

Comparative Study of Posterior Lumbar Interbody Fusion and Transforaminal Lumbar Interbody Fusion Treatment in Adult Degenerative Spondylolisthesis

Saurabh Bansal¹, Mukul Agrawal², Pallela Sai Mani Kumar³, Ramdhan Naranja⁴

¹Associate Professor, Department of Orthopaedics, Krishna Mohan Medical College and Hospital, Mathura

²Assistant Professor, Department of Orthopaedics, Krishna Mohan Medical College and Hospital, Mathura

³PG-Resident, Department of Orthopaedics, Krishna Mohan Medical College and Hospital, Mathura

⁴PG-Resident, Department of Orthopaedics, Krishna Mohan Medical College and Hospital, Mathura

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Corresponding Author: Dr. Mukul Agrawal

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Abstract

Background: In order to treat adult degenerative spondylolisthesis, this study will compare the therapeutic outcomes of transforaminal lumbar interbody fusion (TLIF) and posterior lumbar interbody fusion (PLIF) with pedicle screw fixation. Two frequent surgical methods for degenerative spondylosis and disc degeneration are posterior lumbar interbody fusion (PLIF) and transforaminal lumbar interbody fusion (TLIF). For the treatment of lumbar spondylolisthesis, a number of surgical methods have been suggested; nevertheless, there is still debate over the best surgical method. In each of these procedures, the indications and contraindications for TLIF and PLIF are identical. The benefits of PLIF include a 360-degree fusion with only one incision, superior anatomical structure visualization via the posterior approach, and neural decompression with preservation of posterior support structures. The drawbacks include a higher risk of nerve root and dural injury.

Aim: This study is to compare the therapeutic effect of posterior lumbar interbody fusion (PLIF) and transforaminal lumbar interbody fusion (TLIF) with pedicle screw fixation on treatment in adult degenerative spondylolisthesis.

Material and Method: The present study was a retrospective study. All the patients presenting to the OPD department of Orthopedics with a history of recurrent shoulder dislocation were included as the study population. A retrospective study on patients with L5–S1 or L4–L5 adult degenerative spondylolisthesis (grades I–II) had PLIF or TLIF. 60 patients initially fulfilled the study criteria, and 10 patients were lost to follow-up. Thirty-five of the 50 patients that were left for analysis received PLIF with two cages. The institute's Ethical Committee gave the study its blessing. Written informed consent was obtained from the participants before the selected subjects were visited and the questionnaire was delivered. Based on each patient's unique clinical demands, the surgeon's preferences, and the patients' requests in accordance with informed consent and an explanation of the various surgical methods, a customized lumbar fusion approach was chosen.

Results: There was no discernible difference in the rate of spondylolisthesis and decrease between the first postoperative follow-up and the last postoperative follow-up. The two groups exhibited comparable rates of spondylolisthesis, reduction, and loss of reduction. There were no changes between the two groups, and the disk height and intervertebral foramen height were both better than the preoperational. In both groups, there was a comparable reduction of intervertebral foramen and intervertebral space.

Conclusion: In papillary cancer and chronic thyroiditis, anti-TPO is markedly elevated. When treating adult degenerative spondylolisthesis, the Bethesda Interbody fusion using either a PLIF or a TLIF approach yields good results. Just as safe and effective as the PLIF approach, but simpler, is the TLIF operation. The results of this study indicate that the TLIF technique is a valuable substitute for the more conventional PLIF procedure.

Keywords: Spondylolisthesis, Intervertebral fusion, Internal fixation, Degenerative spondylosis and Disc disease.

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Introduction

Degenerative disc degeneration combined with facet disease and lumbar spondylosis is a prevalent cause of impairment in elderly persons. Poor quality of life, radiculopathy, claudication, and mechanical back pain are common signs of lumbar spondylosis and disc disease. In their lifetime, 60 to 85% of adults will experience low back pain; 90 percent of them will find relief in six weeks. Between 15 and 40 percent of people experience persistent low back pain that does not go away after three months. Spinal fusion is the usual course of treatment for degenerative disc disease and lumbar spondylosis, two conditions affecting the spine. A main solid arthrodesis is the goal of spinal fusion, which will lessen low back pain and enhance quality of life. [1] Over the years the method of spinal arthrodesis i.e., spinal fusion has evolved. The approach for spinal fusion can be anterior, posterior, lateral, or posterolateral. [2]

