

Study of Functional Outcome of Posterior Lumbar Interbody Fusion Technique with Implant in Degenerative Spondylolisthesis at L4 and L5 Level

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Abstract

Background: Lumbar interbody fusion is the most reliable fusion technique currently available for the lumbar spine as these constructs are biomechanically stronger, provide axial support with less graft subsidence or collapse comparing to those with posterolateral arthrodesis, and produce a better biologic fusion in lordotic alignment^{1,2}. **Aims and Objectives:** To study functional outcome of posterior lumbar interbody fusion technique with implant in degenerative spondylolisthesis at L4 and L5 level. **Materials and Methods:** The study was carried on 34 patients enlisting in the casualty or inpatient department of orthopaedics at a medical college and tertiary health care centre. Only those patients satisfying the inclusion and exclusion criteria were included in the study. All the patients were explained about the surgical procedure, the purpose of the study and Informed consent was taken. **Results:** As per Japanese Orthopaedic Association score, Normal results were observed in none of the cases while grade I, II and III was observed in 73.5%, 20.6% and 5.9% cases. Post-op results were observed as normal in 64.7% while Grade I, II and III was observed in 32.4% and 2.9% cases respectively (p<0.01). **Conclusion:** Present study concluded that although, long-term role of deformity correction and restoration of lumbar spinal balance in cases of spondylolisthesis is yet to be determined, the current study appears to indicate that satisfactory radiological correction of degenerative focal sagittal deformity can be achieved with the insert and-rotate PLIF technique. There appeared to be high levels of patient satisfaction in this relatively short-term study and low levels of complications. Longer-term and comparative clinical outcome studies are required.

Keywords: Degenerative Spondylolisthesis, Posterior Lumbar Interbody Fusion Technique, Japanese Orthopaedic Association Score

1. 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 instability¹. This pathology can be caused by ligamentous laxity, a defect in the pars interarticularis, previous surgery, or may be traumatic and occurs in up to 5% of the general population and affects all ages².

The surgical treatment of spondylolisthesis is indicated for 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 listhesis, Meyerding grade III and IV listhesis, and spondyloptosis³⁻⁵. The ideal surgical treatment remains controversial^{6,7}.

Posterior Lumbar Interbody Fusion (PLIF) procedure was first introduced by Cloward for lumbar interbody fusion and neural decompression^{8,9,10}. Though PLIF has shown satisfactory clinical results, it had been associated with a high incidence of fusion complications such as a graft collapse and non-union¹¹. In a recent study, Suk *et al.*, showed that interbody fusions were associated with higher fusion rates, better correction of deformity, better maintenance of correction, and improved clinical

outcomes compared with posterolateral fusion alone. The literature is mixed on whether the evaluation of the long term outcomes of PLIF is important. Previously conducted studies had limitations in terms of different diagnoses, different levels and number of fused segments and different fusion techniques^{12,13}. Therefore, we evaluated the long term outcomes of posterior lumbar interbody fusion technique in degenerative spondylolisthesis with implant at L4-L5 level.



Figure 1. MRI lumbar spondylolisthesis.

2. Materials and Methods

Study Area

Department of Orthopaedics at a Tertiary Health Care Centre

Study Population

Radiologically diagnosed cases of degenerative spondylolisthesis.

Study Design

A Prospective, observational, Clinical study

Sample Size Calculation

The sample size was calculated using following formulae:

$$n = (Z\alpha/2)^2 * (PQ) / L^2$$

where;

n- Sample size

Z $\alpha/2$ - Z value at 5% error (1.96) P- proportion (6%)

Q - 1-P

E - allowable error (taken as 20%)

n- 34

Study Duration

August 2018 to December 2020

2.1 Inclusion Criteria

- Patient's age group 25-70 years irrespective of gender.
- Failure of conservative management.
- Radiologically diagnosed cases of degenerative spondylolisthesis

2.2 Exclusion Criteria

- Metabolic bone disorders.
- Multiple level listhesis.
- Revision surgeries.

2.3 Methodology

The study was carried on 34 patients enlisting in the casualty or inpatient department of orthopaedics at a medical college and tertiary health care centre. Only those patients satisfying the inclusion and exclusion criteria were included in this study. All the patients were explained about the surgical procedure, the purpose of the study and consent was taken.

Detailed clinical history, complete general systemic and local examination and preoperative investigation findings were noted. All the patients were evaluated by anteroposterior and lateral radiographs of lumbosacral spine and were evaluated further by MRI to analyse facet joint pathology. All the patients then underwent posterior lumbar interbody fusion after standard pre-op protocol.

