

## Comparative Analysis of Clinical Outcomes: Endoscopic Versus Open Lumbar Discectomy in Single-Level Disc Herniation

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### Abstract

### Original Research Article

**Background:** Lumbar disc herniation is a common cause of low back pain and radiculopathy that often requires surgical intervention when conservative management fails. Endoscopic lumbar discectomy has emerged as a minimally invasive alternative to conventional open discectomy. This study aimed to compare the clinical outcomes of endoscopic versus open lumbar discectomy in patients with single-level lumbar disc herniation. **Methods:** This comparative observational study was conducted at the Department of Orthopaedic Surgery and Department of Neurosurgery of Rangpur Medical College Hospital, Rangpur, Bangladesh, and other Private Hospitals of Rangpur City of Bangladesh, from 01 January 2025 to 31 December 2025. A total of 50 patients with single-level lumbar disc herniation undergoing surgical treatment were included. Patients were divided into two groups: endoscopic lumbar discectomy (n=25) and open lumbar discectomy (n=25). **Results:** The majority of patients were aged 31–50 years (60.0%) and male (62.0%). The most common level of disc herniation was L4–L5 (50.0%), followed by L5–S1 (36.0%). The endoscopic discectomy group showed significantly shorter operative time (68.4±10.6 vs 86.9±12.3 minutes), lower intraoperative blood loss (54.7±15.8 vs 128.5±26.1 ml), shorter hospital stay (2.3±0.9 vs 4.8±1.4 days) and earlier return to work (3.6±1.2 vs 6.7±1.8 weeks) compared with the open discectomy group (p<0.001). Excellent outcomes were observed in 52.0% of endoscopic cases and 36.0% of open cases, though the overall clinical outcome did not differ significantly (p=0.48). **Conclusion:** Endoscopic lumbar discectomy provides favorable perioperative outcomes with comparable clinical results to open discectomy, making it an effective minimally invasive option for single-level lumbar disc herniation. **Keywords:** Lumbar disc herniation, Endoscopic discectomy, Open discectomy, Minimally invasive spine surgery, Clinical outcomes.

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## INTRODUCTION

Lumbar disc herniation is one of the most common causes of low back pain and radiculopathy worldwide and represents a major cause of disability among adults [1]. It occurs when the nucleus pulposus protrudes through a tear in the annulus fibrosus, leading to compression or irritation of the adjacent nerve roots [2]. Patients commonly present with lower back pain, radiating leg pain (sciatica), numbness, weakness and limitation of daily activities [3]. Lumbar disc herniation most frequently affects individuals in the productive age group and therefore has significant socioeconomic consequences due to loss of working capacity and

reduced quality of life [4].

Conservative management, including rest, analgesics, physiotherapy and epidural steroid injections, is usually the first-line treatment for lumbar disc herniation [5]. However, a considerable number of patients fail to respond adequately to conservative therapy and require surgical intervention. Lumbar discectomy remains the standard surgical procedure for relieving nerve root compression and improving functional outcomes in such patients [6]. Traditionally, open lumbar discectomy has been widely performed and has shown satisfactory results in terms of pain relief and

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neurological recovery [7].

In recent years, advances in minimally invasive spine surgery have led to the development of endoscopic lumbar discectomy [7]. This technique utilizes specialized endoscopic instruments and small incisions to access and remove the herniated disc material [8]. Compared with conventional open surgery, endoscopic discectomy is associated with less soft tissue damage, reduced intraoperative blood loss, shorter hospital stay, faster postoperative recovery and earlier return to normal activities. These advantages have made endoscopic procedures increasingly popular among spine surgeons [9].

Despite these benefits, some concerns remain regarding the effectiveness, learning curve, operative time and long-term outcomes of endoscopic lumbar discectomy when compared with the conventional open technique [10]. Several studies have attempted to compare the clinical outcomes of these two surgical approaches, but the results have sometimes been variable depending on patient characteristics, surgical expertise and study design [11-12].

