

## Radiological and Functional Outcomes of Single vs. Multiple Level TLIF Using Local Corticocancellous Bone Grafts: A Retrospective-Prospective Study

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### Abstract:

**Background:** Transforaminal lumbar interbody fusion (TLIF) is a widely accepted surgical procedure for treating lumbar spinal instability and degenerative disorders. While interbody fusion can be achieved using autografts, the utilization of local corticocancellous bone grafts presents a promising alternative. However, the comparative effectiveness of single- versus multi-level TLIF using this graft type remains underexplored.

**Objective:** To assess and compare the radiological and functional outcomes of single- and multi-level TLIF using local corticocancellous laminectomy bone grafts.

**Methods:** A retro-prospective observational study was conducted on 100 patients who underwent TLIF over a 12-month period at a tertiary care center. Patients were categorized into single-level (n=60) and multiple-level (n=40) TLIF groups. Radiological outcomes were measured using anterior disc height (ADH), posterior disc height (PDH), segmental kyphosis (SK), and foraminal height (FH) at preoperative, immediate postoperative, 3-month, and 1-year intervals. Functional outcomes were assessed using Visual Analog Scale (VAS) and Oswestry Disability Index (ODI). Data were analyzed using descriptive statistics and inferential comparisons (p<0.05 considered significant).

**Results:** At 1 year, both groups showed significant improvements in ODI (Single-level:  $12.23 \pm 2.01$ ; Multi-level:  $14.98 \pm 2.34$ ; p=0.018) and VAS (Single-level:  $2.31 \pm 0.94$ ; Multi-level:  $2.92 \pm 0.98$ ; p=0.041). Radiological improvements were greater in the single-level group with higher gains in ADH ( $3.72 \pm 0.47$  vs.  $3.08 \pm 0.52$  mm; p=0.006) and PDH ( $3.26 \pm 0.38$  vs.  $2.93 \pm 0.46$  mm; p=0.012). SK and FH improvements were observed in both groups without significant differences (p>0.05).

**Conclusion:** Both single- and multiple-level TLIF using local corticocancellous grafts result in favorable clinical and radiological outcomes. However, single-level TLIF demonstrated superior improvements in disc height and disability scores, supporting its efficiency for isolated lumbar pathologies.

**Keywords:** Transforaminal Lumbar Interbody Fusion, Corticocancellous, Laminectomy, Bone Grafts.

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### Introduction

Lumbar degenerative pathologies, including canal stenosis and spondylolisthesis, are common causes of chronic low back pain and disability globally. Surgical intervention, particularly lumbar interbody fusion, has evolved as a cornerstone in managing instability and neural compression in degenerative spine disorders [1]. Among various techniques, Transforaminal Lumbar Interbody Fusion (TLIF) offers the advantage of achieving decompression, stabilization, and anterior column support through a posterior approach [2]. Traditionally, iliac crest autografts have been used for spinal fusion, but

associated donor-site morbidity has encouraged the use of locally harvested corticocancellous bone [3]. Studies have demonstrated comparable fusion rates between iliac crest and local autografts, particularly in single-level fusions [4]. However, there is a paucity of literature comparing outcomes between single- and multi-level TLIF using only local bone grafts. Recent investigations have highlighted TLIF's radiological success in restoring disc height and correcting segmental kyphosis, yet debate remains regarding its effectiveness in multi-level procedures [5], [6]. The biomechanical load and

graft biology differ significantly across fusion levels, which may influence outcomes such as graft incorporation, functional recovery, and maintenance of disc height over time.

**Aim:** To evaluate and compare the radiological and functional outcomes of single versus multiple level TLIF using local corticocancellous bone grafts.

**Materials and Methods**

**Study Design and Setting:** A retro-prospective observational study was conducted in the Department of Orthopedics at Bhagwan Mahaveer Jain Hospital, Bengaluru, over a 12-month period.

**Sample Size and Grouping:** 100 patients who underwent TLIF were enrolled. Based on surgical levels, patients were divided into:

- Single-level TLIF (n=60)
- Multiple-level TLIF (n=40)

**Inclusion Criteria:**

- Adults aged 25–70 years
- Diagnosed with lumbar canal stenosis, listhesis, or instability
- Underwent instrumented TLIF using local bone graft
- Minimum follow-up of 1 year

**Exclusion Criteria:**

- Revision surgeries
- Infection or neoplasm

- Inadequate radiological records

**Surgical Procedure:** All patients underwent posterior decompression and interbody fusion using corticocancellous laminectomy bone chips packed into titanium cages. Pedicle screw instrumentation was done under fluoroscopic guidance. No iliac crest harvesting was performed.