2.4 Post-op Assessment

Radiologic assessment was performed using plain lateral view radiographs immediately after surgery, and at the last follow up examination. We evaluated the % slip, the lordosis at L4-L5, the lumbar lordosis and the adjacent segment degeneration.

The % slip was measured using the Taillard method⁸. The lordosis at L4-L5 was defined as the angle subtended by the superior end plate of L5 and the inferior end plate of L4. Lumbar lordosis was measured from the superior end plate of L1 to the inferior end plate of L5 using the Cobb method.

Functional outcome was measured using Japanese Orthopedic Association Score (JOA) at the end of 6 months.

2.5 Statistical Analysis

The quantitative data was represented as their mean±SD. Categorical and nominal data was expressed in percentage. The paired t-test was used for analysing quantitative data while categorical data was analyzed by using chi-square test. The significance threshold of p-value was set at <0.05. All analysis was carried out by using SPSS software version.

3. Results

Table 1. Distribution of study cases as per age

Age group (years)	N	%
<= 30	2	5.9%
31-40	4	11.8%
41-50	10	29.4%
51-60	10	29.4%
> 60	8	23.5%
Total	34	100.0%
Mean age - 57.3 +/- 11.66 years		

Mean age of the study cases was 57.3 years with 23.5% cases being in elderly age group and 17.7% were below 40 years of age (Table 1).

Table 2. Distribution of study cases as per gender

Gender	N	%
Female	25	73.5%
Male	9	26.5%
Total	34	100.0%

Out of the total 34 cases of spondylolisthesis, 25 (73.5%) were females and 9 (26.5%) were males (Table 2).

A total of 20.6% cases of spondylolisthesis were involved in heavy work while 61.8% were housewives (Table 3).

Mean duration of symptoms was 9.23 months with one third of the cases (32.4%) had symptoms from over 12 months (Table 4).

Back pain was seen in all the cases while limp, numbness and weakness was seen in 41.2%, 26.5% and

Table 3. Distribution of study cases as per occupation

Occupation	N	%
Housewife	21	61.8%
Heavy Work	7	20.6%
Light Work	5	14.7%
Student	1	2.9%
Total	34	100.0%

Table 4. Distribution of study cases as per duration of symptoms

Duration of Symptoms	N	%
< 1 month	2	5.9%
1-6 months	12	35.3%
6-12 months	9	26.5%
> 12 months	11	32.4%
Total	34	100.0%
Mean duration - 9.23 +/- 5.49 months		

Table 5. Distribution of study cases as per presenting complaints

Presenting Complaints	N	%
Back Pain	34	100.0%
Limp	14	41.2%
Numbness	9	26.5%
Weakness	4	11.8%
Bowel/ Bladder Dysfunction	2	5.9%

Table 6. Mean per pre-op parameters among study cases

Post-op Parameters	Mean	SD	Min	Max
Slip (%)	2.6	0.7	1.2	5.0
Lumbar Lordosis (deg.)	13.9	4.2	2.9	20.1
JOA Score	15.1	1.9	9.0	18.0

11.8% cases respectively. Bowel or bladder dysfunction was seen in 5.9% cases (Table 5).

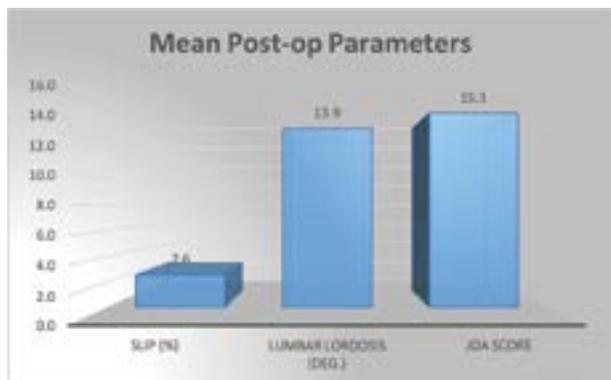
Mean slip was seen as 17.6% while lumbar lordosis and JOA score was observed as 11.5 degrees and 11.9 respectively (Table 6).

As per Japanese Orthopaedic Association score, Grade I, II and III were observed in 73.5%, 20.6% and 5.9% cases (Table 7).

