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Recurrent Disc Herniation Following Transforaminal and Interlaminar Percutaneous Endoscopic Lumbar Discectomy

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ABSTRACT

Background: Disc herniation is one of the most common causes of low back pain in which fragment of disc nucleus pushed out of annulus into spinal canal through tear or ruptures in the annulus and because of spinal canal are limited space so herniated disc fragment pressure on spinal nerve and producing symptoms. This study aimed to study the incidence, causes and management of recurrent dice herniation after both interlaminar and transforaminal percutaneous endoscopic lumbar discectomy (PELD). Methods: This retrospective study included 140 patients with lumbar disc herniation and underwent PELD. The study was carried out at orthopedic Department, Benha University Hospitals. Patients were categorized according to endoscopic approach for two groups: Groups A: 70 patients underwent transforaminal PELD approach and Group B: 70 patients underwent interlaminar PELD approach. Results: Regarding disc height index, ratio value of disc grey scales & range of motion; both transforaminal and interlaminar PELD approaches shows comparable outcomes, with no significant difference between the two groups throughout the follow-up period. Conclusion: Both percutaneous endoscopic interlaminar discectomy (PEID) and percutaneous endoscopic transforaminal discectomy (PETD) have achieved good clinical outcomes in treating recurrent disc herniation. The clinical efficacy of PEID and PETD in the treatment of recurrent disc herniation is comparable. Compared with PETD, PEID has the advantages of shorter operative time and a reduced number of fluoroscopy times..

Keywords: *Recurrent disc herniation, Transforaminal, Interlaminar, Percutaneous endoscopic lumbar discectomy…*

INTRODUCTION

Disc herniation is one of the most common causes of low back pain in which fragment of disc nucleus pushed out of annulus into spinal canal through tear or ruptures in the annulus and because of spinal canal are limited space so herniated disc fragment pressure on spinal nerve and producing symptoms. Most common causes of disc herniation are degenerative process the second most common causes is trauma other causes like connective tissue diseases and congenital disorder like short pedicle. Pathophysiology of disc herniation is combination of mechanical compression on nerve root & local inflammatory chemokines (1).

Disc herniation mostly occurs on postero-lateral site of the disc, as the annulus fibrosis is thinner and lack of support by anterior and posterior longitudinal ligament. Age prevalence is most among 30-50 years old and male; female ratio is 2; 1. About 95% of lumbar disc herniation occurs on (L 4-5, L 5-1) lumbar vertebrae while in cervical spine most occur on C5-6, C6-7 cervical spine. Thoracic spine account for only 1-2% of cases. Disc herniation Affect 1%- 3% oF people in their life. 90% of the patients healed by conservative treatment or epidural steroid inj. Only 10% of patients need surgery (2).

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Recurrent disc herniation is new disc herniation at the same level Either ipsilateral or contra lateral within two years of primary spine discectomy whether open discectomy, micro discectomy or endoscopic discectomy after a period of symptomatic free interval greater than six months in the presence of recurrent concordant radicular symptoms and signs confirmed by appropriate imaging. (3) The six months' pain free is questionable especially that symptomatic reherniation in many patients occurs within first six months (2).

Endoscopic discectomy minimal invasive spine technique techniques well accepted to patients compared to conventional open surgery. This technique developed after anatomical neural foramen described by kambin than followed by endoscopic spine system introduced by yeung. (4, 5) Endoscopic discectomy started with transforaminal approach but with steady progress with the interlaminar approach and now progressing to almost all area of degenerative spinal disease.

The purpose of this study was to study the incidence, causes and management of recurrent dice herniation after both interlaminar and transforaminal PELD.

Patients and methods

This retrospective study included 140 patients with lumbar disc herniation and underwent PELD. The study was carried out at orthopedic Department, Benha University Hospitals.

An informed written consent was obtained from the patients. Every patient received an explanation of the purpose of the study and had a secret code number. The study was done after being approved by the Research Ethics Committee, Faculty of Medicine, and Benha University.

