

STUDY OF FUNCTIONAL OUTCOME OF LUMBAR SPONDYLOLISTHESIS TREATED WITH POSTERIOR LUMBAR INTERBODY FUSION WITH INSTRUMENTATION – A RETROSPECTIVE STUDY

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ABSTRACT

Background: Low back pain (LBP) is a quite common problem observed globally. When motion is the source of pain, the theory is that if the painful vertebrae remain fixed, they should be free of pain. Hence, they must be fixed with adjacent normal vertebrae. So that they heal into a single solid bone. The posterior approach is quite ideal and safer. **Materials and Methods:** 111 (one hundred and eleven) adults with LBP treated with Transforaminal Lumbar Interbody Fusion (TLIF) through a posterior approach. After decompression and discectomy and interbody cage placement with autologous bone graft, followed by pedicle screw fixation. **Result:** The functional outcome improvements are studied with ODI and VAS, and the P-value was highly significant ($p < 0.001$). A radiological study of pre- and post-operative (at the sixth month) was compared, and the p-value was highly significant, and 93.6% (9/111) fusion was observed. **Conclusion:** The TLIF technique ensures successful fusion in spondylolisthesis patients. After 6 months of follow-up, they can lead a normal quality of life.

INTRODUCTION

Low back pain (LBP) is one of the major problems reported in adults globally. The common causes of LBP include injury or overuse and pressure on neural tissue from different patho-physiological conditions (disc herniation, stenosis, degeneration of the disc, etc.).^[1]

Spinal fusion is a surgical procedure used to correct problems with the small bones in the vertebrae. It is essentially a "welding process." The basic idea is to fuse together the painful vertebra with other normal adjacent vertebrae so that they heal into a single solid bone.^[2]

Spinal fusion is a treatment option when motion is the source of pain. The theory is that if the painful vertebrae do not move, they should not hurt.

Posterior lumbar interbody fusion (PLIF) is done to obtain interbody vertebral fusion through a posterior approach. The advantage of PLIF over anterior lumbar interbody fusion (ALIF) is the avoidance of vascular and reproductive system complications that can occur with anterior lumbar surgery. PLIF is used to manage a variety of spinal pathologies, including degenerative disc disease, severe instability, spondylolisthesis, deformity, and trauma.^[3]

Many different modalities have been advocated by different surgeons globally from time to time. Initially, LBP was treated conservatively. However,

when the symptoms persist, surgery needs to be performed. Interbody fusion techniques have been developed to provide solid fixation of spinal segments while maintaining load bearing capacity and proper disc height.^[4] Hence, an attempt is made to evaluate the PLIF in the adult population.

MATERIALS AND METHODS

111 (one hundred eleven) adult patients aged between 25 and 58 years old admitted to the orthopedic department of Kempegowda Institute of Medical Sciences, Bangalore-5600070, Karnataka, India, were studied.

Inclusive criteria: Patients above 20 years of age with grade-I or grade-II isthmic spondylolisthesis (L4-L5 or L5-S1) according to the Meyerding classification. Patients clinically (radiologically) diagnosed with lumbar spondylolisthesis having symptoms of persistent back pain, radiculopathy, or neurogenic claudication for >6 months and not responding to conservative treatment (or management). The patients who gave their consent in writing for study were selected.

Exclusion criteria: Degenerative or traumatic spondylolisthesis, multilevel involvement, and patient has already undergone previous spinal surgery. Spinal infections or tumors were excluded. Functional outcome parameters (tools);

- Oswestry Disability Index (ODI): A validated 10-item questionnaire assessing functional disability related to low back pain with scores ranging from 0 to 100%.
- Visual Analogue Scale (VAS) for back and leg pain: A 100 mm horizontal line with anchors representing “No pain” (0) and “worst pain imaginable” (100).
- Both scores were recorded at the preoperative baseline, the 3rd, the 6th and the 6th months postoperatively

Surgical techniques: Every patient underwent single-level TLIF (transforaminal lumbar interbody fusion) through a posterior approach. After decompression and discectomy, an interbody cage was placed with an autologous bone graft, followed by pedicle screw fixation.

