

## Original Research Article

# Comparison of clinical and radiological outcomes between TLIF and PLIF in degenerative lumbar spondylolisthesis

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## ABSTRACT

**Background:** Degenerative spondylolisthesis, often causing leg pain or radiculopathy, involves the forward displacement of a vertebra over the one below. Therefore, this study aims to compare clinical and radiological outcomes between transforaminal and posterior lumbar interbody fusion techniques in degenerative lumbar spondylolisthesis. The aim of the study was to compare clinical and radiological outcomes between transforaminal and posterior lumbar interbody fusion techniques in degenerative lumbar spondylolisthesis.

**Methods:** This prospective comparative study at the Department of Orthopaedics, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR) and Bangladesh Spine and Orthopaedic Hospital (BSOH), Dhaka, Bangladesh (January 2022–December 2023) included 35 patients with degenerative lumbar spondylolisthesis. Preoperative evaluation included demographics, BMI, VAS, ODI and radiological assessment. TLIF and PLIF were performed under general anesthesia, with operative parameters, complications and postoperative outcomes recorded. Data were analyzed using SPSS v26.0;  $p < 0.05$  was considered significant.

**Results:** Baseline characteristics were similar between TLIF ( $n=18$ ) and PLIF ( $n=17$ ) (all  $p > 0.05$ ). Operative time and hospital stay were comparable, while blood loss was lower in TLIF ( $320 \pm 85$  vs.  $410 \pm 95$  ml,  $p=0.01$ ). Postoperative VAS, ODI and fusion rates were similar. Total complications were lower in TLIF (11.1% vs. 47.1%,  $p=0.03$ ), mainly due to dural tears (0% vs. 29.4%,  $p=0.04$ ).

**Conclusion:** TLIF and PLIF provide comparable clinical and radiological outcomes in degenerative lumbar spondylolisthesis, with TLIF showing a safer perioperative profile.

**Keywords:** TLIF, PLIF, Spondylolisthesis

## INTRODUCTION

Degenerative spondylolisthesis refers to the anterior displacement of a vertebra relative to the one beneath it.<sup>1</sup> Patients with degenerative lumbar spondylolisthesis commonly experience leg pain, including neurogenic claudication or radicular symptoms, which may occur with or without accompanying low back pain.<sup>2</sup>

Lumbar spinal stenosis, often seen in the elderly, frequently coexists with this condition and presents with

radiculopathy, neurogenic claudication and back discomfort.<sup>3</sup> Increasing evidence suggests that surgical management is more effective than conservative therapy for relieving persistent back pain.<sup>4</sup>

Surgical intervention is recommended when there is progression of neurological deficits or when conservative measures, such as physical therapy, fail.<sup>1</sup> In cases of unstable spondylolisthesis, treatment typically involves decompression of the nerve roots combined with spinal instrumentation, including pedicle screw fixation and

interbody cage placement, either alone or in combination.<sup>5</sup> Interbody fusion can be performed posteriorly via posterior lumbar interbody fusion (PLIF) or transforaminal lumbar interbody fusion (TLIF).<sup>6</sup> The conventional PLIF technique uses a bilateral approach to insert two cages and achieve 360° spinal fusion.<sup>7</sup>

TLIF, a modification of PLIF, allows interbody fusion through a unilateral approach after discectomy, reducing the need for dural retraction. TLIF also provides theoretical benefits such as restoration of lordosis, improvement of sagittal balance and decompression of neural foramina through disc-height restoration, leading to better functional outcomes.

Previous research comparing TLIF and PLIF has suggested that TLIF may be less invasive and associated with greater safety, including reduced blood loss, shorter operative times and lower rates of complications such as dural tears and nerve root injury.<sup>8-10</sup> A systematic review and meta-analysis by Kunder et al confirmed these advantages of TLIF over PLIF.<sup>6</sup>

While a limited number of studies have compared TLIF with posterolateral fusion (PLF) and reported similar patient-reported outcomes, there remains a lack of research directly comparing the two techniques in terms of radiological outcomes.<sup>11</sup> Additionally, most existing studies have follow-up periods of no more than five years, highlighting the need for further long-term data.<sup>12</sup> Therefore, the purpose of the study is to compare clinical and radiological outcomes between transforaminal and posterior lumbar interbody fusion techniques in degenerative lumbar spondylolisthesis.

### **Objective**

To compare clinical and radiological outcomes between transforaminal and posterior lumbar interbody fusion techniques in degenerative lumbar spondylolisthesis.

### **METHODS**

This prospective comparative study was conducted at the Department of Orthopaedics, NITOR and BSOH, Dhaka, Bangladesh, from January 2022 to December 2023.

