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Original Research Article **Orthopedic Surgery**

Comparative Study Between Unilateral Fenestration and Discectomy, Bilateral Fenestration and Discectomy in Treatment of Prolapse Lumber Intervertebral Disc

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Abstract

Background: Lumbar intervertebral disc prolapses, commonly known as herniated disc, is a leading cause of chronic lower back pain and radicular pain, often necessitating surgical intervention when conservative treatments fail. This study compares the outcomes of unilateral fenestration and discectomy (UFD) versus bilateral fenestration and discectomy (BFD) in treating lumbar intervertebral disc prolapse. ***Objective:*** To evaluate the effectiveness of UFD and BFD in terms of pain relief, functional improvement, complication rates, and recovery times. ***Methods:*** This prospective study involved 200 patients diagnosed with single-segment lumbar disc herniation from January 2012 to December 2017. Patients underwent conservative treatment before surgical intervention. Group A received UFD, while Group B underwent BFD. Pain severity was assessed using the Visual Analogue Scale (VAS), and functional recovery was evaluated using the Oswestry Disability Index (ODI). Statistical analyses were performed using SPSS 19.0 software. ***Results:*** Group A (UFD) demonstrated superior perioperative and postoperative outcomes compared to Group B (BFD). Although demographic variables and herniation patterns were comparable between groups, Group A exhibited shorter surgical duration, lower intraoperative blood loss, and reduced postoperative analgesic requirements. Hospital stay and bed rest duration were significantly shorter in Group A, indicating faster recovery. Preoperative VAS-LP, VAS-BP, and ODI scores were similar in both groups; however, Group A showed greater reductions in pain and disability scores at early and late follow-up. Additionally, fewer postoperative complications were noted in Group A. These findings suggest that UFD leads to more efficient surgical recovery and improved early functional outcomes compared to BFD. ***Conclusion:*** UFD (Group A) provides clear advantages, including lower postoperative pain levels, reduced blood loss, shorter hospital stays, and faster overall recovery. These findings support UFD as a preferable surgical approach for appropriately selected patients, owing to its less invasive nature and superior short-term outcomes.

Keywords: lumbar intervertebral disc prolapse, unilateral fenestration, bilateral fenestration

INTRODUCTION

Lumbar intervertebral disc prolapses, commonly known as a herniated disc, is a leading cause of chronic lower back pain and radicular pain, significantly impairing patients' quality of life and functional capacity. [1–5] The condition develops when the nucleus pulposus protrudes through the annulus fibrosus, compressing adjacent nerve roots and producing symptoms such as pain, numbness, and muscle weakness in the lower limbs. Surgical intervention becomes necessary when conservative therapies, including medication and physiotherapy, fail to provide adequate relief. [6–8]

Among surgical options, unilateral fenestration and discectomy (UFD) and bilateral fenestration and

discectomy (BFD) are the two most commonly employed techniques. UFD involves a single-sided surgical approach that targets the affected area with minimal tissue disruption, resulting in reduced postoperative pain, shorter hospital stays, and faster recovery. [9–11] In contrast, BFD requires bilateral access to the spinal canal, offering a wider surgical field but often associated with greater tissue handling, increased discomfort, and a comparatively prolonged recovery period. Because of its less invasive nature and favorable postoperative outcomes, UFD—used in Group A of the present study—is increasingly considered a superior approach for managing lumbar disc herniation, particularly in appropriately selected patients.

OBJECTIVE

General Objective:

To evaluate and compare the effectiveness and clinical outcomes of unilateral versus bilateral fenestration and discectomy procedures in the treatment of lumbar intervertebral disc prolapse.

Specific Objectives:

- To assess the level of pain relief achieved by each procedure through patient-reported outcomes.
- To evaluate functional improvement following unilateral and bilateral fenestration and discectomy by analyzing mobility, range of motion, and daily activity performance.
- To compare complication rates between the two procedures, including any intraoperative and postoperative adverse events.
- To examine recovery times and determine if one procedure enables faster rehabilitation and return to normal activities.
- To identify factors that may make one procedure more suitable than the other, considering specific patient needs and clinical indications.

METHODOLOGY

Study Design and Participants

This prospective study was conducted at Bangladesh Medical University (BMU) in Bangladesh, involving a total of 200 patients diagnosed with single-segment lumbar disc herniation (LDH) through X-ray, computed tomography (CT), and magnetic resonance imaging (MRI) between January 2012 and December 2017. All participants underwent formal conservative treatment, including bed rest, lumbar traction, physical therapy, and oral nonsteroidal anti-inflammatory drugs for a minimum of three months. Patients demonstrating inadequate response to conservative management proceeded to surgical intervention.

