

# Posterior lumbar interbody fusion and posterolateral fusion: Analogous procedures in decreasing the index of disability in patients with spondylolisthesis

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## ABSTRACT

**Objective:** The purpose of this study was to evaluate the disability in patients with spondylolisthesis who assigned either to posterolateral fusion (PLF) or posterior lumbar interbody fusion (PLIF) and to compare it between two groups.

**Methods:** In a prospective observational study, 102 surgical candidates with low-grade degenerative and isthmic spondylolisthesis enrolled from 2012 to 2014, and randomly assigned into two groups: PLF and PLIF. Evaluation of disability has been done by a questionnaire using Oswestry Disability Index (ODI). The questionnaire was completed by all patients before the surgery, the day after surgery, after 6 months and after 1-year.

**Results:** There were no statistically significant differences in terms of age and sex distribution and pre-operation ODI between groups ( $P > 0.05$ ). Comparison of the mean ODI scores of two groups over the whole study period showed no significant statistical difference ( $P = 0.074$ ). ODIs also showed no significant differences between two groups the day after surgery, 6<sup>th</sup> months and 1-year after surgery ( $P = 0.385$ ,  $P = 0.093$ ,  $P = 0.122$  and  $P = 0.433$ ) respectively. Analyzing the course of ODI over the study period, showed a significant descending pattern for either of groups ( $P < 0.0001$ ).

**Conclusion:** Both surgical fusion techniques (PLF and PLIF) were efficient to lessen the disability of patients with spondylolisthesis, and none of the fusion techniques were related to a better outcome in terms of disability.

**Key words:** Degenerative, fusion, isthmic, Oswestry Disability Index, spondylolisthesis

## Introduction

Spondylolisthesis is defined as forward displacement of a vertebra over another vertebra.<sup>[1]</sup> nowadays, 30% of lumbar fusion procedures are done for this reason. Spondylolisthesis is classified into 5 types. The degenerative type that mostly affects L<sub>4</sub>-L<sub>5</sub> level is a more common problem in women, but the isthmic type in which L<sub>5</sub>-S<sub>1</sub> is the frequent involved level is more commonly seen in men.<sup>[2]</sup>

About 25% of patients with low-grade spondylolisthesis don't respond to any type of nonsurgical treatments.<sup>[3]</sup> Patients in whom symptoms become intolerable and interfere with their daily function, patients suffering a progressive course and patients with a neurological deficit are candidates of surgery.<sup>[4,5]</sup>

The commonly used accepted technique to reconstruct the affected segment is pedicle screw instrumentation but the procedure of choice for surgery is a field of conflict.<sup>[4,11]</sup>

Posterolateral fusion (PLF) and posterior lumbar interbody fusion (PLIF) are of widely accepted fusion techniques.<sup>[12]</sup> PLIF was firstly introduced by Cloward in 1940.<sup>[13-15]</sup> Some of the studies have represented the PLIF as the superior technique, but comparable results of both techniques have shown by other trials.<sup>[12,16-20]</sup>

In a surgical candidate patient with spondylolisthesis, the aim of treatment is obviously to make the patient capable of getting back to normal life.<sup>[2]</sup>

The goal of this study was to compare the two common techniques of fusion in terms of decreasing the disability

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in patients with low-grade degenerative and isthmic spondylolisthesis.

## Methods

This prospective study involved 102 patients with isthmic and degenerative spondylolisthesis of low grade who admitted to Neurosurgical Department of Poursina Hospital, Guilan, Iran between 2012 and 2014. Based on the day patients visited the clinic, they were randomly assigned into two different groups. Group A included 51 patients in whom the used fusion technique was PLF and Group B composed of 51 patients who were operated on with PLIF. Pedicle screw fixation was the applied technique for reconstruction of the affected segment in both groups. Surgeries were carried out by a single team consisted of an associate professor of neurosurgery, an assistant professor of neurosurgery and a neurosurgical resident of the Guilan University of Medical Science (GUMS).

