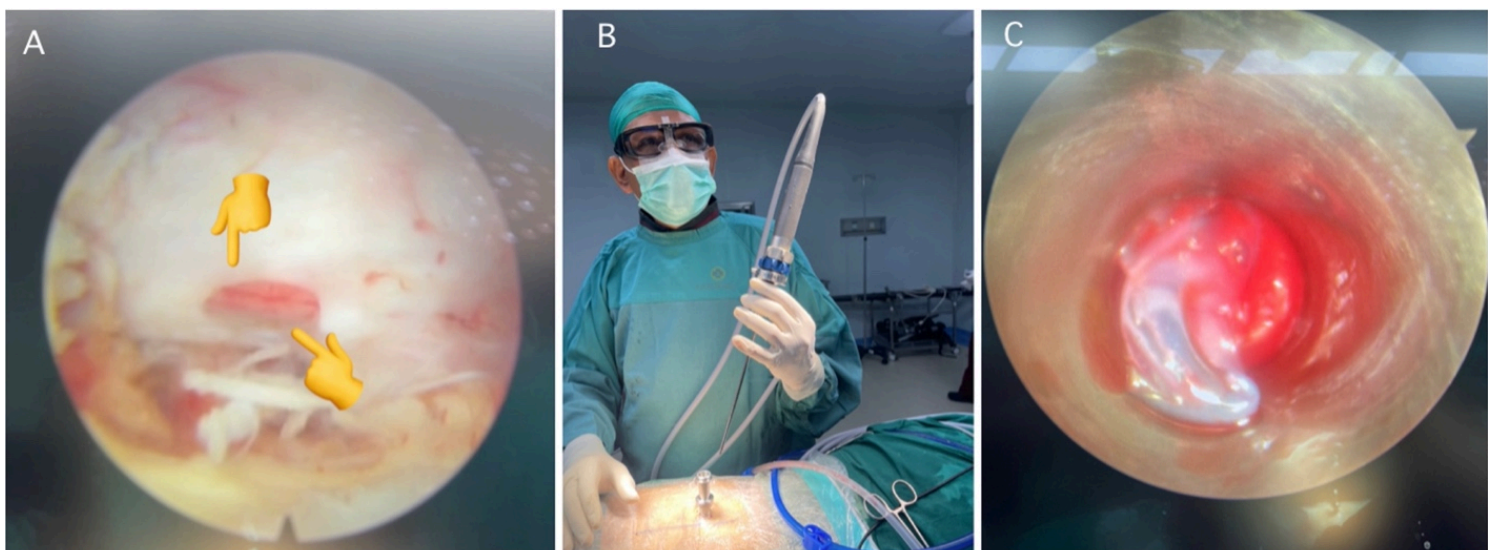


Figure 3

Complicated case (A) durotomy 2mm, (B) Telescope was replaced with smaller diameter , 0 degree, water and blood were suctionated, (C) After administration of autologous muscle graft combine fibrine glue