

# Transforaminal Lumbar Interbody Fusion Versus Instrumented Posterolateral Fusion in Degenerative Lumbar Spine Diseases

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## Abstract

### Purpose

The aim of the present study was to evaluate the outcomes of transforaminal lumbar interbody fusion (TLIF) versus instrumented posterolateral fusion (PLF) in degenerative lumbar spine diseases.

### Method

The study was approved by the local ethics committee, and a written consent was obtained for each subject. The study included 40 patients divided into 2 groups (A and B), group A included 20 patients and it was treated by transforaminal lumbar interbody fusion (TLIF) while group B included 20 patients and it was treated by posterolateral fusion (PLF). Patients were followed for a period of one year.

### Results

Functional outcome was assessed using Modified Oswestry low back pain disability questionnaire (ODI score). There was a statistically significant difference between preoperative and one year postoperative ODI score in TLIF group and PLF group (P-value <0.001) but the difference between preoperative and one year postoperative ODI score in TLIF group was more than that of PLF group. There was no statistical significant difference between both groups regarding post operative complications and the process of disc fusion.

### Conclusion

Although there was no important statistically significant differences between Transforaminal Lumbar Interbody fusion (TLIF) and Posterolateral Fusion (PLF), however TLIF is superior to PLF as regards clinical and radiological outcome. So, our study suggests TLIF over PLF in treatment degenerative lumbar spine diseases.

**Keywords:** Transforaminal; Posterolateral; Fusion; Lumbar; Degenerative

## Introduction

Degenerative disc disease of the lumbar spine is a serious problem that causes varying degrees of disability. Lower back pain, sciatica, paraesthesia, weakness and intermittent claudication are the main symptoms caused by degeneration. Many surgical techniques are used in treating this problem [1]. Spinal arthrodesis (fusion) is one option for the management of debilitating degenerative disorders of the lumbar spine, which were refractory to nonoperative care [2]. The fusion rates in lumbar spine surgery can vary according to the technique. Although numerous studies on spinal fusion have been conducted, their outcomes are so inconsistent that it is difficult to determine which approach provides the highest fusion rate [3]. The usual spinal fusion procedures are instrumented posterolateral fusion (PLF) and lumbar interbody fusion, including anterior lumbar interbody fusion (ALIF), posterior lumbar interbody fusion (PLIF) and

transforaminal lumbar interbody fusion (TLIF) by open discectomy [4]. Nevertheless treatment strategies have moved towards global fusion based on the theoretical point of view that restoration of lordosis, sagittal balance, and neuroforaminal decompression due to restoration of the disc height would result in better functional outcomes. However, this theory has been difficult to validate scientifically [5]. Instrumented posterolateral fusion of the lumbar spine is a common procedure for a variety of spinal disorders. The conventional technique for achieving posterolateral fusion involves placing bone graft between the decorticated surfaces of lamina, facet joints, and transverse Processes [6]. One particular fusion technique, transforaminal lumbar interbody fusion (TLIF), has gained popularity within the surgical community [7]. In TLIF, an interbody arthrodesis with posterior screw fixation is achieved in the lumbar spine by a posterior approach and placement of a cage. When larger diameter cages are necessary, annulotomy should be wide enough to allow insertion of the cage. Self-expandable cages overcome this limitation because a small approach is possible regardless of cage dimensions [8].

Biomechanically, TLIF provides anterior column support and a posterior tension band [9].

## Methods

From January 2015 to June 2018, 40 patients were diagnosed clinically and radiologically as degenerative lumbar spine disease and included in this prospective randomized study. The patients divided into two equal groups, group A which included 20 patients underwent Transforaminal lumbar inter body fusion (TLIF) and group B which included 20 patients underwent posterolateral fusion (PLF) in Beni-Suef University hospital after approval from the local ethical committee and an informed consent for any one of the two techniques. All patients were underwent full detailed history, physical examination, and radiological evaluation by plain X-ray (AP, Lateral, Flexion, Extension and both obliques) and MRI and laboratory investigation and clinically by using Modified Oswestry low back pain disability questionnaire (ODI score) [10]. Randomization was in alternative manner. Inclusion criteria included Patients with degenerative disc diseases and degenerative spondylolisthesis (grades 1 or 2) at age group between 20 and 70 years. Exclusion criteria included Patients with revision surgery, Pathological spine conditions like tumors and infection, Heavy smokers (smoking more than 40 cigarettes/day) and Osteoporosis. Indications of surgery in the patients of both groups included degenerative disc diseases, spondylolysis and spondylolisthesis diagnosed by X-rays and MRI. Technique All surgeries done in prone position under controlled hypotensive general anaesthesia. Posterior midline approach was used. In PLF group, After subperiosteal soft tissue dissection till reaching facets and transverse processes of the involved segments, polyaxial pedicular screws are inserted and screws position is confirmed by fluoroscopy. When indicated decompression is done by removing of laminae, facets, spinous processes and ligaments. Lordotic rods are applied and tightened over screws. Finally posterolateral graft using local bone graft is applied (Figure 1). In TLIF group, after soft tissue dissection and application of polyaxial screws, a rod is applied on one side only (which is the opposite side of TLIF instrumentation) to apply distraction through it. Partial facetectomy of superior and inferior facets of the intended side is done together with partial laminectomy till reachind the disc space through the intervertebral foramen.

