

# A Comparative Study between Pedicle Screw Instrumentation with Posterolateral Fusion and Pedicle Screw Instrumentation with Interbody Fusion in Patients of Lumbar Spondylolisthesis

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## Abstract

**Background:** Many different treatment modalities have been advocated by different authors from time to time for lumbar spondylolisthesis. Many cases, the condition can be treated conservatively. However, when the symptoms persist, surgery needs to be performed. The principle of underlying surgery includes stabilization of the slipping vertebrae. Various operative methods encompassing this principle include stabilization with pedicle screw fixation and fusion which can either posterolateral or interbody fusion, anterior lumbar interbody fusion, posterior lumbar interbody fusion, or transforaminal lumbar interbody fusion. The objective of this study was to compare the surgical efficacy in terms of stability and fusion achieved using pedicle screw-rod instrumentation with posterolateral fusion and pedicle screw-rod instrumentation with interbody fusion in lumbar spondylolisthesis and to study THE functional and clinical recovery using the Revised Oswestry Disability Index score.

**Materials and Methods:** A prospective study was carried out to compare the clinical and radiological outcomes between Pedicle screw-rod instrumentation with either posterolateral fusion and interbody fusion after adequate decompression in patient of lumbar spondylolisthesis. All patients as per the inclusion criteria were admitted, underwent surgery between March 2010 and March 2012, and were included in the study.

**Results:** The total of 50 patients was included in our study. Both male and female patients were equally distributed in both the groups, wherein postreolateral fusion had 13 female patients and those with interbody fusion had 13 male patients. Our study shows marked improvement in Revised Oswestry Disability score postoperatively with good-to-excellent results in both the groups. We achieved good solid radiological fusion earliest on the 3<sup>rd</sup> month in both the groups with good stability.

**Conclusion:** Our results showed similar clinical and functional outcome in both the groups with no significant statistical difference found. However, we conclude that in cases where reduction is required and there is instability affecting the three column of spine interbody fusions with pedicle screws-rod instrumentation provide a more solid mechanical construct.

**Key words:** Pedicle screw-rod instrumentation, Posterior lumbar fusion, Posterior lumbar interbody fusion, Revised Oswestry Disability Index, Spondylolisthesis

## INTRODUCTION

Spondylolisthesis is the subluxation of a vertebral body over another in the sagittal plane. It represents

a particular and relatively frequent mechanism of intervertebral instability.<sup>[1]</sup> The first case of lumbosacral (LS) spondylolisthesis was described by Herbiniaux in 1772, an obstetric surgeon who described a bony prominence, anterior to the sacrum, and caused pelvic outlet narrowing, due to a forward slip of L5 on the sacrum, causing a difficult delivery.<sup>[2]</sup> This pathology can be caused by ligamentous laxity, a defect in the pars interarticularis, previous surgery, or may be traumatic. It occurs in up to 5% of the general population and affects all ages.<sup>[3]</sup> The surgical treatment of spondylolisthesis is indicated for

Access this article online	
 www.ijss-sn.com	<b>Month of Submission</b> : 01-2019 <b>Month of Peer Review</b> : 02-2019 <b>Month of Acceptance</b> : 02-2019 <b>Month of Publishing</b> : 03-2019

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cases of neurogenic claudication, intractable radicular pain, severe low back pain, presence of neurological symptoms, failure of conservative management, radiological instability, progressive worsening of the spondylolisthesis, Meyerding grade III and IV listheses, and spondyloptosis.<sup>[4]</sup> The ideal surgical treatment remains controversial.<sup>[2]</sup>

Posterolateral fusion involving instrumentation-assisted segmental fixation represents a valid procedure in the treatment of lumbar instability.<sup>[5]</sup> In cases of anterior column failure, such as in isthmic spondylolisthesis, supplemental posterior lumbar interbody fusion (PLIF) may improve the fusion rate and endurance of the construct. PLIF is, however, a more demanding procedure and increases costs and risks of the intervention.<sup>[6]</sup> The advantages of this technique must, therefore, be weighed against those of a simple posterior lumbar fusion.