Therefore, the present study was conducted to perform a comparative analysis of clinical outcomes between endoscopic lumbar discectomy and open lumbar discectomy in patients with single-level lumbar disc herniation. The study aimed to evaluate differences in operative time, intraoperative blood loss, duration of hospital stay, return to work and postoperative clinical outcomes between the two surgical techniques. The findings of this study may contribute to a better understanding of the relative advantages of these procedures and help optimize the management of patients with lumbar disc herniation.

## METHODOLOGY & MATERIALS

This comparative observational study was conducted at the Department of Orthopaedic Surgery and Department of Neurosurgery of Rangpur Medical College Hospital, Rangpur, Bangladesh, and other Private Hospitals of Rangpur City of Bangladesh, over a one-year period from 01 January 2025 to 31 December

2025. A total of 50 patients diagnosed with single-level lumbar disc herniation and requiring surgical management were included in the study. The patients were divided into two groups based on the surgical technique used: 25 patients underwent endoscopic lumbar discectomy and 25 patients underwent conventional open lumbar discectomy.

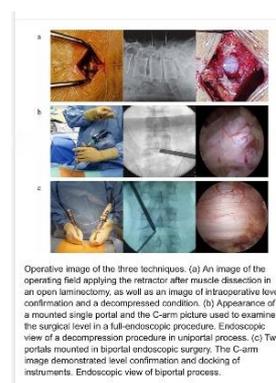
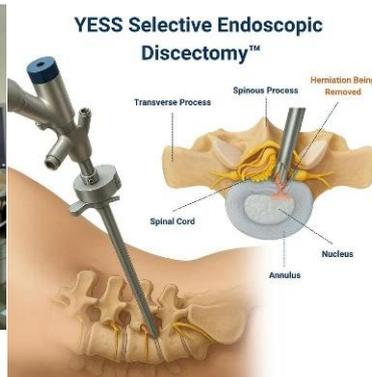
Patients were selected consecutively according to predefined inclusion and exclusion criteria during the study period until the desired sample size was achieved. Detailed clinical history, physical examination and relevant investigations including magnetic resonance imaging (MRI) were performed to confirm the diagnosis and identify the level of disc herniation. Data were collected using a structured data collection sheet that included demographic characteristics, operative parameters and postoperative clinical outcomes. Operative and hospital parameters such as operative time, intraoperative blood loss, duration of hospital stay and time required to return to work were recorded and compared between the two groups. Postoperative clinical outcomes were assessed during follow-up visits and categorized as excellent, good, fair, or poor according to standard clinical outcome criteria.

The inclusion criteria were patients aged between 20 and 60 years with confirmed single-level lumbar disc herniation who underwent either endoscopic lumbar discectomy or open lumbar discectomy and who provided informed consent to participate in the study. Patients with multilevel disc herniation, previous lumbar spine surgery, spinal infections, spinal tumors, spinal fractures, severe spinal deformities, or significant neurological disorders were excluded from the study.

All collected data were checked, coded and entered into Statistical Package for the Social Sciences (SPSS) version 25.0 for analysis. Descriptive statistics such as frequency, percentage, mean and standard deviation were used to summarize the data. Categorical variables were compared between groups using the Chi-square test, while continuous variables were analyzed using the independent sample t-test. A p-value of less than 0.05 was considered statistically significant.



Percutaneous Transforaminal Endoscopic Lumbar Discectomy.



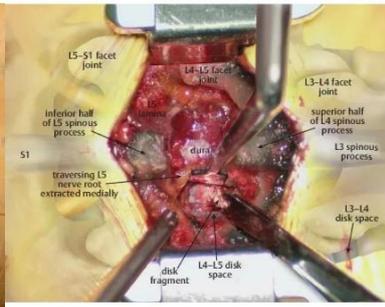
Operative image of the three techniques. (a) An image of the operating field applying the retractor after muscle dissection in an open laminectomy, as well as an image of intraoperative level confirmation and a decompressed condition. (b) Appearance of a mounted single portal and the C-arm picture used to examine the surgical level in a full-endoscopic procedure. Endoscopic view of a decompression procedure in uniportal process. (c) Two portals mounted in bipolar endoscopic surgery. The C-arm image demonstrated level confirmation and docking of instruments. Endoscopic view of bipolar process.

