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Functional outcome of back pain after percutaneous endoscopic lumbar discectomy and annuloplasty for lumbar disc herniation: A prospective study

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Abstract
Objective: Percutaneous Transforaminal endoscopic lumbar discectomy and annuloplasty (PELDA) is a minimally invasive spinal technique for lumbar disc herniation. Following discectomy, the relief of leg pain is common; however, the relief of back pain is less predictable. The purpose of this study was to evaluate changes in back pain and to examine the predisposing factors for postoperative back pain following PELDA.
Material and Method: In this prospective study, 104 patients with leg and back pain associated with disc herniation underwent PELDA. The patients were divided into two groups: unfavorable and favorable. Patients were defined as having unfavorable outcomes if the percentage improvement of back pain <50% or the postoperative Oswestry Disability Index (ODI) >20% at postoperative 12 months. The preoperative demo-graphic, clinical, and radiologic factors for each group were statistically analyzed.
Results: 104 patients were enrolled in this study. The mean visual analog scale scores for back pain and the ODI scores significantly improved from 6.6 and 55.9% preoperatively to 2.5 and 12.7% at the 12 month follow-up. The surgical satisfaction rate was 78.4% at the final follow-up. Eighteen (34.6%) patients had unfavorable outcomes. Patients with advanced disc degeneration of operative levels had significantly worse outcomes than those with mild disc degeneration (odds ratio: 6.316, 95% confidence interval 1.25–31.86, P<0.05). The severity of postoperative back pain was negatively correlated with surgical satisfaction (correlation coefficient: -0.564).
Conclusion: PELDA can relieve back pain as well as leg pain through direct decompression and thermal ablation of the annular defect. Disc degeneration can be expected to influence clinical outcomes following PELDA.

Keywords: back pain, PELDA, disc degeneration, Pivd

Introduction
Percutaneous endoscopic lumbar discectomy (PELD) has many advantages when compared with open lumbar discectomy. The advantages of PELD include quick rehabilitation, reduced anatomical trauma, facilitation of revision operation, and relative preservation of disc height when treating lumbar disc herniation [1, 2]. Minimal invasive lumbar discectomy resulted in less postoperative back pain when compared with open lumbar discectomy [3]. Following discectomy, the relief of leg pain is common; however, the relief of back pain is less predictable. The cause of low back pain is unclear, and the pain may vary in intensity, often being severe enough to disrupt normal daily activities. Management of postoperative back pain has been associated with substantial health care costs [4]. Although a few reports have evaluated back pain after open lumbar discectomy [5-7], there are few studies of back pain following PELD [8, 9]. Therefore, in this prospective study, we evaluated changes in back pain and exam- ined the predisposing factors for postoperative back pain after percutaneous endoscopic lumbar discectomy and annuloplasty (PELDA).

Material and Methods
After obtaining approval from our Institutional Review Board for this study, written informed consent was obtained from each participant. In this prospective study, we enrolled 104 patients who underwent PELDA between august 2019 to Sep 2021 to treat lumbar disc herniation.

Minimum one year follow up for each patient. This is multicentric study carried out at three centres of Udaipur-pacific medical college and hospital, American international institute of medical science and sanjivani hospital. There were 66 male and 38 female patients whose ages ranged from 17 to 68 years (mean 48 years). All patients presented with sciatica and back pain that did not improve with conservative treatment for a minimum of 3 months. All patients underwent plain radiographs, magnetic resonance imaging (MRI), and computed tomography (CT). For inclusion in study, the patients were required to have an obvious disc herniation that caused compression of a nerve root corresponding to the dermatomal distribution of the leg symptoms. The exclusion criteria included extra-disc herniation, spinal stenosis, spondylolisthesis, scoliosis, prior lumbar surgery, spinal infection, spinal tumor, and a history of hip or knee arthritis.

Clinical Assessment

Questionnaires with outcome measurements evaluating pain intensity and functional disability were completed preoperatively at the 1, 6, and 12 month follow-up visits, or during telephone interviews by the independent observer. At each follow-up, the back and leg pain intensity was measured using a visual analog scale (VAS, 0–10) points, and the functional status was assessed using the Oswestry Disability Index (ODI, 0–100%) with the Oswestry Low Back Pain Disability Questionnaire. Subjective surgical satisfaction was assessed by asking the patient the following question: "How satisfied were you by this operation?" We divided the patients into two categories: favorable outcome and unfavorable outcome. Unfavor-able outcomes were defined if the percentage improve- ment of the postoperative VAS score for back pain was less than 50% compared with the preoperative VAS score, or if the postoperative ODI score was more than 20% when assessed at the 12 month follow-up. Favorable out-comes were defined as the absence of all unfavorable outcomes.

We analyzed the demographic, clinical, and preoperative radiographic variables that influenced back pain following PELDA. The sample size was calculated in consideration of our main hypothesis: that the proportion of advanced disc degeneration (Pfirrmann grade > III) in the unfavorable group would be larger than in the favorable group. We analyzed the data with a two-sample proportion test.

