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Clinical Outcomes of Open Decompression with or without Transpedicular Fixation for Large Lumbar Disc Herniations: A Prospective Comparative Study

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ABSTRACT

Large lumbar disc herniations occupying more than 50% of the spinal canal are frequently associated with severe low back pain, radiculopathy, neurological deficits, and functional disability. Although decompression surgery is an established treatment modality for symptomatic patients, the role of supplemental transpedicular fixation remains controversial. This prospective comparative study was conducted in the Department of Orthopaedics, at a tertiary care teaching hospital in Gujarat, India, from September 2022 to February 2024 to compare the clinical and functional outcomes of decompression with transpedicular fixation and decompression alone in patients with large lumbar disc herniations. Thirty patients with symptomatic single-level large lumbar disc herniation who failed conservative management were included and divided into two groups of 15 patients each. Clinical outcomes were assessed using the Visual Analogue Scale (VAS), Oswestry Disability Index (ODI), Modified MacNab Criteria, and pain-free walking distance at baseline and during postoperative follow-up. Baseline demographic and clinical characteristics were comparable between groups. Mean operative time was significantly higher in the fixation group (116.00 ± 12.42 minutes) compared with the decompression-alone group (91.33 ± 9.94 minutes; $p < 0.001$), whereas blood loss and hospital stay were comparable. Both groups demonstrated substantial improvement in VAS and ODI scores during follow-up. Pain-free walking distance improved significantly in both groups, with greater improvement observed in the decompression-alone group at 3 months ($p = 0.020$). At 6 months, excellent Modified MacNab outcomes were observed in 66.7% of patients in the fixation group compared with 26.7% in the decompression-alone group. Both surgical techniques provided effective treatment for large lumbar disc herniations, resulting in significant improvement in pain and functional status. Larger multicentric studies with longer follow-up are required to establish the long-term benefits of supplemental fixation.

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INTRODUCTION:

Lumbar disc herniation is one of the leading causes of low back pain and radiculopathy worldwide and contributes substantially to disability and reduced quality of life. The condition develops when disc material protrudes beyond the intervertebral disc space and compresses adjacent neural structures, resulting in pain, sensory disturbances, and motor deficits [1,2]. Large lumbar disc herniations represent a more severe subset of disease. These lesions, frequently defined as occupying at least 50% of the spinal canal, may produce marked neural

compression, severe radicular symptoms, bilateral neurological involvement, and significant functional limitation [3,4]. Magnetic resonance imaging (MRI) remains the primary modality for diagnosis and surgical planning, and objective classification systems have been developed to standardize assessment of lumbar disc pathology [6]. Although conservative management remains the initial treatment for many patients, surgery is often indicated when symptoms persist, neurological deficits progress, or quality of life becomes significantly impaired. Open decompression through laminotomy, laminectomy, and discectomy effectively relieves neural compression and remains a widely accepted treatment option [5]. However, extensive decompression may compromise posterior spinal elements and potentially contribute to postoperative instability, recurrent symptoms, and chronic mechanical low back pain. To address these concerns, transpedicular fixation has been increasingly employed as an adjunct to decompression surgery. Pedicle screw instrumentation may provide additional segmental stability and reduce abnormal motion at the operated level [7,8]. Despite increasing use of fixation, the evidence regarding its routine application in large lumbar disc herniation remains inconclusive. Previous studies have reported varying results regarding pain relief, functional recovery, and overall clinical outcomes following decompression alone versus decompression combined with stabilization procedures [7–10]. Therefore, the present prospective comparative study was undertaken to evaluate and compare the clinical and functional outcomes of decompression with transpedicular fixation and decompression alone in patients with large lumbar disc herniations.

MATERIALS AND METHODS:

Study design and setting

This prospective comparative open-label study was conducted in the Department of Orthopaedics at a tertiary care teaching hospital in Gujarat, India, between September 2022 to February 2024. Prior to initiation of the study, approval was obtained from the Institutional Ethics Committee, and the study was carried out in accordance with the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants before enrollment.

Study Population

A total of 30 patients diagnosed with symptomatic single-level large lumbar disc herniation were included in the study. Eligible patients were aged 18 years or older, had magnetic resonance imaging (MRI)-confirmed lumbar disc herniation occupying at least 50% of the spinal canal, and continued to experience symptoms despite receiving

conservative treatment for a minimum period of one month. Patients with a history of previous lumbar spine surgery, multilevel lumbar disc disease, spondylolisthesis, spinal deformity, active spinal infection, spinal tumors, or traumatic spinal pathology were excluded from the study. The enrolled patients were divided into two groups of 15 patients each.

