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**Dr. Sarath Babu AN**  
Department of Orthopaedics,  
Government Medical College,  
Krishnagiri, Tamil Nadu, India

**Dr. Dhanasekaran R**  
Department of Orthopaedics,  
Government Medical College,  
Krishnagiri, Tamil Nadu, India

**Dr. Sathish Muthu**  
Department of Orthopaedics,  
Government Medical College &  
Hospital, Dindigul, Tamil Nadu,  
India

## Methods of fusion did not have any significant role in improving the functional outcome in the management of grade 1,2 degenerative spondylolisthesis at 5-year follow-up

**Dr. Sarath Babu AN, Dr. Dhanasekaran R and Dr. Sathish Muthu**

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### Abstract

**Background:** We conducted this study to compare the functional outcome of patients who underwent posterolateral fusion for the management of grade 1,2 degenerative spondylolisthesis with patients who underwent interbody fusion for the same condition. Studies on either of the treatment methods demonstrated significant improvement, but the latter is implant-driven while the former is not. Although radiological outcomes were better in the interbody fusion, we aimed to compare and analyze the functional outcome in these two groups of patients.

**Methods:** This is a retrospective cohort study analyzing 44 patients undergoing posterolateral fusion and 46 patients undergoing interbody fusion for grade 1,2 degenerative spondylolisthesis with a minimum 5-year follow-up were reviewed. Patient demographics, the functional outcome with Oswestry Disability Index (ODI), and complications were analyzed.

**Results:** Although we noted significant improvement in the ODI scores ( $p < 0.001$ ) compared to the pre-operative status, we did not find any significant difference in the ODI scores at 5-year follow-up between the cohorts ( $p = 0.96$ ). We did not find any significant difference in the complication rate ( $p = 0.54$ ) or re-operation rates ( $p = 0.93$ ) between the two groups.

**Conclusion:** The fusion method did not have a significant role in improving the functional outcome in the management of grade 1,2 degenerative spondylolisthesis. There was also no significant difference between the two fusion methods concerning the dural tear rates, reoperation rate, or infection.

**Keywords:** Degenerative Spondylolisthesis, Posterolateral Fusion, Interbody Fusion, Functional Outcome, Complications

### Introduction

Degenerative spondylolisthesis represents segmental instability and subluxation caused solely by a degenerative change in the intervertebral disc and facet joints<sup>[1]</sup>. The degree of the subluxation is necessarily mild because the intact neural arch provided a bony limit to forward translation. Relatively more sagittal orientation of the facet joints is associated with degenerative spondylolisthesis. The degenerative spondylolisthesis is more common at the L4-L5 level than at the L3-L4 level, which is the next most affected<sup>[2]</sup>. The reason advocated for its location at L4/L5 level includes the more sagittal orientation of the L4/L5 facet joint about the coronal placement of the L5/S1 joint, and the stability of L5, which is provided by the large transverse process supported by the strong ligaments and muscle attachments<sup>[3]</sup>. Spondylolisthesis is present in 5% of the adult population with clinical evidence of low back pain.<sup>4,5</sup> These patients are treated initially by conservative measures, failing which surgical intervention is mandatory. Numerous studies prove that the reduction of severe high-grade spondylolisthesis is essential, whereas low-grade listhesis can be managed by several methods of fusion, such as instrumented posterolateral fusion (PLF), and interbody fusion (IBF) with or without decompression<sup>[6-8]</sup>.

We conducted this study to compare the functional outcome of patients who underwent posterolateral fusion for the management of grade 1,2 degenerative spondylolisthesis with patients who underwent interbody fusion for the same condition.

**Corresponding Author:**  
**Dr. Sarath Babu AN**  
Department of Orthopaedics,  
Government Medical College,  
Krishnagiri, Tamil Nadu, India

Studies on either of the treatment methods demonstrated significant improvement but the latter is implant driven while the former is not [9, 10]. Although radiological outcomes were better in the interbody fusion [9]. We aimed to compare and analyze the functional outcome in these two groups of patients.

**Methodology**

This is a retrospective study conducted in a tertiary care hospital between Jan 2010 to Dec 2015, including all patients treated for degenerative spondylolisthesis with instrumented PLF or IBF. Patients were included if they had single-level fusion for a grade 1,2 degenerative spondylolisthesis with preoperative and follow-up data of Oswestry disability index (ODI) were available. Patients were excluded if they had prior lumbar spine surgeries, high-grade spondylolisthesis (grade 3 or above), or were not willing to participate in the study.

**Operative technique**

All the patients were operated on in a prone position through a standard posterior midline dissection. All the patients received central and foraminal decompression either through laminectomy or hemi-laminotomy, the choice being that of the operating surgeon. Pedicle screw instrumentation was performed. In the PLF group, intertransverse fusion was performed bilaterally, while in the IBF group, interbody fusion was achieved using a cage with a bone graft from the locally available material. Patients were asked to wear a lumbar brace for 3 months post-surgery.

Records were reviewed for demographic data such as age, body mass index, smoking status, and surgical information such as complications, including dural tears, infection. We retrieved the preoperative functional status with ODI and followed up with the patient for the latest functional scores and compared their improvement with the preoperative status. A student t-test was used to compare the continuous data and a chi-square test was used to compare the categorical data between the follow-up points within patient cohorts. Between-group analysis of the functional outcome was performed with the Mann-Whitney rank-sum test. A p-value <0.05 was considered significant.