## Inclusion criteria

patients with the diagnosis of degenerative and isthmic type spondylolisthesis of Grade 1 and 2 who failed to respond to conservative therapy and age between 18 and 75. Patients who reported any prior spinal surgery for spondylolisthesis or had a history of alcohol abuse and patients with an inadequate disk space for performing PLIF were excluded. This study was approved by Ethical Committee of GUMS, and all patients signed a consent form.

On admission, a questionnaire containing ODI was completed by the patient under supervision of a resident of neurosurgery.

In the operation room, all patients were positioned prone. After a midline incision and complete bony exposure, subperiosteal dissection continued till transverse processes were exposed. Decompressive procedure was done thorough laminectomy, medial facetectomy and extensive foraminotomy. Then after pedicle screw fixation, in PLF Group (A), PLF was done by autografting with bone chips and in PLIF Group (B), after a complete discectomy, lumbar interbody fusion was done by polyetheretherketone cages. A brace was prescribed for 3 months and then was tapered off if fusion was achieved.

All the patients were informed of a scheduled follow-up program explained by residents and they were asked to complete the same questionnaire using Oswestry Disability Index (ODI) in the day after surgery, after 6 months and after 1-year.

Statistical analysis was performed using repeated measure ANOVA with *post hoc* tests (Bonferoni method) of IBM SPSS statistics version 21. All of the tests were two-tailed and a  $P < 0.05$  was considered to be statistically significant.

## Results

A total of 102 patients with low-grade spondylolisthesis of isthmic and degenerative type were enrolled in our study;

including 51 patients in Group A (PLF) and 51 patients in Group B (PLIF). A summary of demographic features has shown in Table 1. The basic demographic features such as sex and age did not differ significantly, but the distribution of types of spondylolisthesis showed a significant difference between two groups ( $P = 0.025$ ).

The mean values of ODIs before surgery, the day after surgery, 6 months and 1-year after surgery showed no significant difference between the groups [Table 2].

Analyzing the course of ODIs over the study period using repeated measure ANOVA, both groups followed a descending pattern that was statistically significant for both of them ( $P < 0.0001$ ) [Table 3 and Figure 1]. Comparison of the mean ODIs of two groups over the whole period of study, using an adjustment for multiple comparisons (Bonferroni test) did not show a significant statistical difference ( $P = 0.074$ ). It has been demonstrated that the mean value of ODIs was insignificantly lower in Group B (difference of the mean values of ODIs:  $5.03 \pm 2.77$ ; 95% confidence interval:  $-0.49-10.55$ ) [Table 4].

For each group, mean values of ODIs before surgery represented a significant difference compared to the value of 6 months later and 1-year after surgery ( $P < 0.001$  for both groups). Other comparisons of mean values of ODIs at different points in time has been illustrated in Table 5.

The interaction of sex and age with the courses of mean values of ODIs during the study period has been displayed in Figures 2-6. Analyzing the interactions using two-ways ANOVA revealed no effect of gender and age on the course of ODIs related to two methods of surgery ( $P = 0.620$  and  $P = 0.079$ , respectively).

## Discussion

In our study, both methods of fusion resulted in a remarkable decrease of ODIs after 1-year of follow-up. Compared with PLF group, PLIF group reported a less degree of disability that was not of statistical significance.

**Table 1: Basic characteristic features of the study population**

Variable	Groups		P
	A	B	
Age	55±9	52±8	0.250
Gender (%)			
Male	17.8	19.5	0.836
Female	82.2	80.5	
Type of spondylolisthesis (%)			
Degenerative I	53.3	24.4	0.025
Isthmic I	15.6	14.6	
Isthmic II	11.1	14.6	
Degenerative II	20.0	46.3	