Inclusion criteria were both genders between 18-55 years old, gave consent to participate this study, with established diagnosis of disc herniation clinically & radiological who had radicular pain more than 3 months that not respond to 6 weeks of conservative treatment and MRI and CT show lumbar disc herniation related to the clinical symptoms, single level lumbar disc herniation only from (L1 to S1) and weight from 40-140 kg.

Exclusion criteria were multi -level disc herniation, central and foraminal stenosis due to degenerative disc disease, patients with previous surgical discectomy (open or endoscopic), spondylolethesis & instability and spondylodiscitis.

Grouping: 140 cases were enrolled in this study and were categoried according to endoscopic approach for two groups: Groups A: 70 patients underwent transforaminal PELD approach and Group B: 70 patients underwent interlaminar PELD approach.

All studied cases were subjected to the following: **Demographic data collection from each patient including** [Name, age, gender, smoking and previous disease.]. **History of present illness** including: [Back Pain or Radicular Pain severity, radiation, associated symptoms (numbness and parasthesia, motor weakness, fecal & urine control and sexual state]. **General examination including** [Vital signs: Blood pressure, pulse and respiratory rate and assess fitness of the patient for surgery if needed]. **Local examination including [**Back was examined for tender spine or paravertebral muscles, angulation deformity and limited movements]**. Radiological assessment including** [X ray: Ap and lateral views, computed tomographic scan (CT): coronal, sagittal, axial and 3D views, magnetic Resonance Imaging (MRI): It was done to evaluate soft tissue including spinal cord, nerve roots, disc herniation and ligament]. **Surgical procedure:** [Operating room setup: The patient is taken to the operating room and placed prone on a radiolucent operating table and fluoroscopy C-Arm was used throughout the procedure].

PELD via TF approach:

Full-endoscopic visualized foraminoplasty and discectomy was performed via the TF approach under general anesthesia in prone position. All operations were performed by the same surgeon. Posteroanterior and lateral views were obtained by C-arm fluoroscopy to identify the intervertebral disc space and foramina. At the entry point, the puncture target and direction were marked according to the C-arm fluoroscopy. The identified horizontal line was located between the spinous process line and facet line using C-arm fluoroscopy in lateral view. The transversal line was identified and located in the midline of the disc space that would be operated by C-arm fluoroscopy in posteroanterior view. After, the entry point was identified as the intersected of the transversal and horizontal line, the spinal needle was inserted under the guidance of the C-arm fluoroscopy in lateral view. The spinal needle was close to the medial pedicular line in the anteroposterior view of the C-arm fluoroscopy as well as close to the posterior vertebral line in the lateral view of the C-arm fluoroscopy. A guidewire was inserted through the spinal needle, then the spinal needle was removed. A dilator was inserted along with the guidewire until touching the annulus fibrosus and through the disc by hammering. The guidewire was removed. The working sleeve and endoscopic surgical systems were inserted. All subsequent steps were performed with endoscopic visualization under continuing saline irrigation. The working sleeve was inserted until touching the facet joint and then rotated 180 degrees to get away from an existing nerve root. The endoscopic was then inserted. A radiofrequency electrode was applied to control the bleeding. The herniated fragments were completely removed until the thecal sac was floated, fluctuated, and free from compression. The working sleeve was carefully removed, and the skin was closed by a single suture.

PELD via IL approach:

Full-endoscopic visualized discectomy performed via IL approach was under general anesthesia in the prone position. All operations were performed by single surgeon, who had many years of experience in endoscopic spine surgery. Posteroanterior and lateral views were obtained by C-arm fluoroscopy to identify the intervertebral space and IL window. An 8 mm skin and fascia incision was made at the entry point through the IL window and the dilator was inserted through the outside of the spinal canal. The dilator's position was confirmed by fluoroscopy on the lateral view. Next, a working sleeve and endoscopic was inserted to the laminar window from medial to lateral of the facet joint exposed to the ligamentum flavum. After confirming the position of the working sleeve and the endoscopic surgery system into the epidural space, the dura matter and nerve root were exposed. The gentle retraction of the root was accomplished by rotating the working sleeve to protect the neural structures. The subsequent procedures were performed with visualization via the endoscopic camera under continued saline irrigation. A radiofrequency electrode was applied to control the bleeding. After the protruded or sequestrated disc was removed to ensure sufficient decompression of the nerve root, the working sleeve was carefully removed, and the skin was closed by a single suture.