**Results**

A total of 90 patients were treated for grade 1,2 degenerative spondylolisthesis between the defined study period with PLF (n=44) or IBF (n=46) at our institution. Of these, 44 (27 F/17 M) patients met inclusion/exclusion criteria in the PLF group and 46 (26 F/20 M) in the IBF group (Table 1). There were no statistically significant differences between the groups regarding age, BMI, and smoking status. Pre-operative functional (ODI) scores were not statistically different between groups.

**Table 1:** Patient demographics

Demographics	PLF group	IBF group	p-value
N	44	46	-
Gender (Female/Male)	27/17	26/20	0.40
Age (years)	65±10	68±10	0.23
BMI (Kg/m <sup>2</sup> )	28.3±3.5	29.5±4.3	0.54
Smoking	6.9%	6.2%	0.64
ODI (%)	43.8±17.5	41.7±18.7	0.53

BMI, body mass index; ODI, Oswestry Disability Index; PLF, posterolateral fusion; IBF, interbody fusion.

Perioperative surgical data can be found in Table 2. All patients were decompressed and fused at one level and

decompressed at up to five additional levels. There was no difference between groups in the number of levels decompressed. Dural tears occurred more commonly in the PLF cohort. There was no statistical difference in epidural hematoma or infections requiring a return to the operating room.

**Table 2:** Perioperative data and complications

Variables	PLF group	IBF group	p-value
N	44	46	-
Levels decompressed (median, range)	2, [1-4]	2, [1-5]	0.89
Dural tear	3	2	0.38
Epidural hematoma	0	0	1.0
Infection	2	3	0.34
Reoperation	2	2	0.93

PLF, posterolateral fusion; IBF, interbody fusion.

Post-operative functional (ODI) scores were not statistically different between groups (Table 3). The ODI improvement (change) at five years from baseline in each group was the same for the two surgical treatments (PLF: 17.9%±19.5%; IBF: 17.9%±19.8%). There was no statistically significant difference between the two groups (p=0.96). But both the intervention had significant improvement compared to the preoperative ODI status (p<0.001). When all patients were considered together (PLF with IBF), smokers tended to see their ODI scores worsen, while non-smokers tended to improve their ODI scores. This difference was significant (p=0.043).

**Table 3:** Functional outcome results

Outcome	PLF group	IBF group	p-value
N	44	46	-
Preoperative ODI	43.8±17.5	41.7±18.7	0.53
Postoperative ODI	25.9±21.2	23.8±19.2	0.57
Change	17.9±19.5	17.9±19.8	0.96

ODI, Oswestry Disability Index; PLF, posterolateral fusion; IBF, interbody fusion.

**Discussion**

Our results fail to show any statistically significant or clinically significant difference in the functional outcomes as measured by the ODI between fusion methods such as PLF or IBF at a five-year follow-up (p=0.96). Moreover, both the groups demonstrated significant improvement compared to the preoperative status as depicted by the individual studies on the fusion methods [9-11]. In addition, we found no statistical differences in reoperation rate, infection, or epidural hematomas.

We also noted roughly around 12% of our patients have worse outcome scores after surgery. Unfortunately, for the individual patient, this outcome is not uncommon. Others have also reported on greater (worse) functional outcomes scores after surgery [12-14]. Although our retrospective analysis was not designed to identify specific causes of failed back surgery for which there is a myriad of reasons, including inadequate nerve root decompression, inadequate stabilization, failure to fuse, instrumentation failure, and epidural fibrosis [15, 16], careful screening of patients before surgery will help reduce peri- and post-operative risks and contribute to better functional outcomes [17].

When comparing PLF to IBF, others report mixed results, ranging from the equivalence between the two to favoring IBF. We found no difference between PLF and IBF in

functional outcomes for degenerative spondylolisthesis alone. Results between PLF and IBF were not dependent upon smoking status, although current smokers tended to see their ODI scores worsen, while non-smokers tended to see their ODI scores improve, which is in corroboration with the literature [18].

There was a 6.8% dural tear rate in the PLF group and 4.3% in the IBF group. This difference was not statistically significant. Moreover, there was less direct and more indirect decompression in the IBF cases, which might reduce the rate of dural tear. Nevertheless, the overall results and clinical outcomes did not seem to be affected. This was similarly observed in the SPORT trial too [19]. There was no apparent relationship between surgeon and incidences of dural tears as the complication that occurred had no relationship with the experience of the surgeon [20].

One limitation of our study is its retrospective non-randomized nature. Although we have 123 patients eligible for inclusion we finally included only 70 because the loss to follow-up was largely due to the absence of pre-and/or post-operative ODI scores. This limitation can introduce bias since it is not known if the observed outcomes are different from the unknown outcomes. Because the percentages of patients lost to follow-up were the same for both cohorts, we assume that the results are the same as if there had been fewer lost patients.

Our primary outcomes in this study were functional status (ODI, and complications. Future work should include fusion status and the relative rates of pseudoarthrosis and reoperation between the two cohorts.

## Conclusion

In the management of grade 1,2 degenerative spondylolisthesis, the fusion methods such as PLF or IBF did not have a significant role in improving the functional outcome. There was also no significant difference between the two methods of fusion concerning the dural tear rates, reoperation rate, or infection.

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