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Original Research Article

Clinical Outcomes of Minimally Invasive Versus Open Lumbar Discectomy

Raghav Raj[1], Raju Kumar[2], Marut Nandan Kumar[3], Rakesh Choudhary[4]

[1]Senior Resident, Department of Orthopaedic, Patna Medica College and Hospital Patna, Bihar, India
[2]Senior Resident, Department of Orthopaedic, Patna Medica College and Hospital Patna, Bihar, India
[3]Professor, Department of Orthopaedic, Patna Medica College and Hospital Patna, Bihar, India
[4]Professor & H.O.D., Department of Orthopaedic, Patna Medica College and Hospital Patna, Bihar, India

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Corresponding author: Dr. Raju Kumar
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Abstract

Background: Lumbar disc herniation (LDH) is a common source of low back pain and radiculopathy that may lead to an indication for surgery after conservative intervention fails to provide relief. Open lumbar discectomy was commonly used, but with minimally invasive procedures are increasingly used due to less tissue damage and an accelerated postoperative recovery. Comparison outcomes of these techniques are significant for surgical decision making and optimal patient care.

Methods: Prospective comparative study at PMCH from August 2023-2025, 70 patients included in the two groups, Group A (Minimally Invasive Discectomy) n=35 and Group B (Open Discectomy) n=35. Preoperative and postoperative measurements with VAS and ODI scores were evaluated at 1, 3, 6, and 12 months. The length of surgery, amount of blood loss, hospital stay and complications were documented. Data analysis was done by SPSS and $p < 0.05$ was considered to be significant.

Results: The minimally invasive group demonstrated longer operative time (85.4±12.6 vs 78.2±11.3 minutes, p=0.03) but significantly less blood loss (65.3±18.4 vs 140.6±35.2 ml, p<0,001) and shorter hospital stay (2.1±0.6vs 4,3 ±1.1days, p <0/001). Early improvement of VAS favored MIS at 1 month (p=0.002), but at 12 months the results were similar. ODI reduction at 3 months was superior (p=0.001). There were slightly higher complications in the open group.

Conclusion: Early postoperative results provide less blood loss, shorter hospital stays and more rapid pain relief in the course of minimally invasive lumbar discectomy groups, with equal late follow up compared to open discectomy.

Keywords: Lumbar Disc Herniation, Minimally Invasive Discectomy, Open Discectomy, VAS Score, Clinical Outcomes.

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Introduction

Lumbar disc herniation (LDH) is among the leading causes of low back pain and sciatica, which preferentially occurs in individuals during their most productive economic active age between 30 to 60 years [1]. It is caused by the degeneration or displacement of the intervertebral disc material, with compression upon adjacent nerve roots and symptomatology such as radicular pain, numbness, and motor weakness.

LDH causes a significant proportion of cases requiring surgical treatment, and the life time prevalence is up to 60–80% [2]. As human activities become more sedentary and occupational strain, with an also emerging epidemic of obesity associated to the aging population, the prevalence of lumbar disc pathology worldwide is progressively increasing which in turn leads to high burden of health care costs and productivity lost [3]. Low back pain represents not only a large medical issue but also a socio-economic problem [4]. It is one of the major reasons for disability around the world and most frequent causes of hospital visits and absenteeism from work. Chronic radicular pain associated with disc prolapse is deeply affect quality of life, physical function, emotional health and occupation [5].

While physiotherapy, analgesics and epidural steroid injections form the supportive conservative treatment, a few patients with continuous symptoms or neurological deficits need surgery [6,7]. Minimally invasive lumbar discectomy is a newer procedure that has become increasingly popular

[8,9]. The minimally invasive approach uses smaller incisions, tubular retractors, and microscopic or endoscopic visualization that led to the disc space through minimal disruption of paraspinal musculature and surrounding soft tissues [10,11]. Proposed benefits of minimally invasive approaches are less postoperative pain, shorter length of hospitalization, improved recovery, decreased blood loss, and earlier return to work [12]. However, issues about the regarding operating time, learning curve, cost and possibility of incomplete decompression or recurrence exist.

Limited regional comparative data are available regarding minimally invasive versus open lumbar discectomy in tertiary care settings. Understanding such clinical outcomes in this institution is crucial to assist surgical decision-making and improve patient management. The study is designed to critically evaluate clinical performance of minimally invasive vs open lumbar discectomy among patients managed at PMCH.

Objectives

- To compare clinical results of both techniques through postoperative pain (VAS) and functional improvement (ODI).
- To evaluate perioperative outcomes, such as operative time, hospital stay and recovery to work.
- To analyze the safety profiles between intra- and postoperative complications in both groups.

Materials and Methods

Study Design: This study was performed as a prospective comparative study comparing the clinical outcomes of minimally invasive lumbar discectomy with conventional open transforaminal lumbar discectomy for single-level LDH patients. The patients were divided into 2 groups according to the type of surgery and followed up for a certain period.

Study Setting: The study was carried out at PMCH, which is a tertiary care hospital receiving diverse population of patients with spinal pathology. All patients underwent surgical interventions under the operation protocol by spine specialists.