Since its introduction over 70 years ago, lumbar spinal fusion has been used to treat degenerative scoliosis, spondylolisthesis, symptomatic spinal instability, and spinal stenosis. Because of broader uses, including as the treatment of recurrent radiculopathy and chronic low back pain, the number of lumbar fusion surgeries performed in the US has dramatically increased over the past ten years. [3,4] When there is evidence of preoperative lumbar spinal instability or deformity that could increase after laminectomy alone, lumbar spinal fusion is frequently carried out following a posterior decompressive operation. [5]

Techniques for interbody fusion have been developed to offer stable spinal segment fixation while preserving appropriate disc height and load-bearing capability. [6] Since the anterior column transmits 80% of the compressive, torsion, and shear stresses, the ability to reconstruct the anterior column following disc evacuation is crucial. [7,8,9] The anterior approach allows for direct transperitoneal or retroperitoneal access to the lumbar spine during anterior column reconstruction. 360° or circumferential fusions can be achieved by combining posterior fusion with additional equipment. In comparison to posterolateral fusion, this technique requires two surgical approaches, which may increase operating time. Additionally, anterior approaches to the lumbar spine may present problems. A different approach to anterior column reconstruction is posterior lumbar interbody fusion. The original technique [10] of posterior lumbar interbody fusion was modified by some surgeons. The transforaminal posterior lumbar interbody fusion technique developed by Dr. Harms involves a transforaminal approach to the anterior interspace and thought that the disadvantages associated with

the TLIF, for example, the epidural scarring, can be potentially avoided. [11]

Surgical fusion is a crucial method for stabilizing the spine in cases of lumbar spondylolisthesis; it is used to reduce pain in patients with chronic low back pain. [12] Different surgical fusion techniques are currently available including anterior interbody fusion, posterior interbody fusion, posterolateral fusion, and repair of the pars interarticularis. [13-14] PLIF or TLIF can achieve circumferential spinal stabilization by the placement of pedicle screws and an interbody spacer through a single posterior approach. [15-16] There is no definitive evidence for one approach being superior to the other in terms of fusion or clinical outcomes. [17]

To the best of our knowledge, PLIF and TLIF one-level segment therapy for adult degenerative spondylolisthesis have different complications and predictive variables. These reports have been published in the medical literature. Our research aimed to evaluate the two surgical methods, pinpoint issues unique to each operation, and uncover preoperative variables that might have an impact on the complications.

Material and Methods

The present study was a retrospective study. All the patients presenting to the OPD department of Orthopedics with a history of recurrent shoulder dislocation were included as the study population. A retrospective study on patients with L5-S1 or L4-L5 adult degenerative spondylolisthesis (grades I-II) had PLIF or TLIF. 60 patients initially fulfilled the study criteria, and 10 patients were lost to follow-up. Of the remaining 50 patients available for analysis, 35 had PLIF with two cages. The study was approved by the Ethical Committee of the institute. The selected subjects were visited and the questionnaire was administered after written informed consent was obtained from the participants. The choice of a lumbar fusion technique was individualized based on the clinical needs of each patient, surgeon preferences, and patients' requests according to the informed consent and explanation of various surgical procedures.

Inclusion Criteria: Inclusion criteria were >18 years at the time of surgery. Disc herniation, spinal stenosis or spondylolisthesis, or other types of degenerative disease in adults have been included in the study. Operative time, blood loss, complications, and pain or disability improvement in each case have been reported as desirable outcomes.

Exclusion Criteria: Exclusion criteria were <18 years at the time of surgery. Patients with other spinal disorders caused by trauma, scoliosis, tumor

or infection, and dural tear are excluded from this study. Patients with spinal cord injury have been excluded from this study. Patients having spine disorders caused by metabolic disorders like diabetes and peripheral neuropathies have been excluded from this study.