Table 7. Distribution of study cases as per pre-op JOA grade

JOA Grade	N	%
Normal	0	0.0%
Grade 1	25	73.5%
Grade 2	7	20.6%
Grade 3	2	5.9%
Total	34	100.0%

Graph 1. Mean post op parameters among study cases



Among post-op parameters, mean slip was seen as 2.6% while lumbar lordosis and JOA score was observed as 13.9 degrees and 15.1 respectively (Graph 1).

Table 8. Distribution of study cases as per post-op JOA Grade

JOA Grade	N	%
Normal	22	64.7%
Grade 1	11	32.4%
Grade 2	1	2.9%
Grade 3	0	0.0%
Total	34	100.0%

As per Japanese Orthopaedic Association score, post op results were observed as normal in 64.7% while Grade I, II and III was observed in 32.4% and 2.9% cases respectively (Table 8).

Table 9. Mean pre and post-op comparison of slip percentage, lumbar lordosis and JOA score

Variables	Time	N	Mean	SD	p- value
Slip (%)	Pre-	34	17.59	4.24	<0.01
	Post	34	2.56	0.68	

Lumbar Lordosis	Pre-	34	11.54	4.72	<0.01
	Post	34	13.93	4.21	
JOA Score	Pre-	34	11.85	2.15	<0.01
	Post	34	15.15	1.92	

Mean slip (%) was significantly reduced after posterior lumbar interbody fusion while mean lumbar lordosis and JOA score improved significantly (p<0.01) (Table 9).

Table 10. Comparison of pre and post-op JOA grade among study cases

JOA Grade	Pre-op		Pre-op	
Normal	0	0.0%	22	64.7%
Grade 1	25	73.5%	11	32.4%
Grade 2	7	20.6%	1	2.9%
Grade 3	2	5.9%	0	0.0%
Total	34	100.0%	34	100.0%
p- value <0.01				

As per Japanese Orthopaedic Association score, Normal results were observed in none of the cases while grade I, II and III was observed in 73.5%, 20.6% and 5.9% cases. Post op results were observed as normal in 64.7% while Grade I, II and III was observed in 32.4% and 2.9% cases respectively (p<0.01) (Table 10).

Table 11. Distribution of study cases as per complications

Complications	N	%
Neuropathic Pain	2	5.9%
Wound Infections	1	2.9%
Re-operation*	1	2.9%
None	30	88.2%
*adjacent segment canal stenosis		

No complication was observed in 88.2% cases while neuropathic pain and wound infection was seen in 5.9% and 2.9% cases respectively. Re-operation was required in 1 case (2.9%) due to canal stenosis (Table 11).

4. Discussion

Present study aimed to evaluate the functional outcome of posterior lumbar interbody fusion technique with implant in degenerative spondylolisthesis at L4 and L5 level. Study

included 34 radiologically diagnosed cases of degenerative spondylolisthesis. All the patients underwent posterior lumbar interbody fusion after standard pre-op protocol. We evaluated the % slip and the lumbar lordosis at L4 and L5 both pre- and post-operatively. Functional outcome was measured using Japanese Orthopedic Association Score (JOA) at the end of 6 months.

4.1 Demography

Mean age of the study cases was 57.3 years with 23.5% cases being in elderly age group. Out of the total 34 cases of spondylolisthesis, 25 (73.5%) were females and 9 (26.5%) were males (Table 2).

Patil T *et al.*,⁶ in studied the clinical profile of patients with degenerative spondylolisthesis. About 28% of the patients belonged to 61-65 years. About 24% of the patients belonged to 56-60 years. The mean age was 62.1 years. In a study by Alunima *et al.*,⁷ the mean age was 57.1 years. In a study by Ekman *et al.*,⁸ the mean age of the patients was 40 years. In a study by Abdu *et al.*,⁹ the mean age was 59.7 years. In a study by Kim *et al.*,¹⁰ the mean age of the patients was 53.4 years. In a study by La Rosa *et al.*,¹¹ the mean age of the patients was 57.2 years (Table 1).

The sex-wise distribution had shown that, 57.34% were females and 42.67% were males in the study by Patil T *et al.*,⁶ In a study by Alunima *et al.*,⁷ 61.1% cases were females while 38.9% were males. In a study by Ekman *et al.*,⁸ 53 female patients were observed as compared to 33 males. In a study by Abdu *et al.*,⁹ 79.4% cases were females while in the study by Kim *et al.*,¹⁰ 72.9% cases were females.