**a) Endoscopic Discectomy**



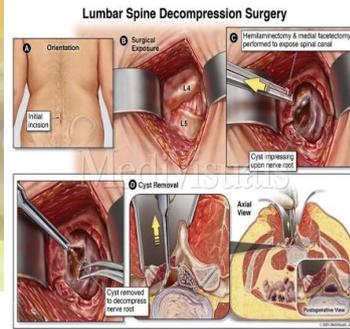
Midline Lumbar Spine decompression (for spinal stenosis) Surgical ...

**b) Selective Endoscopic Discectomy**



Open Laminectomy and Discectomy

**c) Endoscopic Surgical procedure**



**d) Open Lumbar Spine Exposure**

**e) Open Lumbar Discectomy**

**f) Lumbar Spine Decompression**

**Figure 1: Comparison of Endoscopic and Open Lumbar Discectomy Surgical Techniques.**

**RESULTS**

**Table I: Distribution of Patients According to Age Group**

Age Group (Years)	Endoscopic Discectomy n=25 n (%)	Open Discectomy n=25 n (%)	Total n=50 n (%)	p-value
20-30	6 (24.0)	5 (20.0)	11 (22.0)	0.91
31-40	8 (32.0)	7 (28.0)	15 (30.0)	
41-50	7 (28.0)	8 (32.0)	15 (30.0)	
51-60	4 (16.0)	5 (20.0)	9 (18.0)	
Total	25 (100.0)	25 (100.0)	50 (100.0)	

Table I shows the distribution of patients according to age group. Among the 50 study participants, the majority were within the 31-40 years and 41-50 years age groups, each comprising 15 (30.0%) patients. In the endoscopic discectomy group, 8 (32.0%) patients were aged 31-40 years, while 7 (28.0%) patients were in the 41-50 years age group. In the open discectomy

group, 8 (32.0%) patients belonged to the 41-50 years age group and 7 (28.0%) patients were aged 31-40 years. A smaller proportion of patients were found in the 20-30 years (22.0%) and 51-60 years (18.0%) groups. There was no statistically significant difference between the two groups (p = 0.91).

**Table II: Distribution of Patients According to Sex**

Sex	Endoscopic Discectomy n=25 n (%)	Open Discectomy n=25 n (%)	Total n=50 n (%)	p-value
Male	16 (64.0)	15 (60.0)	31 (62.0)	0.77
Female	9 (36.0)	10 (40.0)	19 (38.0)	
Total	25 (100.0)	25 (100.0)	50 (100.0)	

Table II presents the distribution of patients according to sex. Out of the total 50 patients, the majority were male 31 (62.0%), while 19 (38.0%) were female. In the endoscopic discectomy group, 16 (64.0%) patients were male and 9 (36.0%) were female, whereas in the

open discectomy group 15 (60.0%) were male and 10 (40.0%) were female. The sex distribution between the two surgical groups was comparable and showed no statistically significant difference (p = 0.77).

**Table III: Comparison of Operative and Hospital Parameters**

Variables	Endoscopic Discectomy (n=25) Mean ± SD	Open Discectomy (n=25) Mean ± SD	p-value
Mean operative time (minutes)	68.4 ± 10.6	86.9 ± 12.3	<0.001
Mean blood loss (ml)	54.7 ± 15.8	128.5 ± 26.1	<0.001
Mean hospital stay (days)	2.3 ± 0.9	4.8 ± 1.4	<0.001
Mean return to work (weeks)	3.6 ± 1.2	6.7 ± 1.8	<0.001

Table III shows the comparison of operative and hospital parameters between the endoscopic and open discectomy groups. The mean operative time was  $68.4 \pm 10.6$  minutes in the endoscopic discectomy group compared to  $86.9 \pm 12.3$  minutes in the open discectomy group. The mean intraoperative blood loss was significantly lower in the endoscopic group ( $54.7 \pm 15.8$  ml) than in the open discectomy group ( $128.5 \pm 26.1$  ml).