**Radiological Assessment:** Measured at baseline, Day 1 post-op, 3 months, and 1 year:

- Anterior Disc Height (ADH)
- Posterior Disc Height (PDH)
- Segmental Kyphosis (SK)
- Foraminal Height (FH)

**Functional Evaluation:**

- Visual Analog Scale (VAS) for pain
- Oswestry Disability Index (ODI) for function

**Statistical Analysis:** Data were analyzed using SPSS. Descriptive statistics summarized baseline variables. Intergroup differences were evaluated using Student’s t-test or chi-square test, and repeated measures ANOVA was used for longitudinal comparison.  $p < 0.05$  was considered statistically significant.

**Results**

**Demographics:** Mean age was  $52.8 \pm 10.3$  years. The male-to-female ratio was 1.2:1. No significant age or gender difference between groups.

**Table 1: Functional Outcomes:**

Time Point	VAS (Single-Level)	VAS (Multi-Level)	ODI (Single-Level)	ODI (Multi-Level)
Pre-op	$7.61 \pm 0.88$	$7.55 \pm 0.91$	$54.21 \pm 6.34$	$56.13 \pm 5.82$
Day 1	$3.92 \pm 0.97$	$4.13 \pm 0.91$	$27.23 \pm 2.01$	$29.68 \pm 2.34$
3 months	$3.02 \pm 0.85$	$3.44 \pm 0.94$	$18.15 \pm 2.48$	$20.92 \pm 2.76$
1 year	$2.31 \pm 0.94$	$2.92 \pm 0.98$	$12.23 \pm 2.01$	$14.98 \pm 2.34$

**Table 2: Radiological Outcomes:**

Parameter	Single-Level (1 Year)	Multi-Level (1 Year)	p-value
ADH (mm)	$3.72 \pm 0.47$	$3.08 \pm 0.52$	0.006
PDH (mm)	$3.26 \pm 0.38$	$2.93 \pm 0.46$	0.012
Segmental Kyphosis (°)	$4.1 \pm 1.1$	$4.3 \pm 1.2$	0.302
Foraminal Height (mm)	$16.7 \pm 2.4$	$15.9 \pm 2.6$	0.171

**Fusion Success Rate:** Radiological fusion was confirmed in 93.3% of single-level and 90% of multi-level cases at 1 year ( $p=0.441$ ).

**Discussion**

The present study demonstrates that both single- and multiple-level TLIF using local corticocancellous bone grafts offer significant clinical and radiological improvement. Notably, patients undergoing single-level fusion exhibited superior outcomes in terms of disc height restoration and functional recovery at 1-year follow-up. Prior research by Patil et al. emphasized the feasibility of using local bone

chips in TLIF, reporting satisfactory outcomes without iliac crest harvesting [7]. Similarly, Park et al. found no significant difference in fusion rates between local and iliac crest grafts in single-level procedures [8]. Our results extend these findings by comparing multi-level outcomes, where although improvement was seen, gains were modest relative to single-level TLIF. Segmental kyphosis and foraminal height showed comparable changes in both groups, which supports earlier evidence that local bone grafts maintain segmental alignment over time [9]. Moreover, the 93.3% fusion success observed aligns with established benchmarks for au-

tograft-based TLIF fusion [10]. Nevertheless, the relatively lower gain in ADH and PDH in multi-level cases may be due to limited graft quantity or altered mechanical loading, consistent with findings by Tohmeh et al., who noted higher pseudoarthrosis rates with increased fusion levels [11-15].

Limitations of our study include its non-randomized design, potential selection bias, and lack of long-term data beyond one year.

### Conclusion

Single- and multi-level TLIF using local corticocancellous bone grafts provide effective decompression and fusion in lumbar pathologies.

Single-level TLIF shows greater improvement in disc height and functional scores, highlighting its advantage in isolated degenerative disease.

Local bone grafts remain a cost-effective, biologically viable option for interbody fusion.

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