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Outcomes of instrumented posterolateral fusion in patients with low grade lumbar spondylolisthesis

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Abstract

Background: Spondylolisthesis the forward slippage of a cephalad vertebra on a caudal vertebra. Fusion is the recommended procedure for spondylolisthesis. However, choice between the different methods of fusion remains under debate. Posterolateral fusion with posterior instrumentation (PLF) has shown good clinical outcomes and fusion rates.

Objectives: To study clinical and radiological outcomes of PLF in grade 1 and 2 spondylolisthesis.

Methods: This is a prospective study of 30 patients who underwent PLF and followed up for 2 years. The outcome measures were (1) clinical outcomes as assessed with a visual analogue scale and the Modified Oswestry Disability Index, (2) the fusion rate based on radiographs.

Results: There was a significant improvement in VAS of low back pain (82.45%, $p < 0.001$) and VAS of radiating (93.55%; $p < 0.001$). The ODI scores were significantly improved (69.86%, $p < 0.001$) at 2 years follow up. The fusion rate was 70% and 63.33% patients reported excellent outcomes.

Conclusion: Based on 2 year clinical outcomes and the fusion rates of PLF, we conclude that PLF is an excellent surgical procedure for management of low grade spondylolisthesis.

Keywords: PLF, fusion, VAS, ODI, spondylolisthesis

Introduction

Spondylolisthesis commonly describes the forward slippage of a cephalad vertebra on a caudal vertebra. Although vertebra may slip in any direction, forward slippage is more commonly reported [1]. Surgery with fusion has been proven to be the effective management of spondylolisthesis [2]. Various methods of fusion have been described. They can broadly be classified as posterolateral fusion and interbody fusion [3].

Posterolateral fusion combined with posterior instrumentation (PLF) is a widely used procedure with proven fusion rates and superior clinical outcomes. PLF includes pedicle screw fixation, decompression of the spinal canal to relieve pain and nerve compression, and fusion with bone graft. PLF has been shown to be safe, with improved biomechanics of the spine by restoring sagittal alignment [4].

In spite of several recent studies, there remains considerable debate for the best operative technique for spondylolisthesis [5-11].

Our objectives were; 1. To compare functional outcomes as assessed with a visual analogue scale (VAS) and the Oswestry disability index (ODI) before surgery and 2 years after the surgery. 2. To assess fusion rates at 2 years after the surgery.

Material and Methods

Source of Data: The study was conducted in the Department of Orthopaedics, Vydehi Institute of Medical Sciences and Research Centre, Whitefield, Bangalore, following institutional guidelines and after ethical committee approval

Patient Demographics: The study was a prospective study of 30 patients conducted between January 2016 and May 2019, with a follow up of 2 years. We included patients between ages 18-70 years, with single level low grade spondylolisthesis (Meyerding grade I or II) and failed conservative therapy. Patients with, failed back syndrome, infections, bedridden/non ambulatory patients and cognitively impaired patients were excluded from the study.

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Patient demographics including age, sex and levels of lesion are summarized in Table 1.

Table 1: Patient demographics PL

| | |
|---|------------------|
| Mean Age (Years) | 49.6±7.06 |
| Total Number of Patients | 30 |
| Male | 12 (40%) |
| Female | 18 (60%) |
| Level of Lesion | |
| L4-L5 | 19 (63.3%) |
| L5-S1 | 11 (36.7%) |
| Grade of Slip (Meyerding Classification) | |
| Grade 1 | 12 (40%) |
| Grade 2 | 18 (60%) |

Table shows summary of mean age of patients, number of male and female patients, level of lesion, and Meyerding grade of slip.

Surgical procedure

PLF procedure have been performed using the standard described technique [12]. An open midline dissection was performed and was carried down the lamina bilaterally to the level of the facet joints and transverse processes. Segmental, bilateral polyaxial pedicle screw fixation was done at all levels treated, by free hand technique. Reduction screws are used selectively as per preoperative planning. Final screw position is confirmed using image intensifier. In cases with adjacent segment degenerative changes, fixation was extended to one more level. This was proceeded with laminectomy and decompression. Discectomy was done when required. Graft bed was prepared by decorticating transverse processes. Laminectomy bone chips and spinous process were used as bone graft and placed posterolaterally between the facets and transverse processes of the vertebrae (Figure 1).