Surgical Procedure

Patients in Group A underwent open decompression combined with transpedicular screw fixation. Following adequate decompression of the affected neural structures, pedicle screws were inserted under fluoroscopic guidance and connected with rods to provide segmental stabilization. Patients in Group B underwent standard open decompression consisting of laminotomy or laminectomy with discectomy without spinal instrumentation.

Outcome Measures

Clinical and functional outcomes were evaluated using the Visual Analogue Scale (VAS) for pain assessment, Oswestry Disability Index (ODI) for functional disability, Modified MacNab Criteria for overall surgical outcome, and pain-free walking distance. Assessments were performed preoperatively and during postoperative follow-up at 1 month, 3 months, and 6 months. Perioperative variables including operative time, intraoperative blood loss, and duration of hospital stay were also recorded and compared between the two groups.

Statistical Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 25.0. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Independent sample t-tests were used to compare continuous variables between groups, whereas Chi-square test or Fisher's exact test was applied for categorical data as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS:

A total of 30 patients with symptomatic single-level large lumbar disc herniation were included in the study, with 15 patients allocated to each treatment group. Group A underwent decompression with transpedicular fixation, whereas Group B underwent decompression alone.

Baseline Characteristics

Table 1. Baseline Demographic and Clinical Characteristics of the Study Participants

Variable	Group A	Group B	p-value
Age (years)	50.73 $\pm$ 12.13	48.53 $\pm$ 14.08	0.65
Duration of symptoms (months)	8.20 $\pm$ 3.05	7.93 $\pm$ 1.75	0.77

The baseline demographic and clinical characteristics of the study participants are presented in Table 1. The mean age of patients in Group A was 50.73 ± 12.13 years, compared with 48.53 ± 14.08 years in Group B. Similarly, the mean duration of symptoms was 8.20 ± 3.05 months in Group A and 7.93 ± 1.75 months in Group B. No statistically significant differences were observed between the groups with respect to age ($p=0.65$) or duration of symptoms ($p=0.77$), indicating that both groups were comparable at baseline.

Perioperative Outcomes

Table 2. Comparison of Perioperative Outcomes Between Decompression with Transpedicular Fixation and Decompression Alone

Variable	Group A	Group B	p-value
Blood loss (mL)	533.33 ± 154.30	493.33 ± 161.32	0.49
Operative time (min)	116.00 ± 12.42	91.33 ± 9.94	<0.001
Hospital stay (days)	10.13 ± 2.83	9.60 ± 2.29	0.57

Perioperative outcomes are summarized in Table 2. The mean operative time was significantly longer in Group A (116.00 ± 12.42 minutes) compared with Group B (91.33 ± 9.94 minutes) ($p<0.001$). However, the mean intraoperative blood loss was comparable between Group A (533.33 ± 154.30 mL) and Group B (493.33 ± 161.32 mL) ($p=0.49$). Similarly, the mean duration of hospital stay did not differ significantly between Group A (10.13 ± 2.83 days) and Group B (9.60 ± 2.29 days) ($p=0.57$).

Pain Assessment (VAS Scores)

Table 3. Comparison of Visual Analogue Scale (VAS) Scores During Follow-up

Follow-up	Group A	Group B
Pre-op	7.80 ± 1.42	7.73 ± 1.10
1 Month	5.87 ± 0.92	5.93 ± 0.88
3 Months	3.67 ± 0.82	3.73 ± 0.59
6 Months	1.33 ± 0.62	1.47 ± 0.52

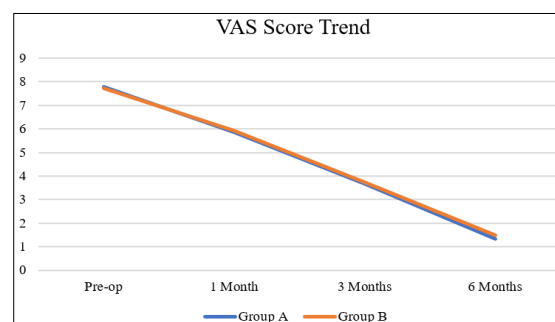


Figure 1. Trend of Mean Visual Analogue Scale (VAS) Scores During Follow-up

The changes in VAS scores during follow-up are shown in Table 3 and Figure 1. Both groups demonstrated a progressive reduction in pain intensity following surgery. In Group A, the mean

VAS score decreased from 7.80 ± 1.42 preoperatively to 1.33 ± 0.62 at 6 months. Similarly, in Group B, the mean VAS score decreased from 7.73 ± 1.10 preoperatively to 1.47 ± 0.52 at 6 months. The graphical representation illustrates a consistent decline in pain scores throughout the follow-up period in both groups, indicating substantial postoperative pain relief.

