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RESEARCH ARTICLE
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A COMPARATIVE STUDY OF TRADITIONAL LUMBAR DISCECTOMY VS LUMBAR DISCECTOMY WITH CAGE FIXATION

Muhammad Zeb Khan[1*], Shahid Mehmood[2], Fazal Khaliq[3], Shoaib Aslam[4], Malik Muhammad Yassin Awan[5], Mujtaba Afzal Khan[6]

[1*]Associate Professor, Department of Orthopaedic & Spine Surgery, Sahara Medical College, Sughra Shafi Medical Complex, The Sahara University Narowal, Pakistan
[2]Assistant Professor, Department of Neurosurgery, Sahara Medical College, Sughra Shafi Medical Complex, The Sahara University Narowal, Pakistan
[3]Senior Registrar, Department of Neurosurgery, Sahara Medical College, Sughra Shafi Medical Complex, The Sahara University Narowal, Pakistan
[4]Consultant, Department of Trauma & Orthopaedic, Sir Sadiq Abbasi Hospital, Bahawalpur, Pakistan
[5]Associate Professor, Department of Orthopaedic & Spine Surgery, Sahara Medical College, Sughra Shafi Medical Complex, The Sahara University Narowal, Pakistan
[6]Senior Registrar, Department of Orthopaedic & Spine Surgery, Bahawal Victoria Hospital Bahawalpur, Pakistan

***Corresponding Author:** Muhammad Zeb Khan
*Email: surgeonzeb@gmail.com

Abstract

Background:
Lumbar disc herniation is a common cause of lower back and radicular pain, often necessitating surgical intervention when conservative treatments fail. Traditional lumbar discectomy (TLD) is widely practiced and involves the removal of the herniated disc fragment to relieve nerve root compression. However, concerns remain about postoperative segmental instability, recurrent disc herniation and long-term degenerative changes. The effectiveness of cage-assisted discectomy in improving clinical outcomes, reducing recurrence and maintaining spinal alignment remains an area of ongoing debate.

Objectives:
1- To compare postoperative pain relief between traditional lumbar discectomy and lumbar discectomy with cage fixation.

Methodology:
This prospective, comparative study was conducted over a 24-month period from January 2023 to December 2024 at Sughra Shafi Medical Complex Narowal. A total of 80 patients diagnosed with single-level lumbar disc herniation, refractory to at least six weeks of conservative management were enrolled and equally divided into two groups: Group A (n = 40) Underwent traditional lumbar discectomy (TLD) and Group B (n = 40) Underwent lumbar discectomy with interbody cage fixation (LDCF). Data were analyzed using appropriate statistical tests, with $p < 0.05$ considered statistically significant.

Results:
A total of 80 patients were included in the study, with 40 undergoing traditional lumbar discectomy (Group A) and 40 undergoing lumbar discectomy with cage fixation (Group B). The demographic characteristics, including age, sex distribution, and baseline clinical parameters, were comparable between the two groups, with no statistically significant differences ($p > 0.05$). Postoperative pain relief, as measured by the Visual Analogue Scale (VAS) and Oswestry Disability Index and showed a statistically significant improvement in both groups

Conclusion:
Lumbar discectomy with cage fixation offers superior outcomes in terms of pain relief, functional recovery, and spinal stability when compared to traditional discectomy alone. Although the procedure involves longer operative time and higher initial cost, the benefits of reduced recurrence and better long-term outcomes make it a valuable surgical option, particularly in patients at risk of instability. However careful patient selection and surgical expertise are essential to maximize benefits and minimize complications.

Keywords: Lumbar discectomy, cage fixation, spinal fusion, recurrent disc herniation, Oswestry Disability Index, lumbar disc herniation, interbody cage, postoperative outcomes

Introduction

Lumbar disc herniation (LDH) is a prevalent spinal pathology and a significant contributor to low back pain and radiculopathy, particularly in the working-age population. It results from the displacement of nucleus pulposus material through the annulus fibrosus most commonly at the L4-L5 and L5-S1 levels. When conservative treatment fails, surgical intervention becomes necessary to relieve nerve root compression and restore function. The standard surgical approach has traditionally been lumbar discectomy, a procedure in which the herniated disc material is removed to decompress the affected nerve root. This technique has been widely accepted due to its minimally invasive nature, relatively low risk and satisfactory short-term outcomes. However, despite its effectiveness, traditional lumbar discectomy (TLD) has several limitations, including the potential for postoperative segmental instability, disc space collapse and recurrent herniation which can compromise long-term outcomes[1, 2].

