Original article

Comparison of Complications Between Percutaneous Endoscopic Lumbar Discectomy and Open Lumbar Microdiscectomy for The Treatment of Lumbar Disc Herniation

Md. Shamsuzzaman Mondle,[1] Md. Joynul Islam,[2] ATM Ashadullah,[3] Mohammad Masum Ali,[4] Soumen Sarkar[5]

1. Associate Professor
   Department of Neurosurgery
   National Institute of Neurosciences & Hospital
   Dhaka, Bangladesh
2. Professor
   Department of Neurosurgery
   National Institute of Neurosciences and Hospital
   Dhaka, Bangladesh
3. Associate Professor
   Department of Neurosurgery-Spine
   National Institute of Neurosciences and Hospital
   Dhaka, Bangladesh
4. Assistant Professor
   Department of Clinical Neurosurgery
   National Institute of Neurosciences and Hospital
   Dhaka, Bangladesh
5. Registrar
   Department of Neurosurgery
   National Institute of Neurosciences and Hospital
   Dhaka, Bangladesh

Correspondence to:
Md. ShamsuzzamanMondle
Associate Professor
Department of Neurosurgery
National Institute of Neurosciences & Hospital
Dhaka, Bangladesh
Email: sarkarsoumen22@gmail.com

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Abstract

Background:
Lumbar disc herniation (LDH), a common spinal condition causing lower back pain, requires surgical intervention, with common procedures being percutaneous endoscopic lumbar discectomy (PELD) and open lumbar microdiscectomy (OLM).

Objective:
The study was aimed to compare the complications and outcomes of Percutaneous Endoscopic Lumbar Discectomy (PELD) and Open Lumbar Microdiscectomy (OLM) in treating lumbar disc herniation (LDH) at the L4/L5 level.

Methods:
A cross-sectional comparative analysis was conducted from January 1, 2022, to June 30, 2023, at the Department of Neurosurgery, National Institute of Neurosciences& Hospital. Seventy patients with LDH were divided into two groups: Group-I (PELD, n=33) and Group-II (OLM, n=37). Baseline characteristics, motor examinations, reflexes, sensory integrity, gait assessments, and MRI findings were recorded. Primary outcomes included per-operative and post-operative complications such as dural tears, nerve root injuries, wound infections, disk space infections, cerebrospinal fluid (CSF) leaks, foot drop, and recurrence rates. Visual Analogue Scale (VAS) scores for lower back and leg pain, and Oswestry Disability Index (ODI) scores, were evaluated pre-operatively and at the 90th postoperative day follow-up. Statistical analysis was performed using the chi-square test in SPSS version 26.

Results:
Partial nerve root injury occurred in 3.03% of Group-I and 6.06% of Group-II. Post-operative wound infection was noted in 3.03% of Group-I, while no infections were reported in Group-II. CSF leak was observed in 2.7% of Group-II but none in Group-I. Recurrence of LDH occurred in 2.7% of Group-II and none in Group-I.

Conclusion:
PELD and OLM are both effective for treating LDH, with PELD showing fewer complications.

Keywords: Lumbar disc herniation (LDH), Percutaneous endoscopic lumbar discectomy (PELD), Open lumbar microdiscectomy (OLM), Minimally invasive spine surgery, Postoperative complications

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Introduction:

Lumbar disc herniation is a prevalent spinal condition causing lower back pain and radiculopathy, affecting millions globally by pushing the inner core of the intervertebral disc through the outer fibrous ring.[1] LDH, caused by age, trauma, poor posture, and repetitive stress,[2] can be managed conservatively with physical therapy and lifestyle modifications, but surgical intervention is necessary for persistent symptoms.[3] The minimally invasive nature of PELD results in reduced intraoperative blood loss, shorter hospitalization duration, and faster recovery compared to traditional open surgery.Percutaneous