Preoperative planning:

- **Indications:** Grade I or II isthmic spondylolisthesis (L5-S1), mechanical back pain, radiculopathy, and not responding to conservative management (treatment).
- **Imaging:** X-ray (standing, dynamic flexion – extension)
- **MRI:** To assess nerve root + compression.
- **CT:** To find out bony pars defect
- **Plan:** Decompression + reduction if required + interbody fusion (TLIF) + pedicle screw instrumentation.
- **Positioning:** Prone on a radiolucent table with bolsters under chest and pelvis. Maintained the lumbar lordosis. Ensured the neutral alignment and c-arm access.
- **Incision and exposure:** A middle posterior incision was taken (8-10 cm). Subperiosteal dissection of paraspinal muscles (Wiltse approach optional) to expose bilateral facets, lamina, and transverse process of L5-S1.
- Pedicle screw insertion was carried out between L5 and S1 screws bilaterally under c-arm guidance or navigation. Screws are not fully tightened initially to allow reduction maneuvered later.
- **Decompression:** Hemilaminectomy (usually unilateral) at L5. Complete facetectomy (on the approach side) pars defect is visualized, and fibrous tissue is excised. Identified and decompressed the L5 root and traversing S1 root.
- **Discectomy and endplate preparation:** Annulotomy is made on the side of approach. Disc material removed completely. Curettes and rasps were used to prepare end plates (aggressive scrapping was avoided). Disk space was restricted using sequential dilators or trials.
- **Interbody cage insertion:** TLIF banana-shaped PEEK/ Titanium cage inserted obliquely across midline filled with autograft (local bone) ± DBM/allograft Ensured no impingement on nerve roots.
- **Reduction (if required):** Applied gentle compression across screws using rods. Sequential tightening of screws can help achieve a reduction

in slippage. Aggressive manipulation to prevent neural stretch is avoided.

- **Posterolateral fusion:** Decorated the transverse process of L5 and sacral-based bone graft for posterolateral fusion.
- **Closure:** Hemostasis ensured deep fascia, subcutaneous tissue, and skin were closed in layers.
- Drain the place if needed.

Duration of study was June 2025 to July 2026.

Statistical analysis: The functional outcome improvements in ODI and VAS. A radiographic study comparing pre- and post-operative results (at 6 months) was conducted using a t-test. The statistical analysis was carried out in SPSS software; the ratio of males and females is 2:1.



Image 1: Pre-operative MRI



Image 2: Intra Operative Cage Fixation (TLIF)



Image 3: Intra operative Fluoroscope Images



Image 4: Post operative X-ray (AP View)



Image 5: Post operative X-Ray (Lateral View)

RESULTS

[Table 1] Comparison of functional outcome improvement in ODI and VAS parameters

- Pre-operative: 55.8 ($\pm$ 6.4) in ODI, 7.3 ($\pm$ 2.1) in VAS; t-test was 75.8 and $p < 0.001$.
- 3rd month: 30.3 ($\pm$ 5.8) in ODI, 3.9 ($\pm$ 1.0) in VAS; the t-test was 47.2 and $p < 0.001$.
- 6th month: 22.2 ($\pm$ 4.8) in ODI and 2.6 ($\pm$ 0.8) in VAS; the t-test was 42.4 and $p < 0.001$.
- 12th month: 18.4 ($\pm$ 3.6) in ODI and 2.1 ($\pm$ 0.1) in VAS; the t-test was 47.2 and $p < 0.001$.

[Table 2] Comparative study of radiographic outcomes in pre-operative and post-operative outcomes (at 6 months).

- Slip percentage: 33.2 ($\pm$ 6.3) pre-operatively and 9.0 ($\pm$ 3.5) post-operatively (at the 6th month); t-test: 35.3 and $p < 0.001$.
- Segmental lordosis: 6.6 ($\pm$ 2.2) pre-operative, 14.3 ($\pm$ 4.2) post-operative (at the 6th month), t-test 17.1, and $p < 0.001$.
- Radiographic fusion observation was 93.6% (9/11).

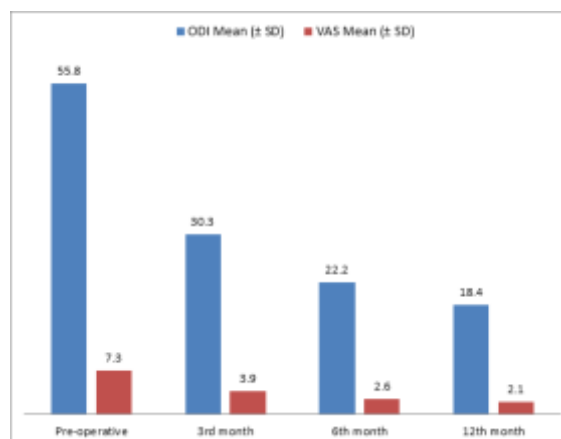


Figure 1: Comparison of functional outcome improvements in ODI and VAS parameters