Annulotomy is done, disc material and end plates are removed using shavers, reamers and curettes. Trials are used to detect the appropriate size of cage. Local bone graft is packed into the disc space and into the cage. Finally the cage is inserted and the othe rod is applied and a compression is done before tightening the screws (Figure 1). Postoperatively, ambulation was allowed one day postoperative, drain was removed after 24 hours and wound stitches were removed within 2 weeks. Clinical outcome was assessed using ODI score up to one year postoperative. Radiological outcome was assessed by X-rays (AP, Lateral, Flexion, Extension and both obliques) every 3 months till one year postoperative.

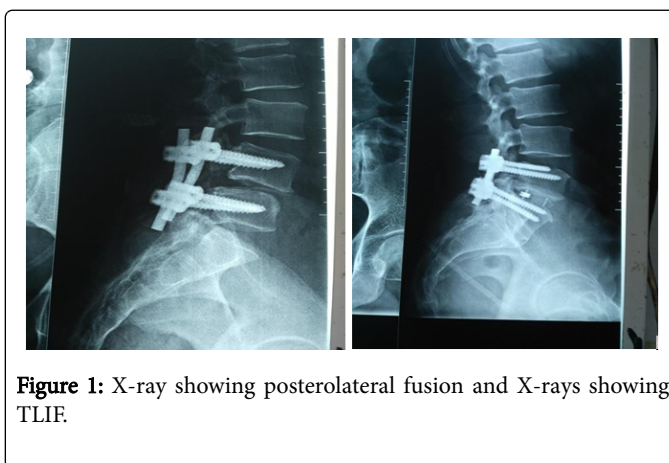


Figure 1: X-ray showing posterolateral fusion and X-rays showing TLIF.

## Results

The current study included 14 males and 26 females with mean age  $36.3 \pm 7.3$  years and  $38.8 \pm 5.6$  years among TLIF group and PLF group; respectively with no statistically significant difference ( $P$ -value=0.245). Indications for surgery were spondylolysis in 2 patients (TLIF group), spondylolisthesis in 22 patients (10 in TLIF group and 12 in PLF group) and disc degeneration in 16 patients (8 in each group). The pre operative ODI score was between 50 and 58 in TLIF group with mean 53.8 while in PLF group it was between 48 and 54 with mean 51.4 (Table 1).

Preoperative ODI score	Mean	P-value	95% Confidence Interval for Mean		Minimum	Maximum
			Lower Bound	Upper Bound		
TLIF group	53.8±2.7	0.002*	52.6	55	50	58
PLF group	51.4±1.8		50.5	52.3	48	54

Table 1: comparison between both groups regarding the Pre operative ODI score.

The length of operations in TLIF group was 110-150 minutes with mean time of 122 minutes while in PLF group it was 80-110 minutes with mean time of 95 minutes. The estimated Blood loss was 600-1600 ml in TLIF group with mean loss of 865 ml while in PLF group it was

400-800 ml with mean loss of 580ml. Thus the estimated blood loss was significantly higher among TLIF group than PLF group ( $P$ -value <0.001) and the length of operation that was significantly higher among TLIF group than PLF group ( $P$ -value <0.001) (Table 2).

Items	Mean±SD	95% Confidence Interval for Mean		Minimum	Maximum
		Lower Bound	Upper Bound		

Length of operation (min)	TLIF group	122±11.9	<0.001*	116.4	127.6	110	150
	PLF group	95±9.5		90.6	99.4	80	110
Estimated Blood loss (CC)	TLIF group	865±245.5	<0.001*	750.1	979.9	600	1600
	PLF group	580±119.6		524	635.9	400	800

**Table 2:** Comparison between both groups regarding the length of operation and the estimated blood loss.

There was no complications in 17 patients of TLIF group and 15 patients of PLF group. Superficial infection occurred in 3 patients (1 in TLIF group and 2 in PLF group) and it was treated by good antibiotic coverage and repeated dressing and finally resolved completely. Deep infection occurred in 1 patient of PLF group, the infection needed surgical debridement. Residual radiculopathy was found in 3 patients (1 in TLIF group and 2 in PLF group). Major intra operative complication occurred in 1 patient of TLIF group and it was lumbar veins injury. This

injury needed surgical intervention where the vascular surgeons ligated the injured veins. Fusion was achieved in 18 patients of TLIF group (90%) and 16 patients (80%) of PLF group. Failure of fusion was found in 4 patients of PLF group while it was found in 2 patients in TLIF group. Thus there was no great statistical significant difference between both groups regarding post operative complications and the process of fusion (P- value >0.05) (Table 3).