Similarly, the mean duration of hospital stay was shorter in the endoscopic group ( $2.3 \pm 0.9$  days) compared with the open group ( $4.8 \pm 1.4$  days). Patients who underwent endoscopic discectomy also returned to work earlier ( $3.6 \pm 1.2$  weeks) than those who had open discectomy ( $6.7 \pm 1.8$  weeks). All these differences were statistically significant ( $p < 0.001$ ).

**Table IV: Distribution of Patients According to Level of Disc Herniation**

Level of Herniation	Endoscopic Discectomy n=25 n (%)	Open Discectomy n=25 n (%)	Total n=50 n (%)	p-value
L3-L4	3 (12.0)	4 (16.0)	7 (14.0)	0.93
L4-L5	13 (52.0)	12 (48.0)	25 (50.0)	
L5-S1	9 (36.0)	9 (36.0)	18 (36.0)	
Total	25 (100.0)	25 (100.0)	50 (100.0)	

Table IV presents the distribution of patients according to the level of disc herniation. Among the total 50 patients, the most commonly affected level was L4-L5 with 25 (50.0%) patients, followed by L5-S1 with 18 (36.0%) patients, while L3-L4 was observed in 7 (14.0%) patients. In the endoscopic discectomy group,

13 (52.0%) patients had herniation at the L4-L5 level and \*\*9 (36.0%) at L5-S1. In the open discectomy group, 12 (48.0%) patients had L4-L5 herniation and \*\*9 (36.0%) had L5-S1 involvement. The distribution of disc herniation levels between the two groups was comparable and not statistically significant ( $p = 0.93$ ).

**Table V: Comparison of Postoperative Clinical Outcomes**

Clinical Outcome	Endoscopic Discectomy n=25 n (%)	Open Discectomy n=25 n (%)	Total n=50 n (%)	p-value
Excellent	13 (52.0)	9 (36.0)	22 (44.0)	0.48
Good	8 (32.0)	10 (40.0)	18 (36.0)	
Fair	3 (12.0)	4 (16.0)	7 (14.0)	
Poor	1 (4.0)	2 (8.0)	3 (6.0)	
Total	25 (100.0)	25 (100.0)	50 (100.0)	

Table V compares the postoperative clinical outcomes between the two surgical groups. Among the 50 patients, 22 (44.0%) achieved an excellent outcome, while 18 (36.0%) had good outcomes, 7 (14.0%) fair outcomes and 3 (6.0%) poor outcomes. In the endoscopic discectomy group, 13 (52.0%) patients had excellent outcomes and 8 (32.0%) had good outcomes, whereas in the open discectomy group 9 (36.0%) patients showed excellent outcomes and 10 (40.0%) had good outcomes. The proportions of fair and poor outcomes were relatively low in both groups. However, the overall clinical outcome between the two procedures did not show a statistically significant difference ( $p = 0.48$ ).

## DISCUSSION

Lumbar disc herniation is a common cause of low back pain and radiculopathy that frequently affects individuals in their productive age group. Surgical management is indicated when conservative treatment fails and both open and endoscopic discectomy are widely used procedures. The present study compared the clinical outcomes of endoscopic versus open lumbar discectomy in patients with single-level disc herniation. The findings of this study demonstrated comparable demographic characteristics between the two groups,

while endoscopic discectomy showed advantages in operative and postoperative parameters.

