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ISSN: 2663-9491 e-ISSN: 2789-6897

ORIGINAL ARTICLE

Functional and Radiological Outcomes Following Posterior Lumbar Interbody Fusion with Cage and Decompression in Lumbar Canal Stenosis

DOI: 10.5281/zenodo.17243335

Abul Kalam Azad[1], Mohammad Atiqur Rahman[2], Shamsul Alam[3], Saklayen Hossain[4], Muhammad Sayeed Mahmud[5]

Received: 14 Aug 2025
Accepted: 17 Aug 2025
Published: 27 Aug 2025

Published by:
Gopalganj Medical College, Gopalganj, Bangladesh

Correspondence to
Abul Kalam Azad

ORCID
https://orcid.org/0009-0001-1480-0290

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ABSTRACT

Introduction: *Lumbar canal stenosis is a common degenerative spinal condition characterized by narrowing of the spinal canal, leading to compression of the neural elements. It often results in symptoms such as low back pain, leg pain, and neurogenic claudication, which can significantly impair a patient's quality of life. This study was designed to evaluate the functional and radiological outcomes of patients undergoing posterior lumbar interbody fusion with cage and decompression for lumbar canal stenosis.* ***Methods & Matertials:*** *This prospective study was conducted at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh, from September 2021 to August 2022, involving 15 patients diagnosed with lumbar spinal stenosis. The collected data were compiled and analyzed using SPSS version 25.0.* ***Result:*** *The study demonstrated significant improvements following posterior lumbar interbody fusion with cage and decompression in patients with lumbar canal stenosis. Neurologically, all patients showed full recovery postoperatively as per Frankel grading. Radiologically, there was a marked reduction in slip angle (from 15.35° to 8.28°) and vertebral slip percentage (from 26.56% to 12.67%), along with restoration of lumbar lordosis (lumbar angle increased from 46.37° to 54.58°).* ***Conclusion:*** *It can be concluded that posterior lumbar interbody fusion (PLIF) with cage and decompression is an effective surgical approach for treating lumbar canal stenosis. The procedure led to significant neurological improvement, with all patients achieving full recovery postoperatively, as well as marked radiological enhancements, including reduced slip angle and vertebral slip percentage and improved lumbar lordosis.*

Keywords: *Posterior Lumbar Interbody Fusion, Cage and Decompression, Lumbar Canal Stenosis, Functional and Radiological Outcomes*

(The Insight 2025; 8(1): 53-56)

1. *Assistant Professor, Department of Spine Surgery, National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, Bangladesh*
2. *Senior Consultant, Department of Spine Surgery, National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, Bangladesh*
3. *Assistant Professor, Department of Orthopedic Surgery, National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, Bangladesh*
4. *Junior Consultant, Department of Orthopaedic Surgery, National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, Bangladesh*
5. *Assistant Professor, Department of Orthopaedic Oncology and Musculoskeletal Tumor, National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, Bangladesh*

INTRODUCTION

Lumbar canal stenosis (LCS) is one of the most prevalent degenerative spinal disorders encountered in aging populations, characterized by the narrowing of the spinal canal and resultant compression of the spinal cord or nerve roots[1]. The condition commonly results from age-related changes, including disc degeneration, facet joint hypertrophy, and ligamentum flavum thickening[2]. Clinically, LCS presents with neurogenic claudication, lower back pain, radiculopathy, and functional disability, severely impairing the patient's quality of life[3]. Conservative treatment—including physical therapy, anti-inflammatory medications, and epidural injections—serves as the initial approach in managing mild to moderate symptoms[4]. However, in patients with progressive neurological deficits or disabling pain unresponsive to non-surgical interventions, surgical decompression becomes