Fig 1: Posterolateral fusion

(A) Pre-operative lateral radiograph showing grade 2 spondylolisthesis of L4 over L5. (B). Post-operative lateral radiograph showing pedicle screw fixation. (C). Intra operative picture showing pedicles screws and bone graft placed posterolaterally.

Outcomes measures

Visual Analogue Scale (VAS) of low back pain, VAS of leg pain and Oswestry disability index (ODI) were assessed at regular intervals and comparisons were made between preoperative and 2 year follow up scores. Radiographic fusion was assessed by Lenke classification [13].

Statistical analysis

Descriptive statistics were used. Data is analysed and plotted using the JASP (Version 0.10.2, University of Amsterdam)

software. P value less than 0.05 is considered statistically significant. Numerical values are expressed as mean± standard deviation.

Results

Clinical and radiographic outcomes are summarized in Table 2.

The mean pre-operative VAS score low back ache was 7.87±0.68 and at two years follow up was 1.37±0.85. There is a significant improvement (82.45%, $P < 0.001$) in VAS scores for back ache (Figure 2A).

21 out of 30 patients had radiating pain along with back pain. The mean pre-operative VAS score for radiating pain was 3.83±2.72 and at two year follow up was 0.3±0.47. There is a significant improvement (93.55%, $P < 0.001$) in VAS scores for radiating pain (Figure 2B).

The mean pre-operative ODI score was 64.73±3.66 and at two-year follow was 19.47±2.73. There is a significant improvement (69.86%, $P < 0.001$) in ODI scores (Figure 2C). Fusion was assessed following Lenke Classification. Based on the classification, 6 patients were Grade A, 15 patients were Grade B. Both Grades A and B are considered for Fusion. 7 patients were Grade C and 2 patients were Grade D (Figure 3 A, B, C, D). Overall, there is 70% fusion rate radiologically. Overall outcome was assessed based on ODI score at 2 year follow up (Figure 2D). There was excellent outcome in 19 patients (63.33%) and good outcome in remaining 11 patients (36.67%).

There was no incidence of infections in either of the groups. Intraoperatively, 2 patients had dural tears, which were repaired immediately. None of the patients had any neurological deficits post-surgery. Re-operative rate at two years follow up was zero.

Table 2: Clinical and Radiographic Outcomes

| Visual Analog Scale- Low Back Ache (N=30) | | |
|--|-------------|-----|
| Pre-Operative | 7.87±0.68 | |
| 2 Year Follow Up | 1.37±0.85 | |
| Percentage Improvement | 82.45±11.06 | |
| Significance | $P < 0.001$ | |
| Visual Analog Scale-Radiating Pain (N=21) | | |
| Pre-Operative | 3.83±2.72 | |
| 2 Year Follow Up | 0.3±0.47 | |
| Percentage Improvement | 93.55±8.73 | |
| Significance | $P < 0.001$ | |
| Oswestry Disability Index Score (N=30) | | |
| Pre-Operative | 64.73±3.66 | |
| 2 Year Follow Up | 19.47±2.73 | |
| Percentage Improvement | 69.86±4.38 | |
| Significance | $P < 0.001$ | |
| Fusion: Lenke Classification | | |
| Grade A * | 6 | 70% |
| Grade B* | 15 | |
| Grade C | 7 | |
| Grade D | 2 | |
| Overall Outcome | | |
| Excellent (ODI 0-20) | 19 (63.33%) | |
| Good (ODI 21-40) | 11 (36.67%) | |

Table shows summary of VAS scores, ODI scores, Fusion rates and overall outcome in PLF.