The purpose of this study was to study the surgical efficacy in terms of stability and fusion achieved using pedicle screw-rod instrumentation with posterolateral fusion and pedicle screw-rod instrumentation with interbody fusion in lumbar spondylolisthesis and to study the functional and clinical recovery using the Revised Oswestry Disability Index (RODI) score.

## MATERIALS AND METHODS

We have prospectively studied 50 patients with lumbar spondylolisthesis, between March 2010 and March 2012.

Patients in the age group of 20-70 years with symptomatic spondylolisthesis not relieved on conservative treatment, patients with spondylolisthesis between Grades I and III (Meyerding Classification), and patients with isthmic or degenerative spondylolisthesis were included in the study.

Patients with severe spondylolisthesis Grade IV (Meyerding Classification), patients with associated scoliosis, patients with failed previous lumbar surgery, patients with poor general condition, and patients with acute traumatic spondylolisthesis were excluded from the study.

All the patients included in the study had undergone pre-operative neurological examination, roentgenogram of LS spine (anteroposterior [AP], lateral, oblique, and flexion-extension views), magnetic resonance imaging of LS spine, and functional status of each patient which was determined using RODI scoring system.

Patients were given a trial of conservative treatment in the form of a short period of rest until pain subsides,

medications with nonsteroidal anti-inflammatory drugs or acetaminophen, physiotherapy in the form of back strengthening exercise avoiding spine extension exercise, abdominal strengthening exercise, and hamstring strengthening exercise, and mobilization with brace. If still patient experiences pain in spite of giving a trial of conservative treatment, then patients are offered surgery.

The patients were operated on by one surgeon in a single institution, using two different techniques with a minimum follow-up of 1 year. Patients were divided into two groups. Group I comprised 25 patients of the series submitted to a pedicle screw-rod fixation with posterolateral fusion and Group II comprised 25 patients submitted to a pedicle screw-rod fixation with interbody fusion procedure.

Patients were assessed clinically and radiographically preoperatively and at 3, 6, and 12 months postoperatively. Clinical and functional outcome was measured with the Oswestry disability scoring system applied on each individual patient and by neurological examination. Furthermore, the complication rates were recorded. Fusion and stability outcomes were assessed radiographically using AP, lateral, and oblique radiographs. Lateral standing flexion-extension films were obtained as well beginning with 3 months.

Before surgery and at the 1-year follow-up, functional disability was quantified by the RODI score and fusion was judged radiologically based on following criteria which includes solid fusion across both facet joints, partial fusion across one and solid fusion across another facet joint, partial fusion across both facet joints, and no fusion. The global outcome was assessed by the patient as much better, better, unchanged, or worse.

## RESULTS

Mean age was 44.3 years for Group I patients and 45.4 years for Group II patients. Both male and female patients were equally distributed in both the groups [Table 1], wherein Group I had 13 female patients (52%) and Group II had 13 male patients (52%) [Table 2]. L5-S1 level was involved in majority patients with 52% in Group I and L4-L5 was involved in 52% of the patients [Table 4]. Degenerative spondylolisthesis patients were more common (54%) than isthmic (46%) [Table 3] and both were more common in female patients. Our study shows marked improvement in Revised Oswestry Disability score postoperatively with good-to-excellent results in both the groups. We achieved good solid radiological fusion earliest on the 3<sup>rd</sup> month in both the groups with good stability [Tables 5 and 6]. Two patients in Group I had superficial skin infection

**Table 1: Age distribution in both groups**

Group	Age distribution					Total (%)
	20–30 years (%)	30–40 years (%)	40–50 years (%)	50–60 years (%)	60–70 years (%)	
Group I	8 (32)	3 (12)	4 (16)	7 (28)	3 (12)	25 (100)
Group II	5 (20)	4 (16)	8 (32)	4 (16)	4 (16)	25 (100)
Total	13 (26)	7 (14)	12 (24)	11 (22)	7 (14)	50 (100)