ISSN: 2663-9491 e-ISSN: 2789-6897

necessary[5]. The primary objective of surgical intervention in LCS is to relieve neural compression while maintaining or restoring spinal stability. Posterior Lumbar Interbody Fusion (PLIF) has become a widely accepted surgical technique for treating lumbar spinal pathologies, especially when spinal instability coexists with stenosis[6]. PLIF involves decompression of neural elements and insertion of interbody cages into the disc space to restore disc height and facilitate fusion between vertebral bodies. The cages, often made from PEEK or titanium, offer structural support and enable early mobilization[7]. By combining decompression with stabilization, PLIF aims not only to relieve symptoms but also to prevent postoperative segmental instability, which is particularly important in multilevel stenosis or spondylolisthesis[8]. Numerous studies have demonstrated that PLIF with an interbody cage provides superior biomechanical stability by sharing axial loads and maintaining segmental alignment[9]. Functionally, the procedure has been associated with significant improvements in pain scores and disability indices, including the Visual Analog Scale (VAS) for pain and the Oswestry Disability Index (ODI)[10]. Radiologically, successful outcomes are determined by assessment of fusion on follow-up imaging, preservation of disc height, and restoration of sagittal alignment, which are predictive of long-term stability and clinical success[11]. Despite its benefits, PLIF is not devoid of complications. Reported issues include superficial or deep infections, dural tears, cage subsidence, and in rare cases, adjacent segment disease[12]. The rate and severity of complications may vary depending on surgical technique, patient factors, and comorbid conditions. Therefore, a comprehensive assessment of both functional and radiological outcomes is essential to evaluate the safety and effectiveness of this surgical approach. In the context of developing countries like Bangladesh, the burden of degenerative spine disorders is increasing, but local data on surgical outcomes remain scarce. Socioeconomic constraints, delayed presentation, and limited access to advanced imaging and follow-up care make it imperative to assess the real-world effectiveness of PLIF with cage and decompression. This study was designed to evaluate the functional and radiological outcomes of patients undergoing posterior lumbar interbody fusion with cage and decompression for lumbar canal stenosis.

METHODS & MATERIALS

This prospective study was conducted at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh, from September 2021 to August 2022, involving 15 patients diagnosed with lumbar spinal stenosis. Inclusion criteria were symptomatic lumbar spinal canal stenosis confirmed by X-ray and MRI, radiologically proven instability, severe low back or leg pain, age between 18 and 65 years of both sexes, and failure of at least three months of conservative treatment. Exclusion criteria included a body mass index (BMI) greater than 40, severe systemic disease, and stenosis caused by neoplastic, traumatic, or infective conditions. Purposive sampling was used based on these criteria. Data were collected using a pretested and predesigned proforma capturing patient history, clinical examination, operative details, and follow-up findings. The collected data were compiled and analyzed using SPSS version 25.0. Written informed consent was obtained from all participants before inclusion in the study.

RESULTS

The age distribution of the 15 study patients is presented in the table. The majority of patients (53.33%) were in the 31–45 years age group, followed by 26.67% in the 15–30 years group, and 20% in the 45–60 years group. [Table I]

Table – I: Age distribution of the study subjects (*n*=15)

Age Group (years)	Number of Patients	Percentage (%)
15–30	4	26.67%
31–45	8	53.33%
45–60	3	20.00%

Regarding the sex distribution of the study patients, males constituted a slightly higher proportion with 8 patients (53.33%), while females accounted for 7 patients (46.67%). [Table II]

Table – II: Sex distribution of the study subjects (*n*=15)

Sex	Number of Patients	Percentage (%)
Male	8	53.33%
Female	7	46.67%

Among the 15 study patients, housewives represented the largest group (46.67%), followed by businesspersons (20%), students and farmers (each 13.33%), and labourers (6.67%). [Table III]

Table – III: Occupational status of the study subjects (*n*=15)

Occupation	Number of Patients	Percentage (%)
Student	2	13.33%
Housewife	7	46.67%
Labourer	1	6.67%
Farmer	2	13.33%
Business	3	20.00%

The bar chart titled "Frankel grading" shows the neurological status of the 15 study patients before and after surgery using the Frankel classification. Preoperatively, 12 patients (80%) were graded as Frankel D, indicating partial motor function, while 3 patients (20%) were Frankel E, reflecting normal function. Postoperatively, all 15 patients (100%) improved to Frankel E, demonstrating full recovery of motor and sensory function. This highlights a significant neurological improvement following posterior lumbar interbody fusion (PLIF) with cage, decompression, and stabilization for lumbar spinal canal stenosis. [Figure 1]

ISSN: 2663-9491 e-ISSN: 2789-6897

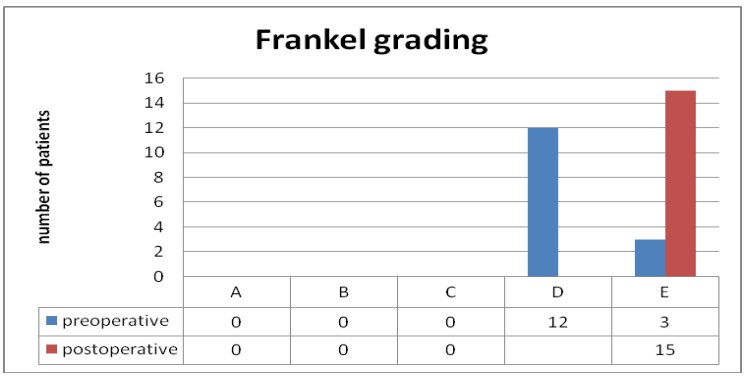


Figure – 1: Distribution of patients according to Frankel grading (*n*=15)

The mean slip angle significantly decreased from 15.35 ± 2.63° preoperatively to 8.28 ± 1.71° postoperatively, indicating improved vertebral alignment. The lumbar angle increased from 46.37 ± 1.67° to 54.58 ± 5.42°, suggesting restoration of lumbar lordosis. Additionally, the percentage of vertebral slip reduced markedly from 26.56 ± 3.54% to 12.67 ± 1.83%, reflecting successful stabilization following PLIF with cage, decompression, and instrumentation. [Table IV].