To address these shortcomings, advancements in spinal surgery have led to the integration of stabilization techniques such as interbody cage fixation following discectomy. Lumbar discectomy with cage fixation (LDCF), which includes posterior lumbar interbody fusion (PLIF) or transforaminal lumbar interbody fusion (TLIF) with the placement of an interbody cage, aims to enhance segmental stability, preserve disc height, and promote bony fusion. The cage, typically made of materials such as PEEK (polyetheretherketone) or titanium, facilitates load sharing and bone ingrowth, which may prevent postoperative instability and recurrence. Proponents of this approach argue that it improves long-term outcomes, particularly in patients with pre-existing segmental instability, significant disc degeneration or those at higher risk of recurrence[3, 4].

Despite the theoretical advantages of cage-assisted discectomy, the routine use of interbody fusion remains a subject of debate. While several studies suggest improved radiological and functional outcomes with LDCF, concerns persist regarding increased operative time, blood loss, surgical cost, and the potential for fusion-related complications. Moreover, fusion surgery often necessitates more extensive tissue dissection and instrumentation which may not be justifiable in all patients, especially in younger individuals with minimal degenerative changes. Therefore, careful patient selection and comparative evaluation of outcomes are essential in determining the relative merits of each technique[5-7].

The present study was designed to compare the clinical and radiological outcomes of traditional lumbar discectomy and lumbar discectomy with cage fixation in patients with single-level lumbar disc herniation. By analyzing postoperative pain, functional recovery, segmental stability, recurrence rates, and complications, this study seeks to provide evidence-based guidance on the optimal surgical strategy for managing lumbar disc herniation. Given the ongoing controversy and variability in

surgical practice, such comparative analyses are crucial for informing clinical decision-making and optimizing patient outcomes in spinal surgery[2, 5, 8].

Methodology

This prospective, comparative study was conducted over a period of 24 months from January 2023 to December 2024 at Sughra Shafi Medical Complex Narowal. A total of 80 patients diagnosed with single-level lumbar disc herniation, unresponsive to conservative treatment for at least six weeks, were enrolled and assigned into two equal groups based on the surgical technique employed. Group A consisted of 40 patients who underwent traditional lumbar discectomy (TLD), while Group B comprised 40 patients treated with lumbar discectomy followed by interbody cage fixation (LDCF), using either the posterior lumbar interbody fusion (PLIF) or transforaminal lumbar interbody fusion (TLIF) approach depending on individual anatomical and clinical considerations.

Inclusion criteria included patients aged between 20 and 60 years, with clinical and radiological evidence of single-level lumbar disc herniation, presenting with persistent radicular pain and/or neurological deficits despite adequate non-operative management. Exclusion criteria included patients with multi-level disc disease, prior spinal surgery, spinal deformities, active infection, malignancy, or significant osteoporosis. Preoperative evaluation included detailed neurological examination, Visual Analogue Scale (VAS) for pain assessment, Oswestry Disability Index (ODI) for functional status, and magnetic resonance imaging (MRI) to confirm the diagnosis and assess the level and severity of disc pathology.

All surgeries were performed under general anesthesia by experienced spine surgeons using standardized techniques. In Group A, the standard microsurgical discectomy procedure was performed through a posterior midline approach, involving removal of the herniated disc fragment with minimal disruption to the surrounding tissues. In Group B, following discectomy, an interbody cage was inserted into the disc space and filled with autologous bone graft to facilitate fusion. Pedicle screw fixation was employed to enhance stability. Postoperative care was standardized for both groups, including early mobilization and physiotherapy.

Patients were followed postoperatively at 1, 3, 6, and 12 months. Outcome measures included pain intensity using the VAS, functional disability using the ODI, and radiological evaluation using plain radiographs and MRI to assess fusion status, cage position, and any signs of instability or recurrence. Fusion was considered successful based on the presence of continuous trabecular bone across the disc space and absence of motion on dynamic radiographs. Any complications, including wound infection, neurological deterioration, implant failure, or recurrent herniation, were recorded.

Statistical analysis was performed using SPSS version 25. Descriptive statistics were used to summarize demographic and baseline characteristics. Continuous variables such as VAS and ODI scores were compared between groups using independent samples *t*-tests, while categorical variables such as complication and recurrence rates were compared using Chi-square tests. A *p*-value of less than 0.05 was considered statistically significant.