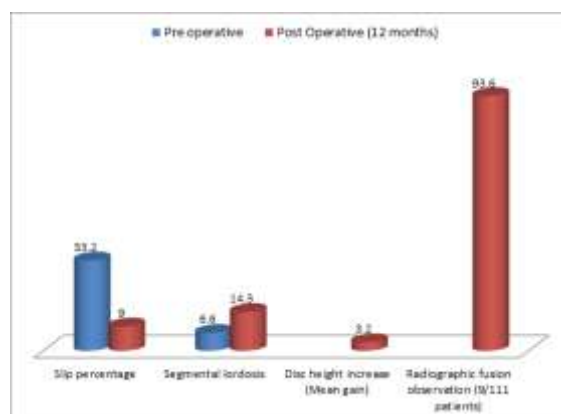


Figure 2: Comparative study of radiographic post operative outcomes.

Table 1: Comparison of functional outcome improvements in ODI and VAS parameters

Time point	ODI Mean ($\pm$ SD)	VAS Mean ($\pm$ SD)	t-test	p-value
Pre-operative	55.8 ($\pm$ 6.4)	7.3 ($\pm$ 2.1)	75.8	P<0.001
3rd month	30.3 ($\pm$ 5.8)	3.9 ($\pm$ 1.0)	47.2	P<0.001
6th month	22.2 ($\pm$ 4.8)	2.6 ($\pm$ 0.8)	42.4	P<0.001
12th month	18.4 ($\pm$ 3.6)	2.1 ($\pm$ 0.5)	47.2	P<0.001

Table 2: Comparative study of radiographic post operative outcomes

Parameters	Pre operative	Post Operative (12 months)	t-test	p-value
Slip percentage	33.2 ($\pm$ 6.3)	9.0 ($\pm$ 3.5)	35.3	P<0.001
Segmental lordosis	6.6o ($\pm$ 2.2)	14.3o ($\pm$ 4.2)	17.1	P<0.001
Disc height increase	--	Mean gain of 3.2mm	--	--
Radiographic fusion observation	--	93.6% (9/111 patients)	--	--

Dynamic X-ray demonstrated 93.6% of significant improvement in sagittal alignment and disc height restoration is observed.

DISCUSSION

Present study of functional outcome of lumbar spondylolisthesis treated with posterior lumbar interbody fusion with instrumentation. Comparison of functional outcome improvements (ODI and VAS) had significant p-values ($p < 0.001$) [Table 1]. Radiographic study of pre-operative and post-operative (at 6th month) had a significant p-value ($p < 0.001$); 93.6% (9/111) had a positive outcome [Table 2]. [Image 1 to 5]. These findings are observed more or less in previous studies.^[5-7]

Over the past several decades, continuous modifications and refinements of surgical techniques, such as minimizing the level of neural tissue required and avoiding broad dissection of the paraspinal musculature during PLIF, have contributed to a reduction in operative risks, operating time, and blood loss during the procedure.^[8]

The major advantage of TLIF in isthmic spondylolisthesis is that it offers multiple benefits, such as restoration of disc height and foraminal space. Decompression of nerve roots without extensive retraction. Moreover, it also corrects segmental kyphosis and sagittal imbalance. Achievement of 360-degree fusion via a posterior approach without any significant postoperative complications.^[9]

A higher fusion rate was observed in PLIF; the successful fusion status can result in a better functional outcome and better satisfaction, which is a clinical advantage.^[10] It is also reported that PLIF is more efficient in degenerative spondylolisthesis as compared to other techniques, and significant fusion rates are also observed in the PLIF technique.^[11]

CONCLUSION

PLIF has the advantages of relief of postoperative pain as well as improvement of patients' satisfaction. The PLIF technique can increase the fusion rate and decrease the reoperation rate. The present study demands that such clinical trials to be conducted in a large number of patients to validate the present significant results and findings.

Limitation of study: Owing to remote location of research Centre, small number of patients and lack of

latest techniques we have limited findings and results.

- This research paper is approved by the Ethical Committee of Kempegowda Institute of Medical Sciences, Bangalore-560070, Karnataka.
- No Conflict of Interest
- Self Funding

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