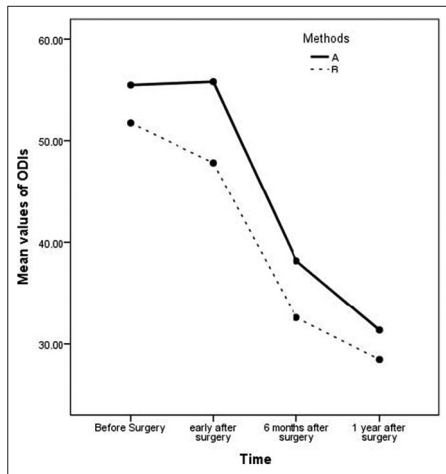


Figure 1: Mean values of Oswestry Disability Index based on time in two groups

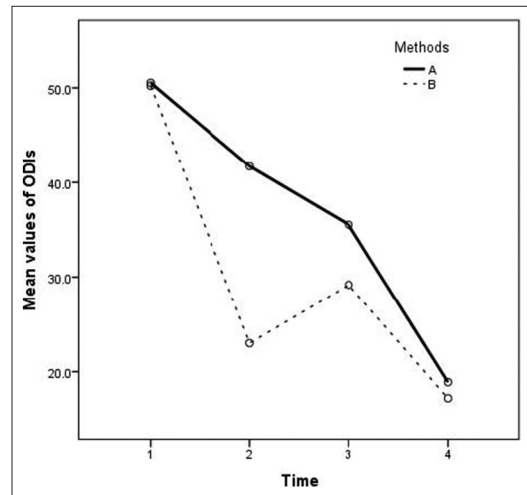


Figure 2: Mean values of Oswestry Disability Index based on time in male population of two groups

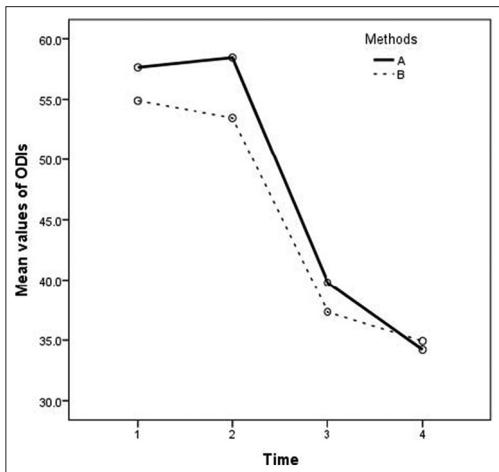


Figure 3: Mean values of Oswestry Disability Index based on time in female population of two groups

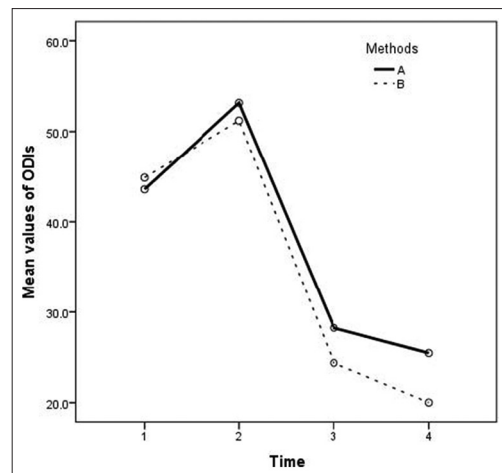


Figure 4: Mean values of Oswestry Disability Index based on time in patients aged <50 in two groups

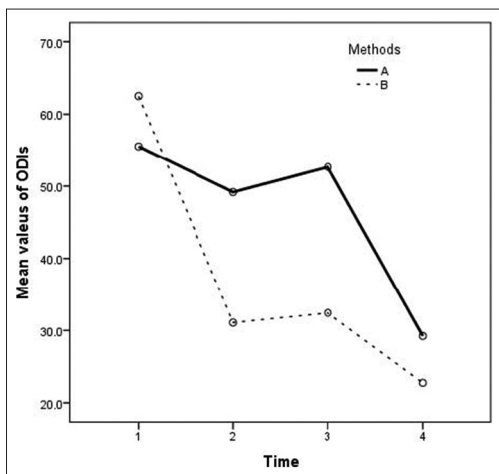


Figure 5: Mean values of Oswestry Disability Index based on time in patients aged 50-60 in two groups