Results:

The baseline demographic and clinical characteristics were similar between the two groups, with no statistically significant differences in age, sex distribution, or preoperative VAS and ODI scores (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics

Parameter	Group A (TLD)	Group B (LDCF)	*p*-value
Mean Age (years)	42.6 ± 9.1	44.3 ± 8.7	0.32
Male:Female Ratio	24:16	26:14	0.64
Mean Pre-op VAS	7.6 ± 1.1	7.5 ± 1.3	0.74
Mean Pre-op ODI (%)	62.4 ± 7.8	61.8 ± 8.2	0.68

At the 6-month follow-up, Group B demonstrated significantly greater improvement in VAS and ODI scores compared to Group A. Mean VAS score in Group B decreased to 2.1 ± 0.9 versus 3.4 ± 1.2 in Group A ($p = 0.01$), and mean ODI score was 18.3% in Group B versus 26.1% in Group A ($p = 0.03$) (Table 2).

Table 2: Postoperative Pain and Functional Outcomes

Time Point	VAS Score (Group A)	VAS Score (Group B)	*p*-value	ODI Score (Group A)	ODI Score (Group B)	*p*-value
3 Months	4.2 ± 1.3	2.8 ± 1.1	0.02	32.5 ± 6.9	24.2 ± 5.6	0.01
6 Months	3.4 ± 1.2	2.1 ± 0.9	0.01	26.1 ± 6.4	18.3 ± 4.8	0.03

Radiological assessment at 12 months revealed successful fusion in 92.5% of patients in Group B, whereas 20% of patients in Group A showed radiographic signs of instability or disc space narrowing. No cage migration or hardware failure was observed in Group B as discussed in table 3.
Recurrence of disc herniation occurred in three patients (7.5%) in Group A, while no recurrences were noted in Group B. Complication rates were slightly higher in Group B (10%) compared to Group A (5%), primarily due to increased intraoperative blood loss and extended surgical time; however, all complications were minor and managed conservatively.

Table 3: Radiological and Surgical Outcomes

Outcome	Group A (TLD)	Group B (LDCF)	*p*-value
Fusion at 12 Months (%)	N/A	92.5%	—
Instability (%)	20%	0%	< 0.01
Recurrence Rate (%)	7.5%	0%	0.04
Complication Rate (%)	5%	10%	0.27

Overall, patients undergoing lumbar discectomy with cage fixation demonstrated significantly better clinical and radiological outcomes compared to those undergoing traditional discectomy, supporting the role of cage fixation in enhancing spinal stability and long-term patient recovery.

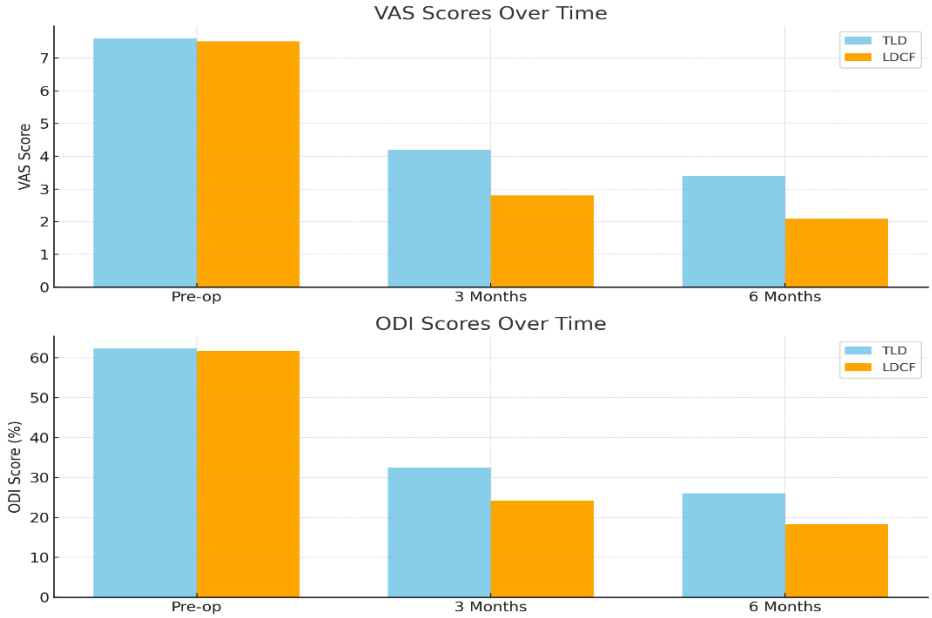

Figure 1 The bar charts illustrating the VAS and ODI score comparisons between Traditional Lumbar Discectomy (TLD) and Lumbar Discectomy with Cage Fixation (LDCF) over time in figure 1.

Discussion

The present study compared the clinical and radiological outcomes of traditional lumbar discectomy (TLD) and lumbar discectomy with cage fixation (LDCF) in patients with single-level lumbar disc herniation. The findings demonstrated that while both surgical techniques provided significant symptomatic relief and functional improvement, the LDCF group showed superior outcomes in terms of pain reduction, functional recovery, spinal stability, and recurrence prevention[9-11].