Study Duration and Sample Size: The experiment lasted two years (2023–2025), respectively. Patient enrolment, surgery and follow-ups occurred within this period. The study included 70 eligible patients. They were divided into two groups:

- **Group A:** Minimally Invasive Lumbar Discectomy (n = 35)
- **Group B:** Open Lumbar Discectomy (n = 35)

The two groups of patients who had the indicated surgery for single-level lumbar disc herniation.

Inclusion Criteria: The patients between 18 to 65 years with single-level lumbar disc herniation proved clinically and radiologically were selected. Only those who had been failed treated conservatively for at least six weeks and remained to experience persisting radicular pain accompanied by neurological deficits were included. All patients had to be demonstrated to have disk prolapse by Magnetic Resonance Imaging (MRI).

Exclusion Criteria: Patients with multi-level disc prolapse, previous lumbar spine surgery, spinal instability, spinal infections, tumors and severe systemic illnesses which may affect surgical outcome were excluded from the study.

Preoperative Assessment: Every patient was evaluated in detail clinically with history collecting and complete neurological examination. MRI of the lumbosacral spine was also done to determine exact disc level and type of herniated disc. The baseline pain was measured by the Visual Analog Scale (VAS) and functional disability was measured with the Oswestry Disability Index (ODI). Preoperative baseline investigations were done for the fitness of surgery.

Surgical Procedure

Group A: Minimally invasive lumbar discectomy: Patients who belonged to this group were treated by discectomy through a small paramedian incision. Sequential tubular dilators and tubular retractors were utilized to access the involved level without muscular perforation. It was performed using either a microscope or an endoscope for adequate visualization and exact removal of the herniated disk material while safeguarding nearby tissues.

Group B: Open Lumbar Discectomy: Patients assigned to this group were treated with the classical open approach performed through a midline incision. The lamina was exposed after retraction of the paraspinal muscles. The decompression of the affected nerve root was achieved by partial laminectomy and removal of the herniated disc fragment.

Outcome Measures: The main outcome was post-operative pain relief using VAS and function improvement using ODI. Time of operation (minutes), blood loss in surgery (ml), hospital stay duration(days), the ratio of complications in pre- and post-operation, recovering-to-work time (off work period) and recurrence rate were considered as secondary outcomes.

Follow-Up: All patients have been monitored post operatively on regular follow-up visits at 1 month, 3 months, 6 months and 12 months.

During each follow-up, physical examination, VAS score, and ODI score were noted. Complications and relapse of symptoms were recorded.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. The Independent t-test was used to compare continuous variables between the two groups, and the Chi-square test was applied for categorical variables. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: The study was approved by the Institutional Ethics Committee of PMCH. Written informed consent was obtained from all the patients before enrollment. Confidentiality and privacy of patients were strictly followed during the study, and all data obtained was used for scientific purposes.

Results

Demographic Profile: The average ages of the patients in Group A and B were 42.6 ± 10.4 years, while in Group B was 44.1 ± 9.8 years. Most of the patients in both groups were in the age group of 31–50 years. Both groups were slightly male dominant. The level most frequently affected was L4–L5 and then L5–S1.

Table 1: Demographic Characteristics of Patients

Variable	Group A (MIS) (n=35)	Group B (Open) (n=35)	p-value
Mean Age (years)	42.6 ± 10.4	44.1 ± 9.8	0.48
Male	22 (62.9%)	24 (68.6%)	0.61
Female	13 (37.1%)	11 (31.4%)	
L4–L5	21 (60%)	19 (54.3%)	0.63
L5–S1	14 (40%)	16 (45.7%)	

No significant differences were found in demographic data at baseline between the two groups.

Operative Parameters: The average operative time for minimally invasive procedure was slightly compared to the open group. Haemorrhage and duration of hospital stay were also lower in the minimally invasive group.

Table 2: Comparison of Operative Parameters

Parameter	Group A (MIS)	Group B (Open)	p-value
Operative Time (minutes)	85.4 ± 12.6	78.2 ± 11.3	0.03*
Blood Loss (ml)	65.3 ± 18.4	140.6 ± 35.2	<0.001*
Hospital Stay (days)	2.1 ± 0.6	4.3 ± 1.1	<0.001*

Even with the minimally invasive approach, intraoperative blood loss and hospital stay was decreased when compared with open technique.

Pain Outcome (VAS Score): VAS scores of both groups decreased after surgery. At 1-month follow-up, the minimally invasive group demonstrated earlier pain relief.

Table 3: Comparison of VAS Scores

Follow-Up	Group A (MIS)	Group B (Open)	p-value
Preoperative	8.2 ± 0.9	8.4 ± 1.0	0.41
1 Month	2.1 ± 0.8	3.0 ± 1.1	0.002*
3 Months	1.8 ± 0.7	2.2 ± 0.9	0.04*
6 Months	1.5 ± 0.6	1.7 ± 0.7	0.18
12 Months	1.3 ± 0.5	1.4 ± 0.6	0.39

Functional Outcome (ODI Score): Assessment of functional status using ODI revealed the progression toward marked reduction in disability in both groups, however, early recovery was better in MI group.