endoscopic lumbar discectomy (PELD) and open lumbar microdiscectomy (OLM) are common surgical treatments for LDH. PELD, introduced in the 1980s, represents a significant advancement in the field of minimally invasive spine surgery involves a small incision and an endoscope for visualization to access a herniated disc, allowing precise removal while minimizing tissue disruption[4], reduces blood loss, shorter hospital stay, and speeds up recovery.[5,6] In contrast, OLM, a surgical technique since the 1970s, involves a larger incision and extensive tissue dissection to access the herniated disc allows for direct decompression of neural structures, but is associated with greater trauma and longer recovery times.[7] Studies compare PELD and OLM outcomes, highlighting PELD's advantages like reduced morbidity, faster recovery, and comparable long-term functional outcomes.[8] Additionally, PELD is associated with lower rates of complications such as infection, dural tear, and postoperative instability.[8] However, critics argue that PELD may have limitations in cases of complex herniations or multi-level disc disease, where adequate decompression and visualization may be challenging.[9] PELD, despite its initial learning curve associated with mastering endoscopic techniques may result in higher rates of intraoperative complications and suboptimal outcomes is increasingly popular among surgeons and patients seeking less invasive treatment for LDH. The choice between PELD and OLM depends on patient characteristics, anatomical considerations, and surgeon expertise. While PELD offers the advantages of minimal invasiveness and faster recovery, OLM remains a valuable option for patients with complex disc herniations or those requiring extensive decompression.[10] In this study, we aim to compare the complications associated with PELD and OLM in the treatment of LDH.

Methods:

The cross-sectional comparative study was conducted from January 1, 2022, to June 30, 2023, at the Department of Neurosurgery, National Institute of Neuro Sciences& Hospital. A total of 70 patients diagnosed with lumbar disc herniation (LDH) at the L4/L5 level were included and divided into two groups: Group-I (Percutaneous Endoscopic Lumbar Discectomy, PELD, n=33) and Group-II (Open Lumbar Microdiscectomy, OLM, n=37). Baseline characteristics, including age, sex, occupation, associated illnesses, and clinical features, were recorded for all participants. Motor examination evaluated hip flexor, knee extensor, ankle dorsiflexion, and toe flexion (EHL and FHL) strengths. Reflexes, sensory integrity, and gait were also assessed. Radiological findings from MRI were used to determine the herniation location. The primary outcomes measured were per-operative and post-operative complications, including dural tears, nerve root injuries, wound infections, disk space infections, cerebrospinal fluid (CSF) leaks, foot drop, and recurrence rates. Visual Analogue Scale (VAS) scores for lower back and leg pain, as well as Oswestry Disability Index (ODI) scores, were recorded pre-operatively and at the 90th postoperative day (POD) follow-up. Chi-square test was performed compared these parameters between the two groups to determine the efficacy and safety of PELD versus OLM in treating LDH. Statistical analysis was conducted in SPSS version 26.

Results:

The study included 70 participants divided into Group-I (PELD, n=33) and Group-II (OLM, n=37), with similar age distribution, with the highest percentage of participants aged 31-45 years (39.39% in group-I vs 32.43% in group-II, p=0.003). Group-II had a higher percentage of participants (29.72%) aged 46-60 years compared to group-I (24.24%). A smaller percentage of participants were over 60 years old (3.03% in group-I and 10.81% in group-II). Males were more common in both groups (60.60% vs 75.67%, p=0.13), while sedentary workers were the majority in both groups (87.87% vs 86.48%, p=0.88), with a smaller percentage of manual workers (12.12% vs 15.15%, p=0.46). Only one case of diabetes mellitus in group-II and one case of hypertension in each group. Clinically, all participants reported low back pain, right leg pain was more common in group-I (48.48% vs 10.81%), while left leg pain was similar in both groups (45.45% vs 43.24%). Weakness in the right lower limb was reported in both groups (90.90% vs 91.89%), while weakness in the left lower limb was predominant in group-II (3.03% vs 21.62%). abnormal sensations were noted in both groups (75.57% vs 94.59%).

Table-I: Baseline characteristics among the participants (N=70)

Basic Characteristics	Group-I (n=33)	Group-II (n=37)	p-value
Age			
16-30	11(33.33)	10(27.02)	0.117
31-45	13(39.39)	12(32.43)	0.003
46-60	8(24.24)	11(29.72)	0.11
>60	1(3.03)	4(10.81)	0.65
Sex			
Male	20(60.60)	28(75.67)	0.13
Female	13(39.39)	9(24.32)	0.78
Occupation			
Manual worker	4(12.12)	5(15.15)	0.46
Sedentary worker	29(87.87)	32(86.48)	0.88
Associated Illness			
Diabetes Mellitus	0(0.00)	1(2.70)	0.117
Hypertension	1(3.03)	1(2.70)	0.003
Hypothyroidism	0(0.00)	0(0.00)	0.11
Clinical Feature			
Low back pain	33(100.0)	37(100.0)	0.12
Leg pain (right)	16(48.48)	4(10.81)	0.90
Leg pain (left)	15(45.45)	16(43.24)	0.22
Weakness of right lower limb	30(90.90)	34(91.89)	0.11
Weakness of left lower limb	1(3.03)	8(21.62)	0.13
Abnormal sensation	25(75.57)	35(94.59)	0.32