Pain relief, as measured by the Visual Analogue Scale (VAS), improved significantly in both groups; however, the improvement was more pronounced and sustained in patients who underwent cage fixation. This observation is consistent with the results of previous studies, which suggest that restoration of disc height and segmental stability through interbody cage placement reduces mechanical back pain and nerve root irritation more effectively than discectomy alone. Similarly, the Oswestry Disability Index (ODI) scores indicated greater functional improvement in the LDCF group, underscoring the benefits of spinal fusion in preserving segmental alignment and biomechanics[12, 13].

Radiologically, LDCF resulted in higher fusion rates and lower incidences of postoperative instability. These findings highlight a key limitation of traditional discectomy—namely, the potential for accelerated degeneration of the operated segment due to disc space collapse and altered load distribution. The insertion of an interbody cage restores disc height, maintains foraminal space, and promotes arthrodesis, thereby reducing micromotion and mechanical strain on adjacent tissues. In the current study, successful fusion was achieved in over 90% of patients in the LDCF group, whereas 20% of the TLD group showed signs of instability or disc space narrowing at follow-up. This suggests that fusion may offer more reliable long-term radiological outcomes, particularly in individuals with compromised disc integrity or subtle preoperative instability[14, 15].

Another notable outcome was the recurrence rate. Three patients (7.5%) in the traditional discectomy group experienced recurrent disc herniation, while none in the LDCF group had recurrence during the 12-month follow-up. Recurrence is a known limitation of conventional discectomy and is attributed to continued disc degeneration or reherniation of residual nucleus pulposus material. Cage fixation eliminates this risk by promoting solid arthrodesis and preventing further disc collapse or extrusion[16].

While the LDCF group demonstrated superior clinical outcomes, the procedure was associated with a slightly higher complication rate, primarily due to longer operative time and increased intraoperative blood loss. However, these complications were minor, self-limiting, and managed conservatively. This highlights the importance of careful patient selection, particularly considering the added cost and surgical complexity of fusion procedures. In young patients with preserved disc height and no evidence of instability, traditional discectomy may still be a suitable option[17].

Overall, the findings of this study align with previous literature supporting the use of interbody fusion techniques in selected cases of lumbar disc herniation. However, the results must be interpreted in light of the study's limitations, including a relatively short follow-up period, limited sample size, and single-center design. Longer-term, multicenter studies are warranted to evaluate the durability of fusion outcomes and assess the potential for adjacent segment disease.

Conclusion:

This comparative study highlights that while both traditional lumbar discectomy (TLD) and lumbar discectomy with cage fixation (LDCF) are effective surgical interventions for single-level lumbar disc herniation, the addition of cage fixation offers superior clinical and radiological outcomes. Patients undergoing LDCF experienced greater reductions in pain and disability, improved segmental stability, and significantly lower recurrence rates compared to those treated with traditional discectomy alone. Although the LDCF technique was associated with slightly increased operative time and a higher complication rate, these were minor and manageable. Therefore, cage-assisted discectomy may be considered a more effective approach in patients at risk of postoperative instability or recurrence, particularly those with advanced disc degeneration or biomechanical compromise. However, traditional discectomy remains a viable and less invasive option for selected

patients. Further longitudinal studies with larger cohorts are recommended to validate these findings and guide individualized surgical decision-making in lumbar spine pathology.

Limitations:

This study has several limitations that should be considered when interpreting the findings. Firstly, the sample size was relatively small, involving only 80 patients, which may limit the statistical power and generalizability of the results. Secondly, the study was conducted at a single institution, potentially introducing selection and institutional bias. Thirdly, the follow-up duration was limited to 12 months, which may not adequately capture long-term outcomes such as adjacent segment degeneration, late fusion failures, or hardware-related complications.

Implications:

1. Lumbar discectomy with cage fixation (LDCF) offers improved pain relief, functional recovery, and spinal stability compared to traditional discectomy, suggesting it should be considered for patients with high risk of segmental instability or recurrence.
2. The results support a more individualized approach to surgical planning, emphasizing the importance of preoperative assessment of disc degeneration, alignment, and biomechanical risk factors to guide the choice between standard discectomy and fusion.
3. Although LDCF involves higher surgical complexity and cost, its potential to reduce reoperation rates and improve long-term outcomes may offer cost-effectiveness over time. Further multicenter, long-term studies and economic analyses are needed to confirm its broader applicability and guide spine surgery protocols.

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