Follow up criteria:

Regular follow up of the patients was done in Out-patient Clinics at Benha University Hospitals. Patients were followed up at standardized appointments [at 2 weeks, 3, 6, 9 months and 1 year post op]. Any early or late complications of those cases in follow up were recorded such as recurrent disc prolapse, surgical site infection or fractured fixation system to be revised.

Clinical follow up

Back pain: According to visual analogue scale (VAS): VAS measures pain intensity. The VAS consists of a 10cm line, with two end points representing 0 ('no pain') and 10 ('pain as bad as it could possibly be'). Ask the patient to rate their current level of pain by placing a mark on the line and According to oswestry disability index (ODI): ODI a patient-completed questionnaire which gives a subjective percentage score of level of function (disability) in activities of daily living in those rehabilitating from low back pain. It was developed by Jeremy Fairbank and Graham Pynsent in Oswestry, England in 1980 and considered one of the best accepted tools for assessment of low back pain.

Radiological follow up:

X ray: Ap and lateral views and MRI scan: For assessment of recurrence of disc prolapse.

Approval code: Rc 23-11-2025

Statistical analysis

The collected data were summarized in terms of mean ± Standard Deviation (SD) and range for quantitative data and frequency and percentage for qualitative data. Comparisons between the different study groups were carried out using the Chi-square test ($\chi 2$) and the Fisher Exact Test (FET) to compare proportions as appropriate. Paired sample t test (for parametric) or Wilcoxon signed rank sum test (for non-parametric) was used to assess changes in parameters over 2 occasions. Freidman's test was used to assess changes in parameters over more than two occasions. McNemar's test was used to determine if there are differences on a dichotomous dependent variable between two related groups. After the calculation of each of the test statistics, the corresponding distribution tables were consulted to get the "P" (probability value). Statistical significance was accepted at P value <0.05. A P value <0.001 was considered highly significant while a P value >0.05 was considered non-significant. The statistical analysis was conducted using SPSS (version 21) software (Spss Inc, Chicago, ILL Company).

Results

There were no significant differences between the two groups regarding age, sex distribution, BMI, Comorbidities, clinical symptoms, pathological classification, duration of the disease, intraoperative blood loss and hospital stay duration. The operative time and fluoroscopy times were significantly longer in group A than group B ($P < 0.001$), indicating that the transforaminal approach required more time and imaging guidance. **Table 1**

Table 1: Demographic data, comorbidities, symptoms, pathological classification, disease duration and perioperative data of the studied groups

		Group A (n=70)	Group B (n=70)	P value
Age (years)	**Mean ± SD**	42.2 ± 8.79	43.04 ± 6.97	0.531
	Range	23 - 55	26 - 54	
Sex	**Male**	46 (65.71%)	43 (61.43%)	0.598
	Female	24 (34.29%)	27 (38.57%)	
BMI (kg/m^2)	**Mean ± SD**	26.75 ± 5.05	26.05 ± 4.91	0.405
	Range	17.28 - 38.14	16.98 - 36.58	
Comorbidities				