Occupational activity was divided into three categories according to the following physical criteria, i.e., light work (office job), medium strenuous work (including household tasks), and heavy work (construction workers, farmers;) [17].

Surgical Technique

In all of the patients, the PELDA procedure was performed under total intravenous anasthesia in the prone position on a radiolucent table. Before beginning the treatment, the patients were informed of all the steps in the procedure. The patients communicated with the surgeon during the procedure. Painting and draping was done with all aseptic precautions. Affected level is marked in both AP and Lateral view of IITV. The skin entry point was generally 10–12 cm from the midline at kambin triangle. After infiltration of the entry point with local anesthetics, an 18-gauge spinal needle was intro-duced under the guidance of a fluoroscopic image. The final target point of the spinal needle was the medial pedicular line on the anteroposterior image and the posterior vertebral line on the lateral image. After inserting the spinal needle into the disc, the serial dilator was used and working sleeve inserted over dilator. Richard Wolf Endoscope inserted through the working sleeve and radiofrequency ablation attached to control haemostasis. Classical "inside out" technique followed and sub annular disectomy done to decompress the intrdiscal herniation. The endoscopic sleeve is withdrawn out to be half in and half out with annulus traversing in the middle of the endoscopic vision. Endoscopic punch is used to cut the part of annulus to reach more medially (medialisation of annulotomy). Reinserting the sleeve inside the disc over the conical dilator giving more medial and dorsal access to the disc and epidural space. After subannular disectomy and radiofrequency modulation of annulus done. The inflamed nucleus was observed as being anchored by the annular fissure. In the meantime, the inflamed annulus and fibrotic tissues containing free nerve endings and new vessels were treated with a bipolar radio frequency (RF) probe and laser and annuloplasty was done.

The working sleeve was withdrawn to see more of superior articular process (SAP). Undercutting of non articular part of SAP was done with the help of serial reamer till ligamentum flavum curtain was seen. The ligamentum flavum is excised with the help of endoscopic punch and herniated disc fragment is grasped and removed with the help of endoscopic disc forcep. Confirmation of decompression of traversing and exiting root was performed with the blunt probe under endoscopic and fluroscopic control. Wound is closed by 2-0 ethilon suture and dressing done.

Results

104 patients were included in the study with minimum one year of follow-up. The mean age of the 104 patients included in the follow-up was 48 years (range, 17–68 years), and there were 66 (63.5%) male

patients and 38 (36.5%) female patients. two (1.9%) patient underwent PELDA at L2-L3 Level, tweleve (11.5%) underwent treatment at L3-4, 82 (78.9%) underwent treat-ment at L4-5, and eight (7.7%) underwent treatment at L5-S1. The mean VAS scores for back pain preoperatively and postoperatively at the 1-, 6-, and 24-month follow- ups were 6.6 ± 1.8, 4.2 ± 2.7, 2.8 ± 2.0, and 2.5 ± 2.0, respectively. The mean VAS scores for leg pain preopera-tively and at the 1-, 6, and 24-month postoperative follow-ups were 7.6 ± 1.9, 3.3 ± 2.8, 1.7 ± 1.3, 1.8 ± 1.1, respectively.

The mean ODI scores preoperatively and 1, 6 and 12 month follow ups were 55.9 ± 17, 34 ± 19.8, 19.1 ± 18.8, and 12.7 ± 10.9, respectively. The postoperative satisfaction rates at 1, 6, and 24 months were 68.5 ± 23.1%, 73.4 ± 18.5%, and 78.4 ± 21.8%, respectively (Table 1). The improvement rate of back pain and ODI scores for the patients is shown in Table 2. Recurrent disc herniation occurred in three patients (5.8%) requiring surgery.

Table 1: The overall clinical results after PELDA

	VAS (Back)		VAS (Leg)		ODI (%)		Satisfaction Rate (%)	
Preop	6.6	± 1.8	7.6	± 1.9	55.9	± 17.0		
Postop 1 month	4.2	± 2.7	3.3	± 2.8	34.0	± 19.8	68.5	± 23.1
Postop 6 months	2.8	± 2.0	1.7	± 1.3	19.1	± 18.8	73.4	± 18.5
Postop 1 years	2.5	± 2.0	1.8	± 1.1	12.7	± 10.9	78.4	± 21.8

ODI = Oswestry Disability Index; PELDA = percutaneous endoscopic lumbar discectomy and annuloplasty; VAS = visual analog scale.

Table 2: The number of patients by improvement rate (%) of back pain and functional state

Improvement (%)	VAS (back)	ODI
Complete relief	12	0
≥90	4	38
≥80	8	18
≥70	10	20
≥60	18	6
≥50	22	6
≥40	4	2
≥30	6	6
≥20	2	2
≥10	2	4
No change	0	0
Aggravation	16	2

ODI = Oswestry Disability Index; VAS = visual analog scale.