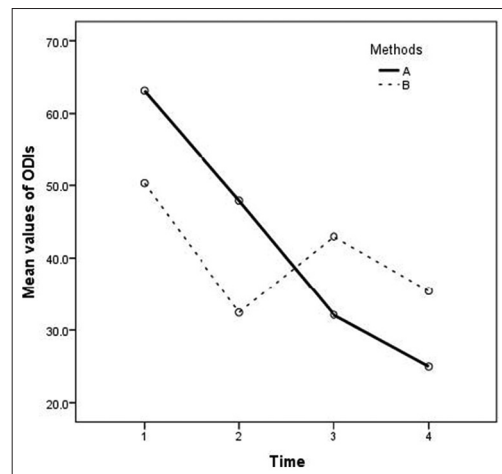


Figure 6: Mean values of Oswestry Disability Index based on time in patients aged >60 in two groups

Measuring and comparing the disability index between two groups at four points in time showed no significant

differences between them and the mean value of ODI related to PLIF group did not differ significantly with the

**Table 2: Mean values of ODIs in two groups before surgery, the day after surgery, 6 months and 1-year after surgery**

Variable	Groups	Mean	SD	P
ODI before surgery	A	55.4344	21.13929	0.385
	B	51.7346	17.85375	
ODI early after surgery	A	55.7599	20.31002	0.093
	B	47.8212	22.98334	
ODI 6 months after surgery	A	38.1884	18.39729	0.122
	B	32.5907	14.33499	
ODI 1-year after surgery	A	31.3622	17.69207	0.433
	B	28.4744	16.19301	

ODI – Oswestry Disability Index; SD – Standard deviation

**Table 3: Difference of variances within and between groups**

Source	Type III sum of squares	Df	Mean square	F	Significant
<b>Time</b>					
Sphericity assumed	35863.522	3	11954.507	47.472	0.000
Greenhouse-Geisser	35863.522	2.346	15284.627	47.472	0.000
Huynh-Feldt	35863.522	2.447	14657.428	47.472	0.000
Lower-bound	35863.522	1.000	35863.522	47.472	0.000
<b>Time×methods</b>					
Sphericity assumed	324.826	3	108.275	0.430	0.732
Greenhouse-Geisser	324.826	2.346	138.437	0.430	0.683
Huynh-Feldt	324.826	2.447	132.757	0.430	0.691
Lower-bound	324.826	1.000	324.826	0.430	0.514
<b>Error (time)</b>					
Sphericity assumed	63459.432	252	251.823		
Greenhouse-Geisser	63459.432	197.096	321.973		
Huynh-Feldt	63459.432	205.530	308.761		
Lower-bound	63459.432	84.000	755.469		

PLF group during the whole period of study. The effect of fusion techniques on ODIs in age and sex groups was similar [Figure 2].

In the Ekman *et al.* study on a population of 163 patients with isthmic spondylolisthesis in 2007, a significant decrease of disability was reported after 2 years of follow-up. Unlike our study they used Disability Rating Index (DRI) to determine disability and to compare it between groups. DRI had a significant reduction from preoperative period to 2 years after surgery, but they find no significant difference in disability between groups at any time interval.<sup>[16]</sup>

Cheng *et al.* conducted a study in 2008 that was performed prospectively on 138 patients with spondylolisthesis; they didn't find any statistical significant difference in the results of the Oswestry scores in a 4 years follow-up ( $P = 0.041$ ).<sup>[4]</sup>

In 2010, Barbanti Bròdano *et al.* in their study on 71 patients with low-grade isthmic spondylolisthesis showed that both

**Table 4: Comparison of mean values of ODIs between Group A and B**

(I) Methods	(J) Methods	Mean difference (I-J)	SE	Significant <sup>a</sup>	95% CI for difference <sup>a</sup>	
					Lower bound	Upper bound
A	B	5.031	2.777	0.074	-0.492	10.554