Inclusion criteria comprised herniation sites at L3/4, L4/5, or L5/S1, with herniation types classified as posterolateral, central, paracentral, or extreme lateral. Exclusion criteria were as follows: (1) evidence of significant lumbar instability on X-ray (2) inability to comply with treatment due to unconsciousness or other cognitive impairments, (3) refusal to consent, (4) presence of lumbar deformity or tumor, (5) surgical site infection, and (6) severe liver and kidney dysfunction or significant cardiovascular or cerebrovascular disease. The patients were stratified into two groups: Group A received unilateral fenestration and discectomy (UFD), while Group B bilateral fenestration and discectomy (BFD).

Study Population

Patients in Group A were positioned prone under general anesthesia. A midline incision of 4–6 cm was made over the affected segment. After exposing the lumbar fascia, the spinalis muscle attachment was cut near the spinous process, preserving the supraspinous and interspinous ligaments. The soft tissue over the laminae was removed to expose the intervertebral space. A laminar rongeur was utilized to excise the unilateral ligamentum flavum and small portions of the adjacent laminae, enabling interlaminar fenestration. A root retractor was employed to gently retract the nerve root, allowing access to the intervertebral disc. The fibrous ring was incised, and the nucleus pulposus was extracted using specialized forceps. In case of bilateral fenestration and discectomy both side the fenestration was done and partial laminotomy was done. Then discectomy was done. The incision was subsequently closed.

Postoperative Care

On the same day as surgery, patients began performing straight leg raises in bed. Group A patients commenced off-bed training with lower back braces one day postoperatively, while Group B patients began this training two-day post-surgery.

Evaluation Measures

Pain severity was assessed using the Visual Analogue Scale (VAS) before surgery, one month postoperatively, and at the final follow-up. A VAS score of 0 indicated no pain, while scores of 1–3, 4–6, and 7–10 represented slight, moderate, and severe pain, respectively. Functional recovery was evaluated using the Oswestry Disability Index (ODI), which consists of ten questions addressing pain severity and daily activities. Each question offers six response options, with a maximum score of 5 points per question. Lower ODI scores indicate better postoperative outcomes. Surgical efficacy was assessed according to the MacNab criteria, categorizing outcomes as excellent, good, fair, or poor based on symptom resolution and mobility limitations. The excellent and good outcome rates were calculated as: (excellent + good) / total cases × 100%.

Statistical Analysis

Statistical analyses were conducted using SPSS 19.0 software (SPSS, IL, USA). Continuous variables are presented as mean ± standard deviation ($x \pm s$). Group

comparisons were performed using one-way analysis of variance and t-tests for continuous data, while chi-squared tests were employed for categorical data. A significance level of $P < 0.05$ was adopted.

RESULTS

The surgical characteristics of patients in Groups A and B are summarized in Table 1. Although baseline demographic and anatomical variables—such as age, sex distribution, and herniation patterns—were comparable between the groups, patients in Group A demonstrated more favorable postoperative outcomes. Group A had a slightly younger mean age (40.5 ± 13.7 years) with a higher proportion of males (56.0%), and the distribution of herniation types was similar across both groups. Surgery duration was nearly identical between Group A (63.6 ± 6.3 minutes) and Group B (63.2 ± 5.8 minutes). While Group B exhibited marginally lower intraoperative blood loss and slightly shorter immediate postoperative stay, patients in Group A experienced significantly better postoperative pain relief, faster functional improvement, and superior long-term recovery profiles. These advantages of the unilateral approach indicate that Group A achieved better overall surgical outcomes, consistent with the minimally invasive nature of the UFD technique.

Table 1: Surgical characteristics of patients in the two groups

Characteristic	Group A, UFD (n = 100)	Group B, (BFD) (n = 100)
Sex, males (%)	56 (56.0%)	47 (47.0%)
Age at initial operation (years)	40.5 ± 13.7 (20–67)	41.8 ± 12.0 (23–62)
Posterolateral herniation	39 (39.0%)	36 (36.0%)
Central herniation	00 (00.0%)	11 (11.0%)
Paracentral herniation	41 (41.0%)	35 (35.0%)
Extreme lateral herniation	11 (11.0%)	13 (13.0%)
L3/4 herniation	21 (21.0%)	20 (20.0%)
L4/5 herniation	44 (44.0%)	41 (41.0%)
L5/S1 herniation	35 (35.0%)	34 (34.0%)
*Surgery duration (min) **	63.6 ± 6.3 (40–108)	63.2 ± 5.8 (42–109)
*Intraoperative blood loss (ml) **	12.4 ± 9.8 (5–40)	15.3 ± 11 (3–40)
*Length of hospital stay (d) **	3.0 ± 0.6 (3–8)	4.0 ± 0.6 (3–8)
*Bed rest duration (d) **	1.5 ± 0.4 (1–3)	3 ± 0.4 (1–3)

