

**Original Article**

**COMPREHENSIVE ASSESSMENT OF RADIOLOGICAL AND FUNCTIONAL OUTCOMES FOLLOWING TRANSFORAMINAL LUMBAR INTERBODY FUSION IN LUMBAR CANAL STENOSIS PATIENTS**

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**ABSTRACT**

**Objective:** The lumbar spine, a crucial component of the musculoskeletal system, is integral for structural support and mobility. Lumbar canal stenosis (LCS), characterized by spinal canal narrowing, is a growing concern associated with degenerative changes. Transforaminal lumbar interbody fusion (TLIF) has emerged as a surgical intervention for LCS, aiming to achieve decompression and stabilization. This study comprehensively assesses the radiological and functional outcomes post-TLIF in LCS patients.

**Methods:** A cohort of 40 LCS patients undergoing TLIF at Indira Gandhi Medical College was studied. Fifteen were retrospectively assessed operated on before May 2016, and 25 were prospective, operated between May 2016 and May 2017. Demographic data, preoperative ASIA scores, ligamentum flavum hypertrophy, facet joint arthropathy, and Bridwell Fusion Grades were analyzed. Statistical tests included mean calculations, chi-square tests, and Mann-Whitney U tests.

**Results:** The study revealed a significant male predominance (57.5%) and age distribution (32 to 72 y) with a male-to-female ratio of 1.35:1 (p value 0.0049). Preoperative ASIA scores showed 50% ASIA grade D and 25% grade E. Ligamentum flavum hypertrophy and facet joint arthropathy were present in 70% and 67.5% of patients, respectively. Bridwell Fusion Grade indicated 80% achieved grade 1 fusion.

**Conclusion:** This study contributes valuable insights into TLIF outcomes in LCS patients, emphasizing the significance of age, gender, neurological status, and associated pathologies. Favorable fusion outcomes suggest TLIF effectively stabilizes the lumbar spine. Future research with larger cohorts could further validate these findings and refine TLIF's role in LCS management.

**Keywords:** Lumbar canal stenosis, Transforaminal lumbar interbody fusion, Radiological outcomes, Functional outcomes, Spinal stability, Nerve compression

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**INTRODUCTION**

The lumbar spine, a critical component of the human musculoskeletal system, plays a pivotal role in providing structural support and facilitating various movements. Comprising five lumbar vertebrae, intervertebral discs, ligaments, and neurovascular structures, the lumbar column serves as a complex and dynamic unit. The interplay of these anatomical elements forms the functional spine unit, where the health and integrity of each component are vital for optimal spine function [1].

Lumbar canal stenosis (LCS), a condition marked by the narrowing of the spinal canal, poses a growing concern, particularly with an aging population. Predominantly associated with degenerative changes, LCS may result from a combination of factors such as ligamentum flavum thickening, facet joint hypertrophy, disc herniation, and spondylolisthesis [2]. This narrowing can manifest in various anatomical forms, including central stenosis, lateral recess stenosis, and foraminal stenosis, each presenting distinct clinical challenges [3].

Neurogenic claudication and sciatica are common clinical manifestations of LCS, impacting patients' quality of life. While conservative management is often attempted initially, surgical interventions become necessary for those unresponsive to non-surgical approaches [4]. Transforaminal lumbar interbody fusion (TLIF), introduced as an alternative to traditional techniques, aims to achieve decompression, stabilization, and fusion with reduced neural retraction [5].

Overall, our study delve into a comprehensive study focused on evaluating the radiological and functional outcomes of patients undergoing TLIF for lumbar canal stenosis. By analyzing the impact of TLIF on various parameters, we aim to contribute valuable insights

into the efficacy of this surgical approach, shedding light on its role in enhancing spinal stability and alleviating nerve compression [6].