A total of 35 patients diagnosed with degenerative lumbar spondylolisthesis were included, selected based on specific inclusion and exclusion criteria. The study aimed to compare clinical, functional and radiological outcomes between TLIF and PLIF techniques.

### **Inclusion criteria**

Adult patients diagnosed with single-level degenerative lumbar spondylolisthesis at L4/L5. Persistent back and/or leg pain refractory to conservative management. Radiographic evidence of lumbar instability requiring

surgical fusion. Patients fit for elective spine surgery under general anesthesia.

### **Exclusion criteria**

Previous lumbar surgery at the index level. Multi-level spondylolisthesis or deformity. Spinal infection, tumor or trauma at the affected level. Severe medical comorbidities precluding surgery. Patients unwilling or unable to provide informed consent.

Preoperative evaluation included collection of demographic data, body mass index (BMI), back and leg pain assessment using the Visual Analog Scale (VAS) and functional disability assessment using the Oswestry Disability Index (ODI), along with radiological evaluation of slip grade (Meyerding classification) and spinal alignment. Surgical procedures were performed under standard general anesthesia, with TLIF involving unilateral transforaminal discectomy, interbody cage placement and pedicle screw fixation and PLIF involving bilateral posterior discectomy, cage placement and instrumentation.

Intraoperative parameters, including operative time, estimated blood loss and perioperative complications, were recorded. Postoperative follow-up included VAS, ODI, radiological fusion assessment via radiographs or CT scans and monitoring of complications. Data were analyzed using SPSS version 26.0.

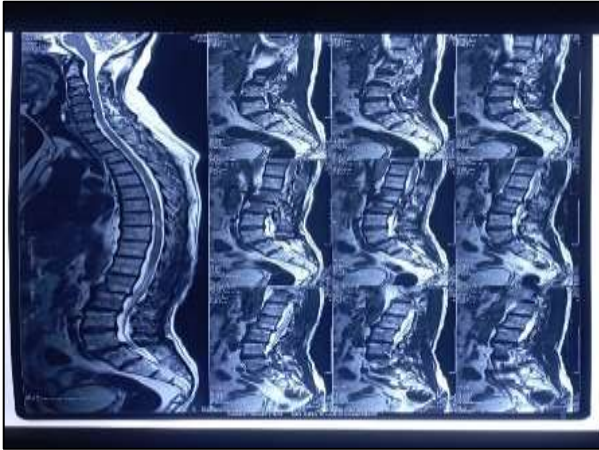
Continuous variables were expressed as mean±standard deviation (SD) and categorical variables as frequencies and percentages. Comparisons between groups were performed using Student's t-test for continuous variables and Fisher's exact test for categorical variables, with a p value <0.05 considered statistically significant.

### **RESULTS**

Baseline characteristics were comparable between TLIF and PLIF groups. Mean age was 57.2±8.1 vs. 58.6±7.5 years (p=0.60), with female distribution of 55.6% vs. 52.9% (p=1.00). BMI (27.4±3.2 vs. 28.0±3.5 kg/m<sup>2</sup>, p=0.60), operative level at L4/L5 (77.8% vs. 76.5%, p=1.00) and Meyerding Grade I (66.7% vs. 64.7%, p=1.00) were also similar.

Preoperative VAS back (7.4±1.1 vs. 7.6±1.0, p=0.58), VAS leg (6.8±1.2 vs. 7.0±1.3, p=0.64) and ODI (46.2±8.5 vs. 47.5±9.0, p=0.67) showed no significant differences. Perioperative outcomes are summarized for the study population.

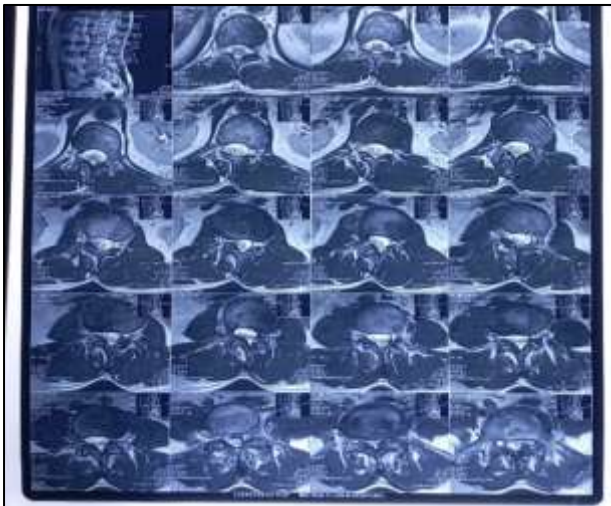
Mean operative time was 165±25 minutes for TLIF and 178±28 minutes for PLIF (p=0.17), showing no significant difference. Estimated blood loss was significantly lower in the TLIF group (320±85 ml) compared to PLIF (410±95 ml, p=0.01). Hospital stay was similar between groups (4.8±1.1 vs. 5.2±1.3 days, p=0.34).