Functional Disability (ODI Scores)

Table 4. Comparison of Oswestry Disability Index (ODI) Scores During Follow-up

Follow-up	Group A	Group B
Pre-op	31.00 ± 9.34	26.47 ± 8.60
1 Month	14.40 ± 9.16	11.20 ± 2.91
3 Months	8.40 ± 5.10	7.93 ± 2.31
6 Months	3.73 ± 2.46	4.53 ± 1.81

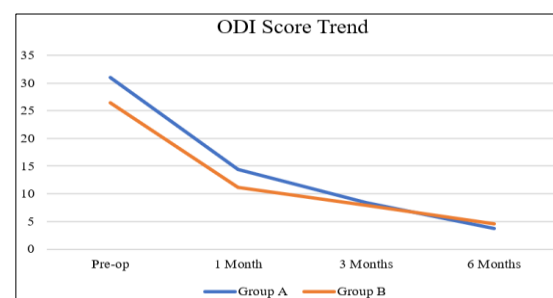


Figure 2. Trend of Mean Oswestry Disability Index (ODI) Scores During Follow-up

Table 4 and Figure 2 present the ODI scores during follow-up. Both treatment groups showed marked improvement in functional disability following surgery. In Group A, the mean ODI score decreased from 31.00 ± 9.34 preoperatively to 3.73 ± 2.46 at 6 months. In Group B, the corresponding reduction was from 26.47 ± 8.60 to 4.53 ± 1.81 . The trend observed in Figure 2 demonstrates a steady reduction in disability over time in both groups.

Pain-Free Walking Distance

Table 5. Comparison of Pain-Free Walking Distance During Follow-up

Follow-up	Group A	Group B	p-value
Pre-op	486.67	620.00	0.085
1 Month	613.33	753.33	0.142
3 Months	706.67	980.00	0.020
6 Months	1013.33	1286.67	0.102

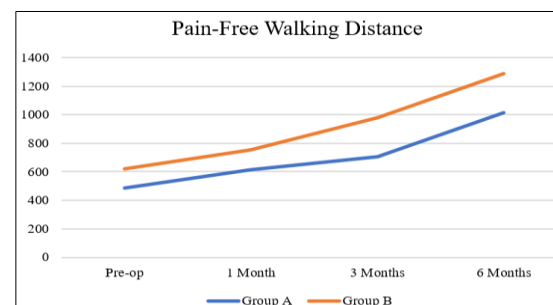


Figure 3. Comparison of Mean Pain-Free Walking Distance During Follow-up

Pain-free walking distance outcomes are summarized in Table 5 and illustrated in Figure 3. Both groups exhibited progressive improvement during follow-up. In Group A, the mean walking distance increased from 486.67 preoperatively to 1013.33 at 6 months. In Group B, the corresponding increase was from 620.00 to 1286.67. A statistically significant difference was observed at the 3-month follow-up, with Group B demonstrating a greater walking distance than Group A (980.00 vs. 706.67; $p=0.020$). However, this difference was no longer significant at the 6-month follow-up ($p=0.102$).

Modified MacNab Clinical Outcomes

Table 6. Modified MacNab Clinical Outcomes at 6-Month Follow-up

Outcome	Group A	Group B
Excellent	10 (66.7%)	4 (26.7%)
Good	5 (33.3%)	11 (73.3%)

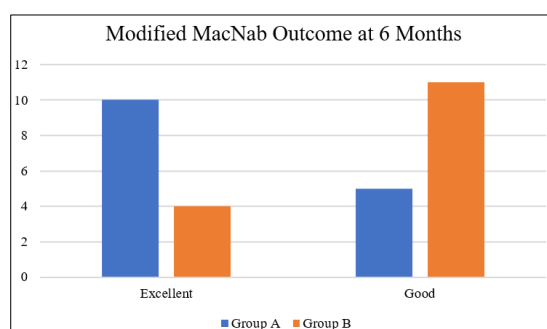


Figure 4. Distribution of Modified MacNab Clinical Outcomes at 6 Months

Modified MacNab outcomes at 6 months are presented in Table 6 and Figure 4. Excellent outcomes were achieved in 10 patients (66.7%) in Group A compared with 4 patients (26.7%) in Group B. Good outcomes were observed in 5 patients (33.3%) in Group A and 11 patients (73.3%) in Group B. Although a higher proportion of excellent outcomes was observed among patients who underwent decompression with transpedicular fixation, both treatment groups demonstrated favorable overall clinical outcomes at the final follow-up assessment.