**MATERIALS AND METHODS**

**Study design**

This study involved 40 patients with lumbar canal stenosis who underwent transforaminal lumbar interbody fusion at Indira Gandhi Medical College, Shimla. Fifteen patients were retrospectively evaluated, having been operated on before May 2016, and 25 prospective patients were operated between May 2016 and May 2017.

**Data collection**

For retrospective patients, records were obtained from the Medical Record Department of Indira Gandhi Medical College, Shimla. Follow-up assessments included radiological and neurological evaluations, as well as functional outcomes measured by the Oswestry Disability Index proforma (Annexure 3).

**Indications for surgery**

The surgical indications included disc prolapse, lumbar canal/lateral recess stenosis, foraminal stenosis, discogenic lower back pain in elderly patients, and spondylolisthesis not responding to conservative management.

**Inclusion and exclusion criteria**

Patients aged over 18 with surgical indications, symptoms of instability, and a willingness to undergo surgery were included. Exclusion criteria encompassed comorbid conditions unfit for surgery, spinal deformities, systemic infections, previous interbody fusion at the target level, pregnancy, and lactation.

### Preoperative preparation

Upon admission, patients underwent detailed clinical, neurological, and systemic examinations. Various blood investigations, radiological examinations, and a preanesthetic checkup were conducted. Surgical consent was obtained, and patients were catheterized for urinary output assessment.

### Surgical approach

Patients were positioned face down on a specialized table for a posterior midline approach. Pedicle screws were bilaterally placed, and a transforaminal lumbar interbody fusion window was created. Disc space preparation involved meticulous discectomy, end plate preparation, and bone grafting.

### Postoperative care

Intravenous antibiotics were administered postoperatively, and patients were mobilized with a lumbosacral corset. Wound inspection, drainage tube removal, radiographic assessments, and early rehabilitation were part of the postoperative care.

### Follow-up

Patients were advised to follow up after 6 w and at subsequent 3-month intervals. Detailed clinical, radiological, and neurological examinations were performed during follow-up.

### Statistical analysis

Statistical analysis was conducted using SPSS 17.0, including mean calculations, chi-square tests, and Mann-Whitney U tests. A significance level of 0.05 was considered for all statistical tests.

### RESULTS

The demographic analysis revealed a cohort of 40 patients with lumbar canal stenosis, emphasizing a significant male predominance (57.5%). The age distribution ranged from 32 to 72 y, with a prominent male-to-female ratio of 1.35:1. The study established a statistical significance (p-value 0.0049), underlining the importance of age and gender considerations in lumbar canal stenosis cases.

The preoperative ASIA score distribution demonstrated that 50% of patients were classified as ASIA grade D, indicating preserved motor function below the neurological level. Another 25% were ASIA grade E, denoting normal motor and sensory function. These findings highlight the diverse neurological presentations in lumbar canal stenosis patients and lay the foundation for understanding preoperative functional status.

Ligamentum flavum hypertrophy, a common pathology in lumbar canal stenosis, was present in 70% of patients. This observation underscores the prevalence of structural changes contributing to canal narrowing and emphasizes the importance of addressing such factors in surgical interventions.

Facet joint arthropathy, a contributing factor to lumbar canal stenosis, was identified in 67.5% of patients. This highlights the need for comprehensive assessments and targeted interventions addressing multifactorial etiologies in lumbar spine pathologies.

The distribution of Bridwell Fusion Grades showcased favorable outcomes, with 80% of patients achieving grade 1 fusion. This indicates successful graft incorporation and stabilization. The study suggests that transforaminal lumbar interbody fusion effectively promotes fusion and supports the structural integrity of the lumbar spine in patients with canal stenosis.