Smoking		30 (42.86%)	27 (38.57%)	0.606
HTN		36 (51.43%)	39 (55.71%)	0.611
DM		30 (42.86%)	32 (45.71%)	0.734
Symptoms				
Backache		30 (42.86%)	23 (32.86%)	0.462
Leg pain		24 (34.29%)	27 (38.57%)	
Both		16 (22.86%)	20 (28.57%)	
Pathological classification				
Central		11 (15.71%)	15 (21.43%)	0.681
Paracentral		36 (51.43%)	33 (47.14%)	
Prolapsus		23 (32.86%)	22 (31.43%)	
Disease duration (months)	**Mean ± SD**	26.66 ± 6.56	25.14 ± 6.06	0.158
	Range	12 - 35	15 - 34	
Perioperative data				
Operative time (min)	**Mean ± SD**	85.29 ± 6.53	66.57 ± 6.17	**<0.001***
	Range	75 - 95	55 - 75	
Fluoroscopy times	**Mean ± SD**	11.17 ± 1.61	2.84 ± 0.79	**<0.001***
	Range	9 - 13	2 - 4	
Intraoperative blood loss (ml)	**Mean ± SD**	34.69 ± 5.85	36.16 ± 6.52	0.162
	Range	25 - 45	25 - 45	
Hospital stay (days)	**Mean ± SD**	4.16 ± 0.83	3.99 ± 0.83	0.222
	Range	3 - 5	3 - 5	

BMI: body mass index

Regarding VAS score, both transforaminal and interlaminar PELD approaches resulted in significant and sustained pain relief, with no significant difference in patient-reported pain reduction between the two groups. Regarding ODI, both transforaminal and interlaminar PELD approaches led to a comparable improvement in functional outcomes, with no significant difference between the two groups throughout the follow-up period. **Table 2**

Table 2: VAS and ODI of the studied groups

		Group A (n=70)	Group B (n=70)	P value
VAS	**Preoperative**	4.33 ± 0.47	4.39 ± 0.49	0.484
	3 months postoperative	2.84 ± 0.61	2.8 ± 0.75	0.711
	6 months postoperative	1.51 ± 0.61	1.59 ± 0.69	0.517
	12 months postoperative	1.13 ± 0.8	1.23 ± 0.64	0.415
ODI	**Preoperative**	51.3 ± 11.35	49.63 ± 10.82	0.374
	3 months postoperative	34.09 ± 11.57	32.21 ± 10.76	0.323
	6 months postoperative	23.87 ± 11.97	23.33 ± 10.64	0.777
	12 months postoperative	16.94 ± 10.63	16.33 ± 8.19	0.702

VAS: visual analogue scale, ODI: Oswestry disability index

There was no significant difference between the two groups regarding postoperative satisfaction and clinical outcome (MacNab evaluation). Low back or lower limb pain occurred in 1 patient (1.43%) in group A and 2 patients (2.86%) in group B. Recurrent disc herniation was reported equally in both groups, affecting 1 patient each (1.43%). There was no significant difference in complication rates between the two groups. No dural tear or disc space infection were reported in any patients. **Table 3**

Table 3: MacNab evaluation and complications of the studied groups

		Group A (n=70)	Group B (n=70)	P value
MacNab evaluation	**Excellent**	43 (61.43%)	46 (65.71%)	0.855
	Good	21 (30%)	18 (25.71%)	
	Fair	4 (5.71%)	5 (7.14%)	
	Poor	2 (2.86%)	1 (1.43%)	
Complications	**Low back pain or lower limbs pain**	1 (1.43%)	2 (2.86%)	1.000

	Recurrent disc herniation	1 (1.43%)	1 (1.43%)	1.000

Regarding DHI, RVG & ROM; both transforaminal and interlaminar PELD approaches shows comparable outcomes, with no significant difference between the two groups throughout the follow-up period. **Table 4**

Table 4: DHI, RVG and ROM of the studied groups

		Group A (n=70)	Group B (n=70)	P value
DHI	**Preoperative**	34.83 ± 3.16	35.09 ± 3.51	0.650
	3 months postoperative	34.79 ± 3.13	35.01 ± 3.46	0.683
	6 months postoperative	34.66 ± 3.02	34.91 ± 3.39	0.636
	12 months postoperative	33.73 ± 3.13	33.81 ± 3.46	0.878
RVG	**Preoperative**	33.34 ± 3.25	33.59 ± 3.53	0.673
	3 months postoperative	33.26 ± 3.14	33.21 ± 3.65	0.941
	6 months postoperative	32.74 ± 3.13	32.71 ± 3.75	0.961
	12 months postoperative	32.31 ± 3.08	32.23 ± 3.86	0.885
ROM	**Preoperative**	8.04 ± 0.84	8.01 ± 0.83	0.840
	3 months postoperative	8.44 ± 0.94	8.37 ± 0.87	0.642
	6 months postoperative	8.41 ± 0.92	8.26 ± 0.91	0.313
	12 months postoperative	8.3 ± 0.89	8.16 ± 0.91	0.350

DHI: disc height index, RVG: the ratio value of the greyscale, ROM: range of motion

Discussion

In the study, there were no significant differences between the two groups regarding age, sex distribution, BMI, Comorbidities, clinical symptoms, pathological classification, duration of the disease, intraoperative blood loss and hospital stay duration.