In this study, most patients were within the 31-40 years and 41-50 years age groups, each comprising 15 (30.0%) patients, indicating that lumbar disc herniation predominantly affects middle-aged individuals. Similar findings were reported by Ahsan *et al.*, who observed that the majority of patients with lumbar disc herniation belonged to the middle-aged population undergoing discectomy in a tertiary care hospital [13]. Likewise, Hoque *et al.* reported that patients with prolapsed lumbar intervertebral disc were mostly within the economically active age group, highlighting the significant impact of this condition on working individuals [14]. The present study also showed male predominance (62.0%), which is consistent with previous studies conducted in similar settings. Rahman *et al.* also reported a higher proportion of male patients undergoing lumbar decompression surgery, which may be related to occupational factors and higher physical workload among males [15].

The distribution of the level of disc herniation in the present study revealed that the L4-L5 level was the most commonly affected (50.0%), followed by L5-

S1 (36.0%) and L3–L4 (14.0%). This pattern is consistent with the anatomical and biomechanical stress distribution in the lumbar spine. Similar findings were reported by Wang *et al.*, who noted that L4–L5 and L5–S1 are the most frequently involved levels in patients undergoing endoscopic lumbar discectomy [16]. Comparable observations were also reported by Wu *et al.*, where lower lumbar levels were predominantly affected in cases of lumbar disc herniation [17].

The operative and hospital parameters in the present study showed significant advantages for the endoscopic technique. The mean operative time was shorter in the endoscopic group ( $68.4 \pm 10.6$  minutes) compared with the open discectomy group ( $86.9 \pm 12.3$  minutes). Additionally, intraoperative blood loss was significantly lower in the endoscopic group ( $54.7 \pm 15.8$  ml) compared to  $128.5 \pm 26.1$  ml in the open group and the hospital stay was also shorter ( $2.3 \pm 0.9$  days vs  $4.8 \pm 1.4$  days). Patients undergoing endoscopic discectomy also returned to work earlier ( $3.6 \pm 1.2$  weeks vs  $6.7 \pm 1.8$  weeks). These findings are consistent with the results of several previous studies. Patel *et al.* in a systematic review and meta-analysis reported that minimally invasive endoscopic discectomy is associated with reduced blood loss, shorter hospitalization and faster postoperative recovery compared with conventional open surgery [18]. Similarly, Yu *et al.* demonstrated that endoscopic procedures resulted in less tissue trauma and quicker functional recovery compared to traditional open surgery [19].

The postoperative clinical outcomes in this study showed that 44.0% of patients achieved excellent outcomes, while 36.0% had good outcomes, indicating a high overall success rate of surgical treatment. In the endoscopic group, 52.0% of patients achieved excellent outcomes, compared with 36.0% in the open discectomy group, although the difference was not statistically significant ( $p = 0.48$ ). Similar results have been reported by Özer and Demirtaş, who found that both endoscopic and conventional microdiscectomy techniques provide satisfactory clinical outcomes with comparable success rates [20]. Furthermore, Rajadurai *et al.* also reported comparable functional outcomes between open and full endoscopic lumbar discectomy in patients with lumbar radiculopathy [21].

#### Limitations of the study

The present study has several limitations that should be considered while interpreting the findings. First, the study included a relatively small sample size of 50 patients, which may limit the generalizability of the results. Second, the study was conducted in different hospitals, which may introduce variations in surgical techniques and postoperative management. In addition, the follow-up period was relatively short and long-term outcomes such as recurrence rates and long-term functional recovery were not evaluated.

## CONCLUSION

The findings of the present study indicate that endoscopic lumbar discectomy is a safe and effective surgical option for the management of single-level lumbar disc herniation. Compared with open discectomy, the endoscopic technique demonstrated shorter operative time, reduced intraoperative blood loss, shorter hospital stay and earlier return to work, while providing comparable postoperative clinical outcomes. Therefore, endoscopic lumbar discectomy may be considered a valuable minimally invasive alternative to conventional open discectomy in appropriately selected patients.

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