**Table 2: Sex distribution in both groups**

Group	Sex distribution		Total (%)
	Male (%)	Female (%)	
Group I	12 (48)	13 (52)	25 (50)
Group II	13 (52)	12 (48)	25 (50)
Total	25 (50)	25 (50)	50 (100)

**Table 3: Distribution of patients according to types of spondylolisthesis**

Group	Degenerative (%)	Isthmic (%)	Total (%)
Group I	13 (52)	12 (48)	25 (50)
Group II	14 (56)	11 (44)	25 (50)
Total	27 (54)	23 (46)	50 (100)

**Table 4: Distribution of patients according to vertebral level**

Group	L3–L4 (%)	L4–L5 (%)	L5–S1 (%)	Total (%)
Group I	2 (8)	13 (52)	10 (40)	25 (50)
Group II	2 (8)	10 (40)	13 (52)	25 (50)
Total	4 (8)	23 (46)	23 (46)	50 (100)

in post-operative period which responded to regular dressing. Three patients in Group I showed deterioration of neurology postoperatively; however, hardware-related complication was not encountered in our study.

## DISCUSSION

In our study, all 50 patients underwent combined decompression and pedicle screw instrumentation with either posterolateral fusion or PLIF and were distributed in two groups where Group I included patients who underwent pedicle screw fixation with posterolateral fusion [Figure 1] and Group II included patients who underwent pedicle screw fixation with interbody fusion [Figure 2].

Mean age of patients in Group I was 44.3 years and in Group II was 45.4 years. According to a study by Dehoux *et al.*,<sup>[5]</sup> Dantas *et al.*,<sup>[7]</sup> and Cheng *et al.*,<sup>[8]</sup> mean age of patients in Group I was 42.4, 52.5, and 48 years, respectively, and mean age of patients in Group II was 39.5, 47.6, and 49 years, respectively.

In our study, both male and female patients were equally distributed in both the groups, wherein Group I had

13 female patients (52%) and Group II had 13 male patients (52%). According to a study by Dehoux *et al.*,<sup>[5]</sup> Dantas *et al.*,<sup>[7]</sup> and Cheng *et al.*,<sup>[8]</sup> both the groups were male predominance.

All the patients in study groups were given adequate period of conservative therapy before undergoing surgical management. The average duration of symptoms before a patient subjected to surgery was 37.2 months in Group I and 28 months in Group II.

In our study, an indication of the surgery included neurological involvement which included 13 patients and remaining were due to progressive worsening backache which failed to respond to a trial of conservative line of management which was similar to the indication in all three studies.

L5–S1 level was involved in majority patients with 52% in Group I and L4–L5 was involved in 52% of the patients in Group II. According to a study by Cheng *et al.*,<sup>[8]</sup> L4–L5 level predominated in both the groups, with 76.4% and 72.9% in Group I and Group II, respectively.

In our study, degenerative spondylolisthesis patients were more common (54%) than isthmic (46%) and both were more common in female patients. Similar results were seen in studies done by Dantas *et al.*,<sup>[7]</sup> and Cheng *et al.*,<sup>[8]</sup>

In our study, Grade 1/2/3 spondylolisthesis patients were 40%/48%/12% in Group I, whereas in Group II, it was 52%/36%/12% which shows that Grade 2 was more common in Group I and Grade 1 in Group II. According to a study by Dehoux *et al.*,<sup>[5]</sup> and Dantas *et al.*,<sup>[7]</sup> both the groups had a predominance of Grade 1 spondylolisthesis patients.

The literature shows concerns with life quality in spondylolisthesis patients. Madan and Boeree<sup>[9]</sup> used the Oswestry questionnaire, among other tools, to evaluate the final outcomes of patients with lumbar spondylolisthesis submitted to a posterior fusion procedure. Oswestry index of 69% was reported in the posterolateral fusion group, and an 81% index was reported in the PLIF group. PLIF patients retained correction and presented better fusion.