Motor examination results showed similar strengths in hip flexors (right side: 4.94±0.48 vs 4.92±0.58 and left side 4.94±0.48 vs 4.90±0.45), knee extensors (5.0±0.00 in both groups), and ankle dorsiflexors (4.63±0.54 on both sides) between Group-I and Group-II. EHL strengths were close, with minor differences (EHL right-side: 4.37±0.73 vs 4.36±0.63 and left side: 4.31±0.71 versus 4.21±0.81) FHL scores were nearly perfect in both groups. Reflex assessments indicated the prevalence of knee jerk reflexes and ankle jerks in both groups, with minimal variations. Sensory system integrity was comparable for both groups (right-sided sensory system intact 51.51% vs 51.35% and left-sided in 60.60% vs 54.05%). SLR positivity (right: 48.48% vs 51.35%, left: 45.45% vs 45.94%) and femoral stretch tests showed slight differences (90.90% vs 97.29%). Gait analysis revealed differences in heel and toe walking between the two groups (intact right-sided heel walking 72.72% vs 63.63%, while intact left-sided heel walking 72.72% vs 48.48%). Spine examination revealed similar findings for kyphosis, scoliosis, gibbus, and point tenderness (90.90% vs 78.78%). Peripheral pulses in the lower limb were present in most participants (87.87% vs 78.78%). MRI findings showed differences in the prevalence of central and paracentral herniation between Group-I and Group-II (75.57% vs 97.29%). (Table-II)

Table-II: Distribution of the study population based on physical examination and radiological findings

Characteristics	Group-I (n=33) no. (%)	Group-II (n=37) no. (%)	p-value
Motor Examination (Evaluation of MRC grade)			
Right-sided Hip flexor	4.94±0.48	4.92±0.58	0.87
Left-sided Hip flexor	4.94±0.48	4.90±0.45	0.72
Right-sided Knee extensor	5±0.00	5±0.00	1.0
Left-sided Knee extensor	5.0±0.00	5.0±0.00	1.0
Right-sided ankle dorsiflexion	4.63±0.54	4.63±0.54	1.0
Left-sided ankle dorsiflexion	4.69±0.46	4.69±0.46	1.0
Right-sided EHL (Extensor Hallucis Longus)	4.37±0.73	4.36±0.63	0.95
Left-sided EHL	4.31±0.71	4.21±0.81	0.58
Right-sided FHL (Flexor Hallucis Longus)	5.0±0.00	5.0±0.00	1.0
Left-sided FHL	4.97±0.70	4.96±0.50	0.95
Reflexes			
Right-sided Knee jerk present	33(100.0)	37(100.0)	0.05
Left-sided Knee jerk present	31(93.93)	35(94.59)	0.09
Right-sided Ankle jerk present	31(93.93)	36(97.29)	0.68
Left-sided Ankle jerk present	31(93.93)	35(94.59)	0.98
Right-sided Planter reflex present	31(93.93)	36(97.29)	0.99

Characteristics	Group-I (n=33) no. (%)	Group-II (n=37) no. (%)	p-value
Left-sided Planter reflex present	31(93.93)	35(94.59)	0.32
Sensory examination			
Right-sided sensory system intact	17(51.51)	19(51.35)	0.15
Left-sided sensory system intact	20(60.60)	20(54.05)	0.09
Right-sided SLR positive	16(48.48)	19(51.35)	0.99
Left-sided SLR positive	15(45.45)	17(45.94)	0.78
Right-sided Cross SLR positive	1(3.03)	0 (0.00)	0.19
Left-sided Cross SLR positive	1(3.03)	0(0.00)	0.12
Right-sided Femoral stretch test positive	30(90.90)	36 (97.29)	0.67
left-sided Femoral stretch test positive	30(90.90)	36(97.29)	0.51
Gait			
Right-sided heel walking intact	24(72.72)	21(63.63)	0.97
Left-sided heel walking intact	24(72.72)	16(48.48)	0.86
Right-sided toe walking intact	29(87.87)	25(75.75)	0.11
Left-sided toe walking intact	29(87.87)	26 (78.78)	0.65
Examination of spine			
Kyphosis	30(90.90)	26(78.78)	0.17
Scoliosis	30(90.90)	26(78.78)	0.46
Gibbus	30(90.90)	26(78.78)	0.31
Point of tenderness	30 90.90)	26(78.78)	0.65
Presence of peripheral pulses of the lower limb	29(87.87)	26 (78.78)	0.01
MRI findings (Hernial location)			
Central	25(75.57)	36(97.29)	0.08
Paracentral	33(100.0)	37(100.0)	0.04