Outcome	Group	Chi-value	P-value	
	TLIF group 20(100%)	PLF group 20(100%)		
Complications				
No complications	17(85)	15(75)		
Superficial infection	1(5)	2(10)	3.2	0.22
Deep infection	0(0)	1(5)		
Residual radiculopathy	1(5)	2(0)		
lumbar vessel injury	1(5)	0(0)		
Fusion of operated level				
Not fused	2(10%)	4(20%)	0.784	0.376
Fused	18(90%)	16(80%)		

**Table 3:** comparison between both groups regarding the post operative complications and the process of disc fusion.

The postoperative ODI score after 1 year follow up was 32-12 in TLIF group with mean of 17.6 while it was 34-14 in PLF group with mean of 20.6. There was a statistically significant difference between

both groups regarding the One year postoperative ODI score as it is higher in PLF group than TLIF group (P-value=0.026) (Table 4) (Figure 2).

One year postoperative ODI score	Mean±SD	P-Value	95% Confidence Interval for Mean		Minimum	Maximum
			Lower Bound	Upper Bound		
TLIF group	17.6±5.4	0.026*	15.1	20.1	12	32
PLF group	20.6±6.2		17.7	23.5	14	34

**Table 4:** comparison between both groups regarding the Postoperative ODI score after one year of operation.

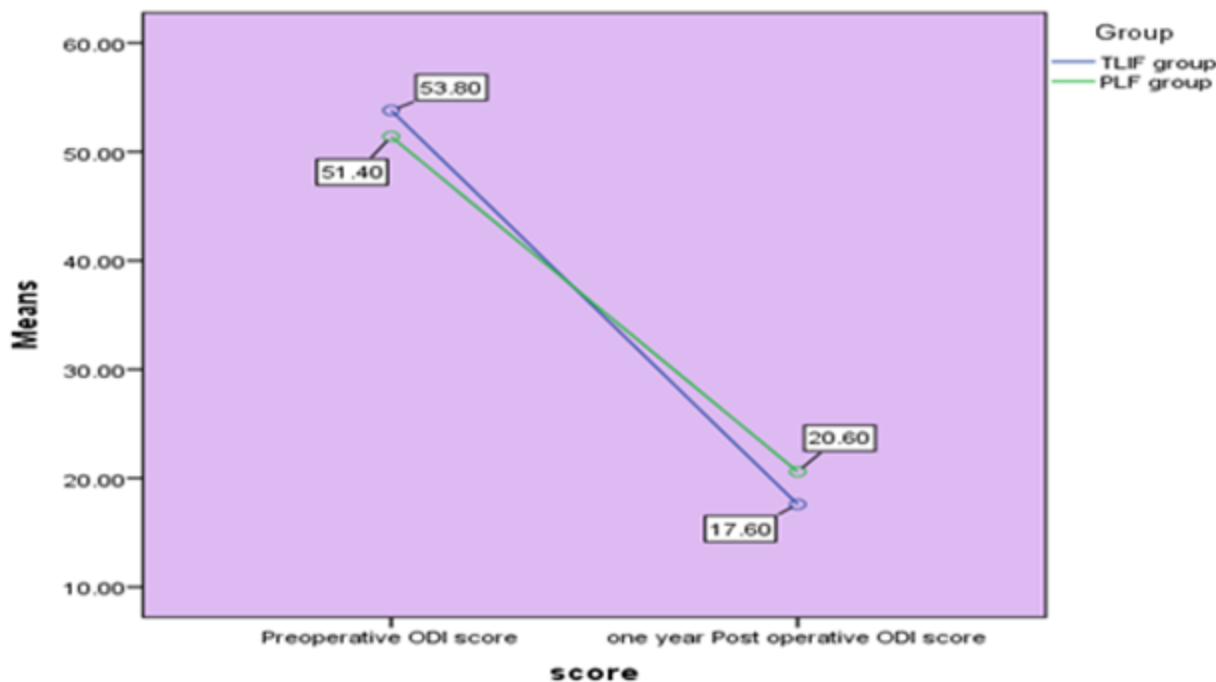


Figure 2: Comparison between both groups regarding pre and one year post operative ODI score.