36 patients (34.6%) had unfavorable outcomes. Three of the 36 patients subsequently underwent open surgery. These patients had operative discs with severe degenerative and Modic changes; two patients underwent lumbar microdiscectomy for recurrent disc herniation, and one patient had a total disc replacement for intractable back pain. The remaining 33 patients in the unfavorable outcome group continued conservative therapy and therapeutic exercise. There were no postoperative complications, such as infections, hematomas, or neurological complications. The demographic and geometric parameters of the favorable and unfavorable outcome groups are provided in Table 3. There was no significant difference in any of these parameters between the two groups. There was only a significant difference in the degree of disc degeneration between the two groups (P<0.05). Patients with advanced disc degeneration of an operative level had significantly worse outcomes than those with mild disc degeneration (odds ratio: 6.316, 95% confidence interval 1.25–31.86, P<0.05; Table 4). Thirty two (45.7%) of the 70 patients with advanced disc degeneration showed unfavorable outcomes, while only four (11.8%) of the 34 patients with mild disc degeneration had unfavorable outcomes (P<0.05). The other radiographic parameters had no significant influence on the outcome, including the existence of adjacent segment degeneration, herniation disc type, location, size, Modic change, disc height, facet arthropathy, and psoas and multifidus muscle volume. The back pain and ODI scores were sig- nificantly different between the two groups since the 6-month postoperative follow-up (Table 5). There was no significant difference in the preoperative clinical param- eters between the two groups (P<0.05). Additionally, we observed that postoperative back pain had an influence on surgical satisfaction. The severity of postoperative back pain was negatively correlated with surgical satisfaction (correlation coefficient: -0.564)

Table 3: The demographic and geometric parameters of the favourable and unfavourable groups

	Favourable Group	Unfavourable Group	P Value
N	68	36	
Age (years)	48.5±15.9	47.5 ±11.5	NS
Male	42	24	NS
Female	26	12	
Symptom duration (Months) Preoperative	5.4 ±3.3	5.6 ±5.1	NS
Dominant pain			NS
Back pain	16	6	
Leg pain	52	30	
History of trauma or accident	6	2	N S
Smoking	30	14	NS
Worker	48	24	NS
Heavy work	10	4	
Medium work	18	12	
Light work	20	8	
Level			NS
L2-3	2	0	
L3-4	8	4	
L4-5	54	28	
L5-S1	4	4	
Body mass index			
(BMI)			
(BMI: kg/m2)	24.3± 3.5	23.9 ± 2.3	NS

Table 4: Preoperative radiologic parameters of favorable and unfavorable groups

	Favorable Group (34)	Unfavorable Group (18)	P value
ASD* (-)	9	6	NS
ASD (+)	2 5	1 2	
Disc herniation Type			
Protrusion	10	7	NS
Extrusion	18	9	
Migration	6	2	
Location			
Central	9	5	NS
Paracentral	25	13	
Size			
<50% canal compromise	31	16	NS
>50% canal compromise	3	2	
Lateral recess stenosis	5	2	NS
Disc height	11.2	10.9	NS
ıDisc height index	0.3	0.3	NS

Table 5: Preoperative and postoperative clinical features of favourable and unfavourable groups

	Favorable Group	Unfavourable Group	P Value
Preop			
VAS of back	6.7 ± 1.9	6.5 ± 1.7	NS
VAS of leg	7.4 ± 2.1	8.1 ± 1.3	NS
ODI (%)	55.6 ± 18.4	56.6 ± 17.0	NS
Postop 1 month			
VAS of back	3.8 ± 2.7	5.0 ± 2.6	NS
VAS of leg	3.4 ± 3.1	3.2 ± 2.3	NS
ODI (%)	31.7 ± 16.3	38.6 ± 25.0	NS
Satisfaction rate (%)	72.2 ± 22.1	61.4 ± 24.1	NS
Postop 6 months			
VAS of back	2 ± 1.3	4.3 ± 2.4	0.002*
VAS of leg	1.8 ± 1.1	1.7 ± 1.5	NS
ODI (%)	15.4 ± 18.5	26.2 ± 17.7	0.01*
Satisfaction rate (%)	78.2 ± 17.7	64.3 ± 16.8	0.008*
Postop 1 years			
VAS of back	1.5 ± 1.4	4.3 ± 1.8	0.017*
VAS of leg	1.8 ± 1.1	1.7 ± 0.9	NS
ODI (%)	7.9 ± 6.1	21.9 ± 12.2	0.015*
Satisfaction rate (%)	83.8 ± 20.5	68.2 ± 21.2	0.011*
Improvement (%) of back VAS	81.2 ± 17.7	33.8 ± 23.3	0.006*

* Comparison made using Mann–Whitney U-test.
NS = non-specific; ODI = Oswestry Disability Index; VAS = visual analog scale.

Conclusion

PELDA can relieve back pain associated with disc herniation as well as leg pain through decompression and thermal ablation of annular defects in selected patients. For patients with advanced disc degeneration, PELDA is more likely to result in unfavorable outcomes and lead to postoperative back pain following surgery.

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