<sup>a</sup>Adjustment for multiple comparisons: Bonferroni. ODI – Oswestry disability index; SE – Standard error; CI – Confidence interval

**Table 5: Differences of mean ODIs within groups based on time**

Methods	(I) Time	(J) Time	Mean difference (I-J)	SE	Significant <sup>b</sup>	95% CI for difference <sup>b</sup>	
						Lower bound	Upper bound
A	1	2	-0.325	3.971	1.000	-11.298	10.647
		3	17.246*	3.521	0.000	7.517	26.975
		4	24.072*	3.466	0.000	14.496	33.649
		2	0.325	3.971	1.000	-10.647	11.298
	2	3	17.571*	3.654	0.000	7.475	27.668
		4	24.398*	3.337	0.000	15.179	33.617
		3	-17.246*	3.521	0.000	-26.975	-7.517
		2	-17.571*	3.654	0.000	-27.668	-7.475
	4	4	6.826*	1.919	0.005	1.525	12.127
		1	-24.072*	3.466	0.000	-33.649	-14.496
		2	-24.398*	3.337	0.000	-33.617	-15.179
		3	-6.826*	1.919	0.005	-12.127	-1.525
B	1	2	3.913	4.447	1.000	-8.432	16.259
		3	19.144*	3.117	0.000	10.491	27.797
		4	23.260*	3.677	0.000	13.053	33.468
		2	-3.913	4.447	1.000	-16.259	8.432
	2	3	15.230*	3.523	0.001	5.450	25.011
		4	19.347*	3.739	0.000	8.969	29.725
		3	-19.144*	3.117	0.000	-27.797	-10.491
		2	-15.230*	3.523	0.001	-25.011	-5.450
	4	4	4.116	1.686	0.115	-0.564	8.797
		1	-23.260*	3.677	0.000	-33.468	-13.053
		2	-19.347*	3.739	0.000	-29.725	-8.969
		3	-4.116	1.686	0.115	-8.797	0.564

Based on estimated marginal means. \*The mean difference is significant at the .05 level, <sup>b</sup>Adjustment for multiple comparisons: Bonferroni. SE – Standard error; CI – Confidence interval; ODI – Oswestry disability index

PLIF and PLF techniques had an acceptable clinical outcome, but without statistically significant differences ( $P > 0.05$ ). They assessed clinical outcome and to define it, what they used was ODI, Roland Morris Disability Questionnaire, visual analog scale (leg score and back score), persistent low back pain and persistent sciatica.<sup>[21]</sup> Unlike our study, they did not assess the disability of patients separately.

Three years later in a meta-analysis by Ye *et al.*, they used random effect model of analysis in order to assess the improvement of ODI. They revealed that after surgery, pooled difference in mean ODI reduction was not significantly different in functional activity when comparing two groups.<sup>[3]</sup>

In a recent study on 50 patients with lumbar isthmic spondylolisthesis, Habib also used ODI to study disability. Unlike what we found, they demonstrated a significant better long term ODI in PLIF group. A follow-up program of 18 months was scheduled for patients.<sup>[12]</sup>

Because lessening the disability and turning patients back to their normal lives is an important target in managing these patients, our findings can be helpful in choosing the better surgical approach.

Finally, we have to mention some of the limitations of our study. The two groups were not matched in terms of the type of spondylolisthesis. The level of spondylolisthesis was not considered in this study. We can't easily introduce PLF and PLIF the same methods in terms of outcome because of the small sample size, short duration of follow-up, low statistical power and variance of spondylolisthesis type and level distribution which acts as a confounder.

Randomization and enrolling age and sex-matched groups in a multidisciplinary follow-up program was strength of this study.

Despite the large number of trials in this field, the fusion method of choice for spondylolisthesis remains as a field of conflict.

Higher-quality observational studies with high power and long term follow-up is required to assess the comparative effectiveness of two techniques.

The substantial reduction of disability resulted by both of techniques was noteworthy in this study.

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