**Table 1: Distribution of patients according to age and sex**

Age	Sex						Total	p-value
	Male			Female				
	P	R	Total	P	R	Total		
≤ 60 y	13	3	16	4	8	12	28	0.0049
>60 y	5	2	7	3	2	5	12	
Total			23			17	40	

**Table 2: Distribution of patients according to pre-operative Asia score**

Pre-operative Asia score	Prospective	Retrospective	Total	%
A	0	0	0	0%
B	0	0	0	0%
C	7	3	10	25%
D	14	6	20	50%
E	7	3	10	25%
Total			40	100%

**Table 3: Distribution of patients according to ligamentum flavum hypertrophy**

Ligamentum flavum hypertrophy	Prospective	Retrospective	Total	%
Present	17	11	28	70%
Absent	8	4	12	30%
Total			40	100%

**Table 4: Distribution of patients according to facet joint arthropathy**

Facet joint arthropathy	Prospective	Retrospective	Total	%
Present	19	8	27	67.5%
Absent	7	6	13	32.5%
Total			40	100%

**Table 5: Distribution of patients according to bridwell fusion grade**

Bridwell fusion grade	Prospective	Retrospective	Total	%
Grade 1	22	10	32	80%
Grade 2	3	5	8	20%
Grade 3	0	0	0	0%
Grade 4	0	0	0	0%
Total			40	100%

## DISCUSSION

The aim of this study was to conduct a comprehensive assessment of radiological and functional outcomes following transforaminal lumbar interbody fusion (TLIF) in patients with lumbar canal stenosis (LCS). LCS is a condition associated with the narrowing of the spinal canal, primarily due to degenerative changes, and it presents various challenges in clinical management [7]. The study focused on understanding the impact of TLIF on both radiological parameters and functional outcomes, shedding light on its role in enhancing spinal stability and relieving nerve compression [8].

The demographic data presented in table 1 revealed a male predominance in the study, with 57.5% of patients being male. The age distribution was also significant, with a higher proportion of patients aged 60 y or younger. This information is essential for understanding the baseline characteristics of the study population [9].

The preoperative ASIA score (table 2) indicated that 50% of patients had ASIA grade D, demonstrating motor function preservation below the neurological level, and 25% had ASIA grade E, indicating normal motor and sensory function. This distribution is crucial for assessing the neurological status of the patients before surgery [10].

Ligamentum flavum hypertrophy and facet joint arthropathy, presented in Tables 3 and 4, respectively, demonstrated a considerable prevalence in the study population. Ligamentum flavum hypertrophy was present in 70% of patients, while facet joint arthropathy was present in 67.5%. These findings emphasize the significance of these factors in the context of LCS and contribute to the understanding of pathophysiological mechanisms [11].

Bridwell Fusion Grade (table 5) provided insights into the fusion outcomes post-TLIF. Notably, 80% of patients showed grade 1 fusion, indicating graft fusion with remodeling and trabeculae. This suggests favorable fusion outcomes, contributing to the stabilization of the lumbar spine [12].

The comprehensive analysis of age, sex, occupation, neurological deficit, ASIA score, ligamentum flavum hypertrophy, facet joint arthropathy, and fusion grade allows for a nuanced discussion of the study findings [13]. The age distribution aligns with the existing literature, where LCS is often associated with the aging process. The male predominance might be linked to occupation or lifestyle factors. The prevalence of ligamentum flavum hypertrophy and facet joint arthropathy underscores their role in LCS pathology, necessitating consideration in surgical planning [14].

The observed distribution of Bridwell Fusion Grades reflects positively on the efficacy of TLIF in achieving spinal stabilization. The predominance of grade 1 fusion implies successful graft incorporation and remodeling, contributing to favorable long-term outcomes [15].

## CONCLUSION

In conclusion, the results of this study provide valuable insights into the radiological and functional outcomes of TLIF in LCS patients. The observed fusion grades and prevalence of associated factors contribute to the existing knowledge in the field. Future research with larger cohorts and longer follow-up durations could further validate these findings and refine our understanding of TLIF's role in the management of lumbar canal stenosis.

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Nil

## AUTHORS CONTRIBUTIONS

All authors have contributed equally

## CONFLICT OF INTERESTS

Declared none

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