**Figure 1: Sagittal MRI of the lumbar spine showing vertebral slippage, disc bulging and spondylolisthesis at the L4-L5 level.**



**Figure 4: Lateral whole-spine X-ray showing sagittal alignment and vertebral morphology in degenerative lumbar spondylolisthesis.**



**Figure 2: Axial MRI of the lumbar spine showing canal stenosis associated with degenerative spondylolisthesis.**



**Figure 5: Postoperative whole-spine anteroposterior X-ray showing lumbar instrumentation following TLIF with correction of degenerative spondylolisthesis.**



**Figure 3: Whole-spine X-ray (anteroposterior view) showing degenerative scoliosis with lumbar spondylolisthesis.**



**Figure 6: Postoperative lateral whole-spine X-ray showing lumbar instrumentation used to assess sagittal alignment and fusion integrity following TLIF.**

Postoperative clinical and radiological outcomes are summarized for the study population. Mean VAS back pain scores were 2.1±0.9 in TLIF and 2.5±1.0 in PLIF (p=0.23), while VAS leg pain scores were 1.8±0.7 and 2.0±0.8 (p=0.44), showing no significant differences. Functional improvement, assessed by ODI, was similar between groups (15.8±5.1% vs. 17.2±5.4%, p=0.44). Radiological fusion was achieved in 94.4% of TLIF and 88.2% of PLIF patients (p=1.00). Perioperative complications are summarized for the study population.

Dural tears occurred exclusively in the PLIF group (0% vs. 29.4%, p=0.04). Surgical site infections (5.6% vs. 11.8%, p=1.00), symptomatic pseudarthrosis (5.6% vs. 11.8%, p=1.00) and new neurological deficits (0% vs. 11.8%, p=0.23) were observed in both groups without statistically significant differences. Overall, the total complication rate was significantly lower in the TLIF group compared to the PLIF group (11.1% vs. 47.1%, p=0.03), suggesting that TLIF may be associated with a safer perioperative profile.

**Table 1: Baseline characteristics of the study population.**

Characteristic	TLIF group (n=18)	PLIF group (n=17)	P value
Age (in years), mean±SD	57.2±8.1	58.6±7.5	0.60
Sex (Female), N (%)	10 (55.6%)	9 (52.9%)	1.00
BMI (kg/m <sup>2</sup> ), mean±SD	27.4±3.2	28.0±3.5	0.60
Operative level (L4/L5), N (%)	14 (77.8%)	13 (76.5%)	1.00
Meyerding grade I, N (%)	12 (66.7%)	11 (64.7%)	1.00
Preoperative VAS back	7.4±1.1	7.6±1.0	0.58
Preoperative VAS leg	6.8±1.2	7.0±1.3	0.64
Preoperative ODI (%)	46.2±8.5	47.5±9.0	0.67

**Table 2: Perioperative outcomes of the study population.**

Outcome	TLIF group (n=18)	PLIF group (n=17)	P value
Operative time (minutes)	165±25	178±28	0.17
Estimated blood loss (ml)	320±85	410±95	0.01
Hospital stays (days)	4.8±1.1	5.2±1.3	0.34

**Table 3: Clinical and radiological outcomes of the study population.**

Outcome	TLIF group (n=18)	PLIF group (n=17)	P value
VAS back pain	2.1±0.9	2.5±1.0	0.23
VAS leg pain	1.8±0.7	2.0±0.8	0.44
ODI (%)	15.8±5.1	17.2±5.4	0.44
Radiological fusion, n (%)	17 (94.4%)	15 (88.2%)	1.00

**Table 4: Perioperative complications of the study population.**

Complication	TLIF group (n=18)	PLIF group (n=17)	P value
Dural tear	0 (0%)	5 (29.4%)	0.04
Surgical site infection	1 (5.6%)	2 (11.8%)	1.00
Symptomatic pseudarthrosis	1 (5.6%)	2 (11.8%)	1.00
New neurological deficit	0 (0%)	2 (11.8%)	0.23
Total patients with complications	2 (11.1%)	8 (47.1%)	0.03