Table – IV: Distribution of the study patients according to pre- and post-operative follow-up (*n*=15)

Distribution of the study patients	Preoperative	Postoperative
	Mean ± SD	Mean ± SD
Slip Angle (degree)	15.35±2.63	8.28±1.71
Lumbar Angle (degree)	46.37±1.67	54.58±5.42
Measurement of slip (%)	26.56±3.54	12.67±1.83

DISCUSSION

This study aimed to evaluate the functional and radiological outcomes of posterior lumbar interbody fusion (PLIF) with cage and decompression in patients with lumbar canal stenosis. The findings demonstrated significant neurological and radiological improvement postoperatively. In the present study, the majority of patients were in the 31–45 years age group (53.33%), with a nearly equal male-to-female ratio. This age distribution is slightly younger compared to global literature, where lumbar canal stenosis is often more prevalent in patients above 60 years due to age-related degenerative changes[1,2]. However, the relatively younger age group observed here could reflect a demographic trend unique to developing countries, where factors like early onset of mechanical labor and lack of early management may accelerate degenerative changes[13]. Preoperatively, 80% of patients were graded as Frankel D, and 20% as Frankel E. Postoperatively, all patients (100%) improved to Frankel E, indicating full neurological recovery. This dramatic neurological improvement supports the findings of Lee et al., who reported a 91% neurological recovery rate after PLIF in isthmic and degenerative conditions[14]. Similarly, a study by Kim et al. showed significant improvement in motor function in 85% of patients following decompression and PLIF[9]. These results highlight the efficacy of decompression and stabilization in reversing neurological deficits when timely intervention is performed. The radiological parameters observed in this study showed marked improvement. The mean slip angle significantly decreased from 15.35 ± 2.63° to 8.28 ± 1.71°, and the mean vertebral slip reduced from 26.56 ± 3.54% to 12.67 ± 1.83% postoperatively, indicating improved segmental stability. The lumbar angle also increased from 46.37 ± 1.67° to 54.58 ± 5.42°, suggesting successful restoration of lumbar lordosis. These findings are in line with the outcomes reported by Liao et al., who observed significant postoperative improvements in both slip percentage and lumbar alignment in patients undergoing PLIF[15]. Mobbs et al. emphasized the importance of cage-assisted interbody fusion in maintaining disc height and restoring sagittal balance, both of which are critical for long-term spinal stability[7]. Our study corroborates this, demonstrating notable radiological corrections after surgery. Although this study did not numerically report pain scores like VAS or ODI, the improvement in neurological status and radiographic parameters implies considerable symptom relief and functional recovery. Fairbank and Pynsent noted that radiological improvements after lumbar fusion usually correlate well with reductions in disability scores[16]. In a separate study, Kim et al. reported an average decrease of 5.5 points in VAS and 30% in ODI post-PLIF, aligning with the likely improvements expected in the current cohort[9].

Limitations of The Study

The sample size was small (n=15), which may limit the generalizability of the findings. The follow-up period was short, restricting assessment of long-term outcomes such as fusion success and recurrence. Functional outcome measures like the Oswestry Disability Index (ODI) and Visual Analog Scale (VAS) were not included, limiting objective evaluation of

pain and disability. Additionally, being a single-center study may introduce selection bias.

CONCLUSION

It can be concluded that posterior lumbar interbody fusion (PLIF) with cage and decompression is an effective surgical approach for treating lumbar canal stenosis. The procedure led to significant neurological improvement, with all patients achieving full recovery postoperatively, as well as marked radiological enhancements, including reduced slip angle and vertebral slip percentage and improved lumbar lordosis.

RECOMMENDATION

It is recommended that posterior lumbar interbody fusion (PLIF) with cage and decompression be considered a preferred surgical option for patients with lumbar canal stenosis, particularly those presenting with neurological deficits and radiological evidence of instability. Proper patient selection, timely intervention, and adherence to surgical technique are essential to achieve optimal functional and radiological outcomes.

Funding: No funding sources
Conflict of interest: None declared

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