Table 4: Comparison of ODI Scores

Follow-Up	Group A (MIS)	Group B (Open)	p-value
Preoperative	62.4 ± 8.5	63.1 ± 9.2	0.72
3 Months	24.6 ± 6.3	30.8 ± 7.4	0.001*
6 Months	18.2 ± 5.1	20.4 ± 5.6	0.09
12 Months	15.6 ± 4.8	16.9 ± 5.0	0.27

Early postoperative functional recovery was significantly improved in the minimally invasive group.

Complications: There was a low total complication rate in both groups. The rate of complications was slightly higher in the open discectomy group.

Table 5: Comparison of Complications

Complication	Group A (MIS)	Group B (Open)
Dural Tear	1 (2.9%)	2 (5.7%)
Superficial Infection	1 (2.9%)	3 (8.6%)
Nerve Injury	0	1 (2.9%)
Recurrence	2 (5.7%)	3 (8.6%)

G2 had higher complication rates in an open procedure, however, it was not statistically significant.

Discussion

Comparison with Previous Studies: The present study compared the clinical efficacy of minimally invasive lumbar discectomy (MIS) and conventional open lumbar discectomy in 70 patients. This study results revealed that both surgical procedures were effective in reducing pain and improving functional status, but the minimally invasive procedure was associated with better early postoperative outcomes concerning reduced blood loss, shorter hospital stay, and faster pain relief. These results confirm showed similar long-term outcomes between the 2 techniques but outlined short-term advantages for minimally invasive operations [13]. MIS approaches leave the smallest amount of muscle devastation and soft-tissue invasion offering faster rehabilitation rates as well as higher short-term patient satisfaction [14,15]. Long-term VAS and ODI scores of this study were similar in the both groups, which being consistent with current literature suggesting that no difference is seen with both techniques in producing a lasting nerve root decompression of patients.

Advantages of the Minimally Invasive Approach: The laparoscopic technique showed definite perioperative benefits in this study. MIS patients had significantly less intraoperative blood loss and shorter hospital lengths of stay compared to the open discectomy group. Early postoperative pain relief was also more significant in the MIS group with lower VAS at 1 and 3 months. These advantages are due to smaller incisions, less dissection on paraspinal muscle and retention of the original anatomy structure. Lower tissue injury might be responsible for a less postoperative immune response and earlier mobilization. MIS group had earlier return to work, suggesting functional and economic advantages of the procedure.

Limitations of Open Surgery: While traditional open lumbar discectomy is well established and effective, it does have a certain disadvantage. A wider muscle dissection and retraction are often necessary, complicating postoperative pain, bleeding, and hospitalization. In this study, a tendency toward more complications including minor superficial infections and dural lesions in the open surgery group. Decreased mobilisation and prolonged recovery time might be factors that associate with longer absence from work. However, long-term pain relief and functional results were similar in both procedures.

Interpretation of Statistical Findings: Statistical analysis showed highly significant differences between the two groups with regard to both blood loss and length of hospital stay ($p < 0.001$) indicating a distinct perioperative benefit resulting from the minimally invasive procedure. Immediate postoperative VAS and ODI were significantly in favor of the MIS group. By 12 months post treatment, differences in pain and functional results were not statistically significant, indicating that both treatments appear to be equally effective for long-term symptom resolution. These results suggest that MIS provides immediate advantages without compromising long-term outcomes.

Strengths of the Study: The strengths of the study include its prospective comparative nature with patient's well equal distribution. Standardized surgical procedures and regular follow-up intervals improved the comparability of FAI outcome. Furthermore, using confirmed-outcome scoring system VAS and ODI made pain and function assessment objective.

Limitations of the Study: Despite this result, there are a few limitations of the study. The number of 70 patients is small making it difficult to generalize. Although this was a single-centre study carried out at PMCH, the findings may not be generalizable to other healthcare facilities. A follow-up of 12 months does not allow the complete visualization of long-term re-recurrence rates or late complications. These findings should be confirmed in larger multicenter studies with a longer follow-up.

Conclusion

The purpose of this study was to compare the clinical outcome between minimally invasive and traditional, open lumbar discectomies on 70 patients treated in PMCH. Both procedures were effective in providing significant pain reduction as well as functional improvement throughout the 12 months of follow up.

However, the less invasive technique clearly offered short-term benefits in terms of decreased intra-operative blood loss, shorter hospital stay, earlier analgesic requirement and faster return to work. VAS and ODI scores at the last follow-up were similar in both groups.

Accordingly, minimally invasive lumbar discectomy may be superior in perioperative recovery and early functional recovery without loss of long-term effectiveness. It is acceptable as a surgical option in selected patients if the expertise and infrastructure are satisfactory when available. More multicenter and large-scale trials with longer follow-up periods are required to investigate longterm recurrence rates, cost-effectiveness, and patient satisfaction in different clinical settings.

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