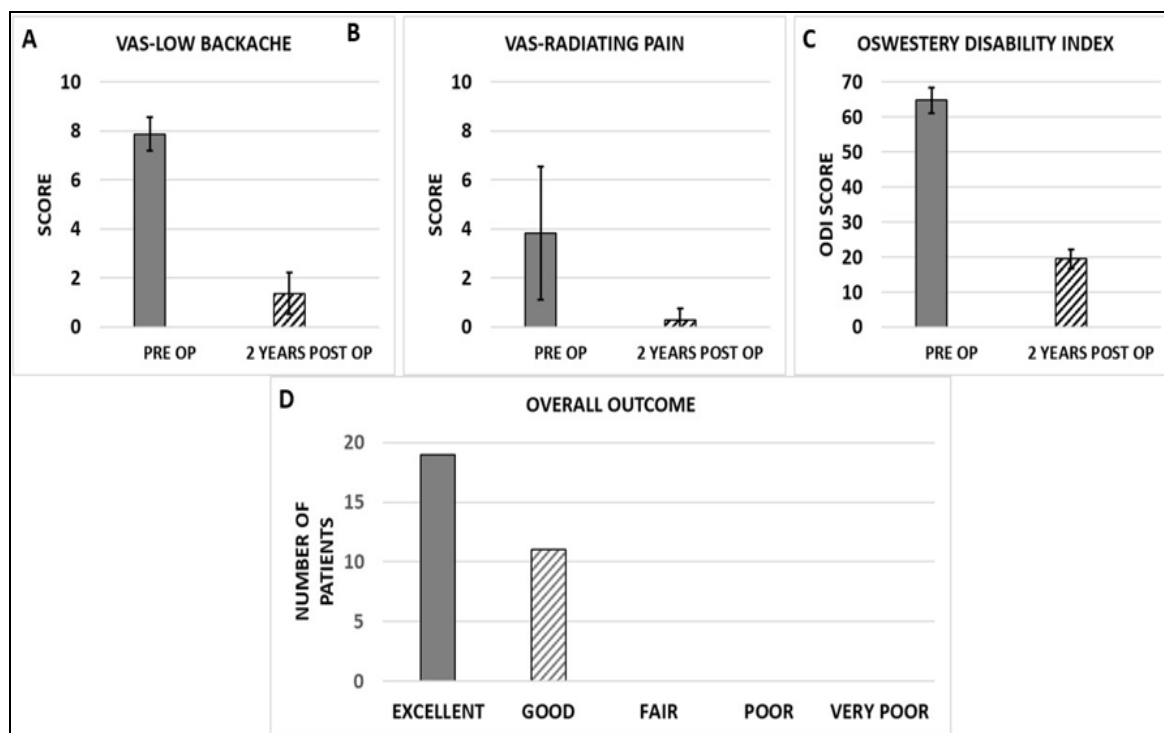


Fig 2: Functional Outcomes in PLF Comparison of VAS scores for low back ache (A), radiating pain (B), Oswestry Disability index score (C) of patients before surgery and at 2 years follow up. (D). Overall outcome of patients at 2 years follow up.

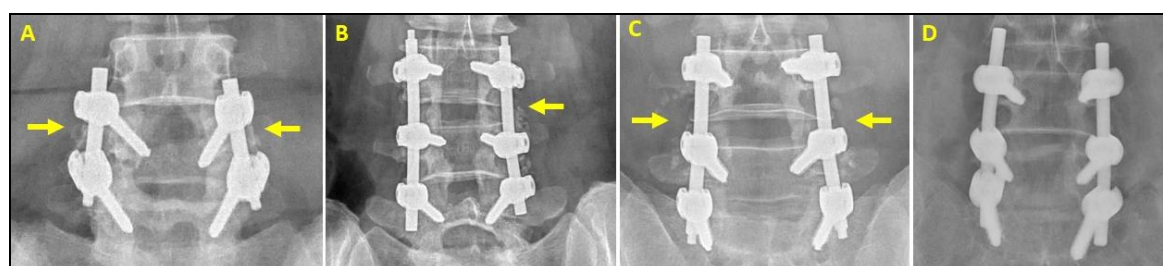


Fig 3: Fusion in PLF Radiographs showing Lenke's Grade A, B, C, D fusion in patients who underwent PLF

Discussion

Spondylolisthesis is one of the common causes for low back pain. The symptoms usually vary with severity of slip and associated degenerative changes. We included symptomatic patients with low grade (1 and 2, Meyerding Classification) lumbar spondylolisthesis in our study. All these patients were given a trial of conservative non-surgical treatment, but their symptoms have not been resolved. We chose posterior instrumentation with posterolateral fusion as our surgical procedure of choice. The goal of the surgical treatment included: the stabilization of the motion segment, the decompression of neural elements, the restoration of sagittal plane translation and prevent further slip.