DISCUSSION:

The management of large lumbar disc herniations remains a subject of ongoing debate, particularly regarding the need for supplemental stabilization following decompression. The present prospective comparative study evaluated the clinical and functional outcomes of decompression with transpedicular fixation and decompression alone in patients with symptomatic single-level large lumbar disc herniations. The findings demonstrated that both surgical approaches resulted in substantial improvements in pain, disability, and functional recovery during the six-month follow-up period.

One of the important findings of the present study was the significantly longer operative time observed in patients who underwent decompression with transpedicular fixation. The mean operative duration in Group A was 116.00 ± 12.42 minutes compared with 91.33 ± 9.94 minutes in Group B ($p<0.001$). This finding is expected because the fixation procedure requires additional surgical exposure, pedicle screw insertion, rod placement, and fluoroscopic guidance. Despite the longer operative duration, no significant differences were observed in intraoperative blood loss or duration of hospital stay between the two groups, indicating that the addition of fixation did not substantially increase perioperative morbidity.

Pain relief following surgery was excellent in both groups. Visual Analogue Scale (VAS) scores demonstrated a progressive decline throughout the follow-up period, with mean scores decreasing from 7.80 to 1.33 in Group A and from 7.73 to 1.47 in Group B. These findings indicate that adequate neural decompression is highly effective in relieving radicular pain irrespective of whether supplemental fixation is performed. Similar improvements in postoperative pain have been reported by Soliman and Elfadle, who observed satisfactory pain relief following both decompression alone and decompression with fixation in patients with lumbar disc pathology [7].

Functional disability, as assessed using the Oswestry Disability Index (ODI), also improved substantially in both groups. The marked reduction in ODI scores observed at six months suggests significant restoration of daily activities and quality of life following surgical intervention. The trend observed in the present study is consistent with previous reports demonstrating favorable functional outcomes following decompression procedures for lumbar disc herniation [8,9].

Pain-free walking distance improved progressively in both groups during follow-up. Interestingly, patients who underwent decompression alone demonstrated significantly greater walking distance at the three-month follow-up assessment. This observation may be attributed to earlier postoperative mobilization and reduced soft-tissue dissection associated with the absence of instrumentation. However, the difference between groups was no longer statistically significant at six months, indicating that long-term functional recovery was comparable between the two treatment strategies.

The Modified MacNab evaluation revealed a higher proportion of excellent outcomes in the fixation group, with 66.7% of patients achieving excellent

results compared with 26.7% in the decompression-alone group. Although this finding suggests a potential advantage of supplemental stabilization in selected patients, caution is warranted when interpreting this result because of the relatively small sample size. Nevertheless, the observation is in agreement with previous studies that have reported improved subjective outcomes following decompression combined with stabilization procedures in carefully selected patients [7,10].

The findings of the present study are broadly consistent with the available literature comparing decompression alone with decompression combined with fusion or stabilization procedures. Soliman and Elfadle reported favorable outcomes with both approaches and emphasized the importance of patient selection when considering additional fixation [7]. Similarly, Sun et al. demonstrated satisfactory short-term outcomes following decompression with or without instrumented fusion in patients with lumbar disc disease [8]. Lin et al. also reported comparable clinical improvement following decompression alone and fusion surgery for upper lumbar disc herniation [9]. Collectively, these studies suggest that while fixation may provide additional segmental stability, decompression remains the primary determinant of symptom relief and functional recovery.

From a clinical perspective, the results of the present study suggest that both decompression alone and decompression with transpedicular fixation are effective treatment options for large lumbar disc herniations. The choice of procedure should therefore be individualized based on factors such as spinal stability, extent of decompression, surgeon preference, and patient-specific characteristics. Routine fixation may not be necessary in all cases; however, it may offer potential benefits in selected patients where postoperative instability is a concern.

Limitations of the Study:

The present study has certain limitations. The sample size was relatively small, which may have limited the statistical power to detect differences between treatment groups. In addition, the follow-up period was restricted to six months and may not fully reflect long-term clinical outcomes or postoperative spinal stability. As the study was conducted at a single center, the findings may not be generalizable to all patient populations. Future multicentric studies with larger sample sizes and longer follow-up periods are required to validate the present findings and establish the long-term role of transpedicular fixation in large lumbar disc herniations.

CONCLUSION

Both decompression alone and decompression combined with transpedicular fixation provided effective treatment for large lumbar disc herniations, resulting in significant improvements in pain and functional status. Although fixation increased operative time, it did not significantly affect blood loss or hospital stay. Larger multicentric studies with longer follow-up are required to establish the long-term benefits of supplemental fixation.

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