Per-operative and post-operative complications were compared in Group-I (PELD, n=33) and Group-II (OLM, n=37). No cases of dural tear or complete nerve root injury occurred during surgery in either group. Partial nerve root injury was slightly higher in Group-II (6. 06%) compared to Group-I (3. 03%) (p=0.07). Post-operatively, wound infection was seen in 3. 03% of Group-I, while no infections were reported in Group-II (p=1.1). Disk space infection was not observed in either group. CSF leak occurred in 2. 7% of Group-II participants, while foot drop was absent in all participants (p=0.8). Recurrence of lumbar disc herniation was seen in 2. 7% of Group-II, with no recurrences in Group-I (p=1.4) (Table-III).

Table-III: Comparison of per-operative and post-operative complications among the participants (N=70)

Complications	Group-I (n=33)	Group-II (n=37)	p-value
Per-operative complications			
Dural Tear	0(0)	0(0)	N/A
Partial Nerve Root Injury	1(3.03)	2(6.06)	0.07
Complete Nerve Root Injury	0(0)	0(0)	N/A
Post-operative complications			
Wound Infection	1(3.03)	0(0)	1.1
Disk Space Infection	0(0)	0(0)	N/A
CSF Leak	0(0)	1(2.7)	0.8
Foot Drop	0(0)	0(0)	N/A
Recurrence	0(0)	1(2.7)	1.4

Discussion:

Study compared complications in Percutaneous Endoscopic Lumbar Discectomy (PELD) and Open Lumbar Microdiscectomy (OLM) for lumbar disc herniation. Findings showed differences and similarities in surgical techniques. Participants aged 31-45 years had higher percentages in both groups, with males predominating, aligning with existing literature.[11-13] Most participants were sedentary workers, few were manual workers, consistent with Kim et al 's study.[14] Participants in Group-I had higher rates of right leg pain compared to Group-II (48.48% vs 10.81%).PELD was effective in reducing postoperative leg pain, consistent with Ruan et al 's meta-analysis.[15] Both groups experienced right lower limb weakness and abnormal sensations that aligns with previous studies reporting similar neurological deficits in patients undergoing lumbar disc surgery.[16,17]The sensory examination showed intact right-sided sensory system in 51. 51% of Group-I and 51. 35% of Group-II, with intact left-sided sensory system in 60. 60% of Group-I and 54. 05% of Group-II.

These findings align with Tawa et al 's review on sensory outcomes after lumbar disc surgeries.[18] Positive SLR test results were similar in both groups, in line with Kido et al 's emphasis on SLR for diagnosing lumbar disc herniation.[19] Consisting with existing literature, our study found a higher incidence of nerve root injury during surgery in Group-II (6. 06%) compared to Group-I (3. 03%).[20] Post-operative wound infection was 3. 03% in Group-I and zero in Group-II.[21] CSF leaks occurred in 2.7% of Group-II,[22] while LDH recurrence was 2. 7% in Group-II, with no such events in Group-I.[23] MRI showed central herniation in 75. 57% of Group-I and 97. 29% of Group-II, aligning with previous reports on typical lumbar disc herniation locations.[24] Complication rates, including partial nerve root injuries, wound infections, CSF leaks, and recurrence, were consistent with literature, emphasizing the need for patient selection and surgical expertise in PELD.[25,26]

The study supported previous research indicating PELD and OLM are effective surgical techniques for treating LDH, each with its advantages and potential complications. The choice should be tailored to the patient's condition, surgeon's expertise, and herniation characteristics, with future research exploring risk mitigation.

Limitations:

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion:

The study compared the complications of Percutaneous Endoscopic Lumbar Discectomy (PELD) and Open Lumbar Microdiscectomy (OLM) for treating lumbar disc herniation (LDH). Both techniques are effective and safe, with different advantages and potential complications. PELD has a lower incidence of nerve root injuries, wound infections, and recurrences, while OLM has slightly higher occurrences but offers better outcomes in complex cases. The choice between PELD and OLM in LDH surgical management should be based on patient's clinical presentation, herniation complexity, and surgeon expertise, with further research neededwith larger sample sizes and longer follow-up periods is necessary to validate these findings and optimize surgical strategies for LDH.

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