The mean age of the patients being treated for spondylolisthesis, according to the available studies has varied from 39.5 years to 57.4 years, with range being 21 years to 70 years [14]. Our study included 30 patients with mean age being 49.6 years, with youngest patient being 38 years and oldest being 66 years.

Spondylolisthesis, especially degenerative has shown more prevalence in females, with studies [15] showing a female: male (F: M) ratio of 1.3:1. We had 18 female and 14 male patients in our study, showing an F: M ratio of 1.5:1.

Lumbar spondylolisthesis commonly involves L4-L5 and L5-S1 levels. L4-L5 level is commonly involved in degenerative spondylolisthesis [16], whereas isthmic spondylolisthesis is more common at L5-S1 level [17]. We included all the patients

with spondylolisthesis from age 18 to 70 years. Our study had 19 patients (63.3%) with lesion at L4-L5 level and 11 patients at L5-S1 level (36.7%).

Endler *et al.*, 2017 [18], in a prospective study reported that the VAS scores for back pain reduced by 63% and for radiating pain reduced by 55% in patients who underwent PLF at two years follow up. Challier *et al.*, 2017 [19], in a randomized controlled trial (RCT) reported that VAS back pain improved by 3.8 and VAS leg pain improved by 3.4 in the PLF group. Etemadifar *et al.*, 2016 [20] in a RCT with two years follow up reported that the VAS scores for back pain and leg pain were significantly decreased in PLF group. Lee *et al.*, 2014 [21], in a prospective randomized study reported mean VAS scores for back pain decreased from 8.7 to 1.5 and for leg pain decreased from 6.4 to 0.9 at 2 years follow up. In our study, we also observed that at 2 years followed up, VAS score for back pain improved by 82.45% and that of radiating pain improved by 93.55%.

We used ODI to assess functional outcome. We assessed percentage improvement in ODI at two years follow up. Endler *et al.*, [18], in their prospective study reported a 51.25% improvement in ODI score in PLF group. Challier *et al.*, [19] in their RCT, reported that ODI scores improved by 19 in the PLF group. Etemadifar *et al.*, [20] in their RCT, observed that ODI improved by 53.2% in the PLF group. Lee *et al.*'s study [21] showed a significant improvement of 70% in ODI scores at 2 year follow up in PLF group. In our study, we observed

69.86% improvement in ODI score. Based on ODI score 63.33% patients reported excellent outcomes.

We had a significant improvement in clinical outcome and we analyzed if the radiological outcome in terms of fusion supported it. Challier *et al.*'s RCT^[19] reported a fusion rate of 56.7% in the PLF group. Lee *et al.*'s study^[21] showed a fusion rate of 89.7% at 2 year follow up in PLF group Levin *et al.*, 2018^[22], in their meta-analysis of 2 RCT's and 5 cohort studies, reported that the pooled fusion success rate was 84.7% in the PLF group of patients. Müslüman *et al.*, 2011^[23], in a randomized study reported 84% fusion rate at 2 years follow up in patients who underwent PLF. In our study, we observed 70% fusion rate in PLF, which is consistent with the recent studies.

Every study has limitations and so did we. Our sample size is 30, which is relatively small when compared to many prospective studies. Our duration of follow up is 2 years and longer studies may show higher fusion rates. Apart from this our operative technique and analysis of results are consistent with the recent and standard literature.

By analyzing our results and comparing them with recent studies, we conclude that posterolateral fusion with posterior instrumentation is a well-established and proven procedure to achieve better clinical outcomes and a solid fusion in adults with low grade spondylolisthesis.

Declaration

The authors did not receive any funding for this study. There are no conflicts of interests.

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