4.2 Clinical Presentation

In present study, back pain was seen in all the cases while limp, numbness and weakness was seen in 41.2%, 26.5% and 11.8% cases respectively. Bowel or bladder dysfunction was seen in 5.9% cases (Table 5).

In the study by Amin MR *et al.*,⁵ pain was the main indication for surgery in all 40 cases. Severe pain was in 31 cases and excruciating in 5 cases. Limp was seen in 40% cases while weakness and bowel/bladder problem was seen in 17% and 12.5% cases. Sears W *et al.*,¹ Trouillier H *et al.*,² and Devkota P *et al.*,³ in their studies also observed pain as the primary indication for surgery, seen in almost all cases followed by neurological symptoms.

4.3 Functional Outcome

Pre-operatively, mean slip was seen as 17.6% while lumbar lordosis and JOA score was observed as 11.5 degrees and 11.9 respectively. Post-operatively, mean slip was seen as 2.6% while lumbar lordosis and JOA score was observed as 13.9 degrees and 15.1 respectively (Table 10). Mean slip (%) significantly reduced after posterior lumbar interbody fusion while mean lumbar lordosis and JOA score improved significantly ($p < 0.01$). As per Japanese Orthopaedic Association score, Grade I, II and III were observed in 73.5%, 20.6% and 5.9% cases pre-operatively. Post op results were observed as normal in 64.7% while Grade I, II and III was observed in 32.4% and 2.9% cases respectively (Table 11).

Sears W *et al.*,² in their study observed mean preoperative slip was 20.0% (range, 12% to 33%) while mean preoperative focal lordosis was 13.1 degrees. Mean preoperative slip reduced from 20.2% to 1.7% (92% correction, $p < .001$). Mean focal lordosis increased from 13.1 to 16.1 degrees (26.0% increase, $p = 0.01$). Thirty-one of 34 patients (91%) considered their outcome to be good or excellent. Devkota P *et al.*,⁴ observed 38 (52.77%) cases of grade I, 14 (19.44%) cases of grade II and 20 (27.77%) cases of grade III according to the grading criteria of Meyerding. According to the evaluation criteria used by Stauffer and Coventry, 59 patients (81.94%) got good results, eight patients (11.11%) belonged to the fair group and five cases (6.94%) had the poor results. Clinical outcome were measured by Oswestry disability index by Amin MR *et al.*⁵. Excellent results were seen in 25 patients (62.5%), good in 12 patients (30%) and fair in 3 patients (7.5%)

4.4 Complications

In present study, no complication was observed in 88.2% cases while neuropathic pain and wound infection was seen in 5.9% and 2.9% cases respectively. Re-operation was required in 1 case (2.9%) due to canal stenosis.

5. Conclusion

Present study concluded that although, long-term role of deformity correction and restoration of lumbar spinal balance in cases of spondylolisthesis is yet to be determined, the current study appears to indicate that satisfactory radiological correction of degenerative focal sagittal deformity can be achieved with the insert and-

rotate PLIF technique. There appeared to be high levels of patient satisfaction in this relatively short-term study and low levels of complications. Longer-term and comparative clinical outcome studies are required.

5.1 Complications

Elias J *et al.*,¹ in their study observed minor wound complication in 4.5% (three patients) while low back pain was seen in 15% cases. One patient incurred a permanent motor deficit with sexual dysfunction (1.4%). Additional procedures were required in 14 out of 67 cases (20%). Sears W *et al.*,² in their study observed 34 cases of degenerative spondylolisthesis. Postoperatively, 1 (2.9%) patient developed deep wound infection, which settled on antibiotics while 1 (2.9%) patient required extension of his fusion at 12 months for adjacent segment stenosis. Amin MR *et al.*,⁵ in their study observed that 2 out of 34 cases (5.9%) had hardware failure, 1 (2.9%) developed pseudoarthrosis while 1 (2.9%) patient had post-operative wound infection.

Thus to summarize, (Table 12) present study indicates that satisfactory radiological correction of degenerative focal sagittal deformity can be achieved with the insert and-rotate PLIF technique. There appeared to be high levels of patient satisfaction in this relatively short-term study and low levels of complications. Longer-term and comparative clinical outcome studies are required.

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How to cite this article: Harkar, V. G., Agarwal, M., Devasthali, K. S., Chudasama, V. D. and Zade, S. S. To Study Functional Outcome of Posterior Lumbar Interbody Fusion Technique with Implant in Degenerative Spondylolisthesis at L4 and L5 Level. *MVP J. Med. Sci.* 2021; 8(2): 313-318.