Li T., et al. (6) conducted a study to compare the clinical advantages of PEID and PETD for treating L5–S1 LDH. 78 patients were included in the study, and all covariates were well balanced between the two groups. The baseline characteristics of the two groups (age, sex distribution, BMI, Comorbidities, clinical symptoms, pathological classification, duration of the disease), were balanced and comparable. There were no statistically significant differences in intraoperative blood loss and postoperative hospital stay between the two groups.

The operative time and fluoroscopy times were significantly longer in group A than group B, indicating that the transforaminal approach required more time and imaging guide.

In agreement with our study, in Cheng Y., et al. (7) showed that, PEID was superior to PETD in terms of operative time and intraoperative fluoroscopy times.

Regarding VAS score, both transforaminal and interlaminar PELD approaches resulted in significant and sustained pain relief, with no significant difference in patient-reported pain reduction between the two groups.

In agreement with our study, Li T., et al. (6) showed that significant improvement in back and leg pain based on VAS score with no statistically significant difference ($P > 0.05$).

In disagreement with our study, Chen Z., et al. (8) showed that the intraoperative VAS scores of both back and leg pain in the TELD group were significantly lower than those in the IELD group. In agreement with our study, both groups showed a significant improvement in VAS score after surgery. For each data collection time, the differences in VAS score between the 2 groups were not significant.

Regarding ODI, MacNab evaluation, DHI, RVG & ROM; Both transforaminal and interlaminar PELD approaches shows comparable outcomes, with no significant difference between the two groups.

In agreement with our study Cheng Y., et al. (7) showed that No significant difference was found in ODI score between the two groups at any follow-up time point before and after surgery. On the basis of the modified MacNab criteria at the last follow-up, no significant difference was found in the excellent and good rates of the two groups (89.29% vs 88.46%, $P = 1.000$).

Regarding complications; Low back or lower limb pain occurred in 1 patient (1.43%) in group A and 2 patients (2.86%) in group B. Recurrent disc herniation was reported equally in both groups, affecting 1 patient each (1.43%). There was no significant difference in complication rates between the two groups. No dural tear or disc space infection were reported in any patients.

In agreement with our study, Li T., et al. (6) showed that 4 patients experienced complications with a complication rate of 5.13%. Two patients in the PEID group and one patient in the PETD group experienced worsening of lower limb neurological symptoms postoperatively. In the PETD group, one patient experienced the recurrence of LDH after surgery. However, there was no significant difference in the complication rates between the two groups. No serious complications such as dural tear or disc space infection were detected among all patients.

Dabo et al. (9) showed that 30 patients of CLDH were treated by PEID with a trephine instrument, but 16 patients had postoperative dysesthesia 3 months after operation. Yu et al. (10) reported that the symptoms of 25 CLDH patients treated by PETD were relieved, but 7 patients had postoperative dysesthesia and 1 patient had recurrence of herniation.

There are some limitations to the current study. The sample size was relatively small, the follow-up period was short, and it was a single-centre study, which might influence the results.

Conclusion

Both PEID and PETD have achieved good clinical outcomes in treating recurrent disc herniation. The clinical efficacy of PEID and PETD in the treatment of recurrent disc herniation is comparable. Compared with PETD, PEID has the advantages of shorter operative time and a reduced number of fluoroscopy times. A future study with a large sample size and long term follow up would provide a better evaluation for treatment of recurrent disc herniation by PEID and PETD.

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Conflicts of interest

No conflicts of interest...

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