## Discussion

Posterolateral fusion (PLF) can reach promising outcomes with relatively low surgical risks and technical demands, and many surgeons have accepted this technique [11]. Interbody fusion like transforaminal interbody fusion (TLIF), has several theoretical advantages. TLIF fuses the anterior column, which bears the majority of weight, thus its addition can increase the rate of fusion and relieves strain from the PLF instrumentation and also achieves foraminal decompression [12].

## Primary endpoints

### Fusion rate

In the present study there was no significant statistical difference between TLIF and PLF groups as regards fusion however there was some superiority to TLIF over PLF since fusion rate in TLIF was 90% while in PLF was 80%. This was reported by many comparative studies. Our study fusion rate was similar to (fusion rate 87% in TLIF group and 80% in PLF group) and (fusion rate 91.9% in TLIF group and 88% in PLF group). However, follow up in our study was 1 year compared to 3 years follow up [13,14]. More recently, compared TLIF versus PLF in degenerative spondylolisthesis in an attempt to evaluate the superiority of one method over the other where 80 patients underwent TLIF technique and 65 patients underwent PLF technique reported fusion rate 92% in TLIF group and 81% in PLF group (nearly the same rate of our study) [15]. Most recently reviewed TLIF technique in 123 patients and PLF technique in 118 patients with low grade spondylolisthesis and reported fusion rate 94% in TLIF group and 84% in PLF group. This fusion rate was slightly higher than our study that may be due to The larger number of patients in the reported study compared to

limited number of patients in our study (20 patients in each group) [16].

### Clinical outcome

In the present study, we detected greater improvement in ODI score in TLIF group than in PLF group, since the mean preoperative ODI score in TLIF group was 53.8 while in PLF group it was 51.4 and the mean 1 year postoperative score in TLIF was 17.6 while in PLF it was 20.6. In our study the mean difference in ODI score after 1 year follow up was greater in TLIF than PLF group (36.2 in TLIF group and 30.8 in PLF group). Thus TLIF technique improved clinical outcome more than PLF technique. In a propensity matched analysis carried out by Glassman et al., 2016 to compare TLIF and PLF in lumbar spine disorders reported more improvement of ODI score in TLIF group than PLF group at 1 year postoperatively, since the mean difference in ODI score in PLF group was 20.8 while in TLIF group it was 29.4 after 1 year follow up [17]. Reported significant improvement in ODI score in both TLIF and PLF groups with superior results in TLIF than in PLF group after 2 years follow up [13]. Clinical improvement after TLIF technique and that after PLF techniques carried out was equal since the mean preoperative ODI score was 49±15 in TLIF group and 48±13 in PLF group while the mean postoperative ODI score was 34±22 in TLIF group and 34±18 in PLF group [18].

### Secondary end points

#### Operative time

In our study the operative time was longer in TLIF technique than that of PLF technique. This fact was reported by many comparative

studies. Reported mean operative time higher in TLIF than PLF group [12,18]. The operative time in the present study in both TLIF and PLF groups was lower than reported mean operative 228 minutes in TLIF and 171 minutes in PLF compared to our study 122 minutes in TLIF group and 95 minutes in PLF group. This may be due to larger number of fused levels in the reported study (36 single level, 16 double level and one case three levels in TLIF group while 29 single level, 19 double levels and one case three levels in PLF group) compared to our study (18 single level and 2 cases double level in TLIF group while 16 single level and 4 cases double level in PLF group) [19].

## Complications

The present study reported 8 complications among 40 patients included in the study in the form of superficial infection in 3 patients (1 in TLIF group and 2 in PLF group), deep infection in 1 patient of PLF group, residual radiculopathy was found in 3 patients (1 in TLIF group and 2 in PLF group) and a major intra operative complication in 1 patient of TLIF group and it was lumbar veins injury. A major vascular injury similar to our study was reported and it was aortic injury with TLIF technique [20]. Reported eight complications among 135 patients included in the study, four in TLIF group and four in PLF group and complications included nerve roots injury, dural tears and severe postoperative radiculopathy [13]. Our results correlated with many previous studies in that outcomes did not differ significantly between TLIF and PLF groups. However, ODI score and fusion was better in TLIF than PLF. Our study has some limitations as the small number of patients, the duration of follow up which was one year compared to other studies in which duration of follow up was up to 2 & 3 years and the learning curve of surgeons especially in TLIF technique.

## Conclusion

Although there was no great statistically significant differences between Transforaminal Lumbar Interbody fusion (TLIF) and PosteroLateral Fusion (PLF), however TLIF is superior to PLF as regards clinical and radiological outcome. So, our study suggests TLIF over PLF in treatment of degenerative lumbar spine diseases.

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