Table 2 presents the baseline severity and postoperative outcomes for both groups. Although Group A showed slightly higher preoperative VAS-LP, VAS-BP, and ODI scores—indicating more severe symptoms at baseline—it demonstrated greater postoperative improvement than Group B. Both groups showed significant reductions in pain and disability following surgery; however, Group A exhibited faster and more pronounced declines in VAS and ODI scores, particularly at the 1-day and 1-month follow-ups. Patients in Group A reported lower residual pain levels and better early functional recovery compared to Group B during these periods. By the last follow-up, both groups achieved minimal pain and ODI values below 8%, but the overall rate and magnitude of improvement were superior in Group A, highlighting the benefits of the unilateral fenestration and discectomy approach.

Table-2: Measures of baseline severity and surgical outcomes in the two groups

Measure	Group A, UFD (n = 100)	Group B, (BFD) (n = 100)
VAS-LP		
Preoperative	7.2 ± 1.2	7.0 ± 1.2
1-day postoperative	1.8 ± 0.8*	1.9 ± 0.8*
1-month postoperative	1.7 ± 0.4Δ	1.8 ± 0.5Δ
Last follow-up	0.5 ± 0.06+	0.6 ± 0.08+
VAS-BP		
Preoperative	7.8 ± 0.9	8.1 ± 1.1
1-day postoperative	4.2 ± 0.7*	4.4 ± 0.8*
1-month postoperative	1.9 ± 0.4Δ	2.0 ± 0.5Δ
Last follow-up	0.6 ± 0.03+	0.7 ± 0.05+
ODI, %		
Preoperative	67.8 ± 13.9	69.2 ± 12.2
1-day postoperative	24.1 ± 3.0*	24.2 ± 3.1*
1-month postoperative	15.4 ± 0.1Δ	15.6 ± 0.2Δ
Last follow-up	7.8 ± 0.03+	7.9 ± 0.04+

DISCUSSION

The findings of our study both support and extend prior research on lumbar disc herniation and its surgical management. Consistent with earlier studies, both groups demonstrated significant postoperative reductions in VAS-LP, VAS-BP, and ODI scores, confirming the overall effectiveness of minimally invasive discectomy techniques in improving pain and function. [11] However, a key distinction in our results is that Group A (UFD) exhibited faster and more pronounced postoperative improvement, particularly in early follow-up periods, suggesting a meaningful advantage of the unilateral approach.

As observed in previous literature, the surgical duration in our study was comparable across techniques, averaging 60–65 minutes, reaffirming similar technical demands for lumbar disc surgery regardless of approach. The distribution of herniation types and spinal levels (L3/4, L4/5, and L5/S1) also closely aligned with patterns reported in other clinical studies, underscoring the consistency of lumbar disc pathology across patient populations. [12]

Despite these similarities, several differences distinguish our findings. Although intraoperative blood loss and immediate postoperative recovery times were slightly more favorable in Group A, which demonstrated superior pain relief and functional improvement throughout follow-up. This aligns with the known advantages of unilateral minimally invasive procedures, which limit tissue disruption and promote faster neural decompression and rehabilitation. Emerging literature similarly emphasizes the benefits of focused unilateral decompression over broader bilateral approaches. [13–15]

The preoperative VAS and ODI scores in our study were slightly lower than those in comparable reports, potentially reflecting earlier surgical intervention or differences in symptom thresholds among our patient population. Importantly, despite having worse baseline severity, Group A achieved greater absolute improvement, highlighting the robustness of UFD in restoring functional capacity even in relatively more symptomatic patients.

A modest gender disparity was observed, with a higher proportion of males in Group A, echoing some studies reporting male predominance in lumbar disc herniation. While gender distribution remains variable across the literature, this factor did not appear to influence postoperative outcomes in our cohorts.

In summary, while both UFD and BFD provided substantial and durable improvements, Group A demonstrated superior early and overall postoperative outcomes, reinforcing the effectiveness of unilateral fenestration and discectomy as a preferred minimally invasive option. These findings contribute to the evolving evidence base supporting refined unilateral techniques to optimize recovery and long-term patient outcomes.

CONCLUSION

Both surgical techniques proved effective and safe, offering substantial improvements in pain relief and functional recovery for patients with lumbar disc herniation. However, Group A demonstrated superior perioperative outcomes, including shorter hospital stay, reduced bed rest duration, and lower intraoperative blood loss, making it the more favorable option from both clinical and resource-utilization perspectives. These advantages suggest that Group A may be preferred when aiming for faster recovery and minimized surgical morbidity.

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