**Table 5: Revised Oswestry disability score in patients of both groups**

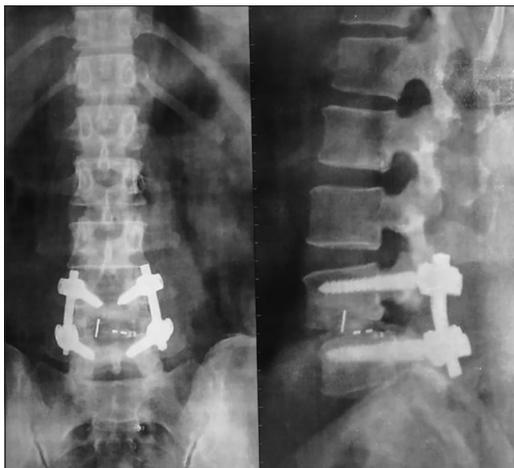
Group	Pre-operative	3 months	6 months	12 months
Group I	44.3 (fair)	24.6 (good)	11.9 (excellent)	4.8 (excellent)
Group II	48.8 (fair)	20.9 (excellent)	11.8 (excellent)	4.2 (excellent)

**Table 6: Fusion/stability in in patients of both groups**

Group	Fusion/stability			Complication
	3 months	6 months	12 months	
Group I	Solid fusion/stable	Solid fusion/stable	Solid fusion/stable	Nil
Group II	Solid fusion/stable	Solid fusion/stable	Solid fusion/stable	Nil



**Figure 1: X-ray of lumbosacral spine showing pedicle screw at L5–S1 level**



**Figure 2: X-ray of lumbosacral spine showing pedicle screw and interbody fusion at L4–L5 level**

Our study shows marked improvement in Revised Oswestry Disability score postoperatively with good-to-excellent results in both the groups which was in accordance with the study done by Dantas *et al.*<sup>[7]</sup> and Cheng *et al.*<sup>[8]</sup>

Mean duration of surgery in Group I was 3 h and in Group II 3.5 h, which is not statistically significant.

We achieved good solid radiological fusion earliest on the 3<sup>rd</sup> month check X-ray in both the groups with good stability checked on flexion–extension X-ray which was in accordance with the studies done by Dehoux *et al.*<sup>[5]</sup> and Cheng *et al.*<sup>[8]</sup>

Two patients in Group I had superficial skin infection in post-operative period which responded to regular dressing. Three patients in Group I showed deterioration of neurology postoperatively.

The complications noted by Suk *et al.*<sup>[6]</sup> in their study on patients who underwent posterolateral fusion such as nonunion, loss of reduction, and hardware failure were not encountered in our study. They also noticed a reduction of slippage in patients who underwent interbody fusion which was not observed in our study.

## CONCLUSION

Based on the present series, we conclude that, if there is spondylolisthesis with or without instability and nerve root compression symptoms, decompression with instrumentation by pedicle screw either with posterolateral fusion or interbody fusion provides a more solid mechanical construct and fusion. Clinical and functional outcome in both the groups was similar, and no significant statistical difference was found; however, all patients were satisfied with both the procedures. We conclude that, where a reduction is required or disc space is high, interbody fusion is preferred as it provides more mechanical strength to spinal construct. Furthermore, if there is instability affecting the three spine columns, the interbody fusions with pedicle screws provide a more solid mechanical construct when compared with the pedicle screws used alone with posterolateral fusion.

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**How to cite this article:** Patel J, Goda N, Shikalgar T, Singh A, Patil V. A Comparative Study between Pedicle Screw Instrumentation with Posterolateral Fusion and Pedicle Screw Instrumentation with Interbody Fusion in Patients of Lumbar Spondylolisthesis. *Int J Sci Stud* 2019;6(12):88-92.

**Source of Support:** Nil, **Conflict of Interest:** None declared.