## DISCUSSION

Clinical and radiological outcomes following lumbar interbody fusion in degenerative lumbar spondylolisthesis at tertiary care centers in Bangladesh. Degenerative lumbar spondylolisthesis, characterized by anterior displacement of a vertebra relative to the one below, poses significant challenges to spinal stability, neural function and patient quality of life. The findings highlight the importance of surgical technique selection, with factors such as operative time, blood loss, functional improvement

and complication rates influencing overall patient outcomes. The observed differences in perioperative complications and fusion success underscore the need for careful surgical planning and technique optimization to enhance both clinical and radiological results. In the study, baseline demographic and clinical characteristics were well balanced between TLIF and PLIF groups, with no significant differences observed in age, sex distribution, BMI, operative level or slip grade. Preoperative pain levels, assessed using VAS for both back and leg pain, as well as disability measured by ODI, were also comparable



across groups, suggesting that the two cohorts were appropriately matched for subsequent outcome analysis. These findings are consistent with those of Yan et al who reported similar age and sex distributions, along with comparable preoperative pain scores between TLIF and PLIF patients, though their reporting of disability indices was more limited.<sup>13</sup> In contrast, Jadhakhan et al in a much larger multicenter cohort, identified a significant difference in preoperative ODI between TLIF and PLIF groups, highlighting how baseline heterogeneity may emerge in larger registry studies compared to smaller, controlled cohorts such as ours.<sup>14</sup>

In the present study, the mean operative time was slightly shorter in the TLIF group compared to the PLIF group (165±25 vs. 178±28 minutes), although this difference did not reach statistical significance ( $p=0.17$ ). Estimated blood loss was significantly lower in the TLIF group (320±85 mL vs. 410±95 mL,  $p=0.01$ ), while hospital stay was similar between groups (4.8±1.1 vs. 5.2±1.3 days,  $p=0.34$ ). These findings are in line with Liu et al who reported higher operative times and blood loss associated with PLIF, though they did not provide data on hospital stay.<sup>15</sup> Similarly, Zhang et al demonstrated significantly shorter operative times and reduced intraoperative blood loss in minimally invasive TLIF compared to PLIF, along with shorter hospital stays in the TLIF cohort.<sup>16</sup> Together, these studies support the observation that TLIF may be associated with reduced intraoperative blood loss and, in some reports, shorter operative times, while hospital stay may not differ significantly between the two techniques.

In the present study, both TLIF and PLIF groups demonstrated marked improvement in postoperative clinical outcomes, with mean VAS back pain scores of 2.1±0.9 and 2.5±1.0, VAS leg pain scores of 1.8±0.7 and 2.0±0.8 and ODI scores of 15.8±5.1% and 17.2±5.4%, respectively, with no significant differences between groups. Radiological fusion was achieved in 94.4% of TLIF and 88.2% of PLIF patients ( $p=1.00$ ). These findings are consistent with Kakadiya et al who reported significant reductions in both back and leg pain, notable improvements in ODI and high fusion rates following TLIF.<sup>17</sup> Similarly, Bredow et al, observed substantial long-term reductions in VAS and ODI scores with high fusion rates, supporting the efficacy of TLIF in achieving both clinical and radiological success.<sup>18</sup> Collectively, these studies reinforce that both TLIF and PLIF provide effective pain relief, functional improvement and high fusion rates in patients with degenerative lumbar spondylolisthesis.

In the present study, the overall complication rate was significantly lower in the TLIF group compared to the PLIF group (11.1% vs. 47.1%,  $p=0.03$ ). Dural tears occurred exclusively in the PLIF group (29.4%,  $p=0.04$ ), while surgical site infections, symptomatic pseudarthrosis and new neurological deficits were observed in both groups but did not reach statistical significance. These findings are broadly consistent with Bhore et al who

reported higher complication rates in PLIF (20%) compared to TLIF (8%), including dural tears and postoperative neurological deficits, although the differences were not statistically significant in their study.<sup>19</sup> Similarly, Bozkurt et al noted that while both TLIF and PLIF effectively improved clinical outcomes in degenerative spondylolisthesis, certain radiological or intraoperative parameters, such as complication risks, tended to favor TLIF.<sup>20</sup> Collectively, these studies suggest that TLIF may offer a safer profile regarding intraoperative and perioperative complications while maintaining comparable clinical efficacy.

The study had a few limitations the study was conducted with a relatively small sample size, which may limit the generalizability of the findings to the broader population. Findings may not be generalizable due to the specific population studied. The study's limited geographic scope may introduce sample bias, potentially affecting the broader applicability of the findings.

## CONCLUSION

In patients with degenerative lumbar spondylolisthesis, both TLIF and PLIF demonstrated similar effectiveness in relieving pain, improving functional outcomes and achieving successful spinal fusion. However, TLIF was associated with reduced intraoperative blood loss and a lower overall complication rate, particularly for dural tears, indicating a potentially safer perioperative profile. These findings suggest that TLIF may provide comparable clinical and radiological benefits to PLIF while minimizing surgical risks, supporting its consideration as a preferred technique in appropriately selected patients.

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