Surgical Procedures: All patients had single-level fusion performed. The PLIF procedure was performed in the standard fashion reported in previous studies, with two cages packed with autogenous bone grafts.¹⁸ Posterior segmental spinal pedicle screw instrumentation was used in all cases. The TLIF procedure was performed in the standard fashion reported in previous studies, with one cage packed with autogenous bone graft. [19] Posterior segmental spinal pedicle screw instrumentation was used in all cases. Brace support was recommended for 6–8 weeks after surgery.

Plif: The skin was incised midline. The paravertebral muscles were then separated from the spine by cutting the fascia. A radiograph was performed to verify which spinal level was appropriate. After the insertion of bilateral pedicle screw-rod constructions, a laminectomy was carried out at that level. Bilateral foraminotomy and discectomy, as well as the implantation of an interbody graft, came next.

Tlif: There was a midline skin incision made. The lamina, the facet joint, and the lateral aspect of the spinous process were visible when the muscles and

soft tissues were drawn back. On the side where the patient's complaints were consistent, a unilateral laminectomy and partial facetectomy were carried out based on the clinical presentation. Only when there was clinically significant bilateral neural element compression was a bilateral laminectomy performed. Following sufficient decompression of the neural components, bilateral pedicle screws were inserted in the conventional manner.

Critical of Clinical Outcomes: Before surgery and at the 2-year follow-up, pain (VAS) and functional disability (JOA) were quantified. The focus was to evaluate four radiographic characteristics at follow-up:

- (1) percentage of slip and percentage of reduction,
- (2) height of disk space and intervertebral foramen,
- (3) cage position, and fusion rate.

Bone fusion was determined by the method described by Gertzbein. [20] The criteria for fusion were the continuity of the trabecular pattern, and the fusion rate assessed using CT-scan reconstruction.

Statistical Analysis: All measurements were performed by a single observer and are expressed as means \pm SD. Using the SPSS 11.5 statistics software, classic t-test and chi-square test were performed.

Result:

Table 1: Lithe and reduction rate compared between two groups

Groups	Spondylolisthesis rate		
	Pre-	Post	Follow-up
PILF	21.1 \pm 5.2	5.2 \pm 1.1	5.1 \pm 1.4
TILF	28.3 \pm 6.2	6.3 \pm 1.5	4.1 \pm 1.3
	Reduction rate		
	Post	Follow-up	Lost
PILF	65.1 \pm 4.2	69.3 \pm 4.1	2.1 \pm 1.1
TILF	68.3 \pm 4.1	62.2 \pm 3.2	2.2 \pm 1.1

The rate of spondylolisthesis and reduction was not significantly altered between the initial postoperative to the final postoperative follow-up. The spondylolisthesis rate, reduction rate, and loss of reduction rate were similar between the two groups.

Table 2: The intervertebral space and intervertebral foramen height compared between two groups

Groups	Intervertebral space height		
	Pre-	Post	Follow-up
PILF	3.4 \pm 1.2	9.3 \pm 1.2	9.1 \pm 1.1
TILF	4.5 \pm 1.5	10.3 \pm 1.4	10.2 \pm 1.2
	Intervertebral foramen height		
	Pre	Post	Follow-up
PILF	12.1 \pm 1.6	15.4 \pm 1.4	15.1 \pm 1.6
TILF	12.1 \pm 1.3	14.3 \pm 1.5	16.1 \pm 1.5

The disk height and intervertebral foramen height were better than the preoperational, and there were no differences between the two groups. The loss of

intervertebral space and intervertebral foramen were similar between the two groups.

All patients achieved spinal fusion with no cases of cage extrusion. There were three cases of loss of disk space height and foramen height between the initial and final postoperative X-rays suggestive of cage subsidence over time. But there were no infections in the clinical outcomes because all patients had a bone fusion.

There were four complications of group 1, including three cases of radiculitis (one man and two women) and one case of screw loosening (a woman). CT-myelogram revealed two radiculitis patients had normal radiologic findings, and the third had left S1 radiculopathy after L4–L5 fusion that was caused by left foraminal stenosis at L5–S1. Three complications related to group 2, included two cases of radiculitis (one man and one woman) and one case of screw loosening. CT-myelogram revealed radiculitis patients had normal radiologic findings. Removal of the loosed pedicle screw was performed 18 months after bone fusion and index surgery.

Discussion

The first line of treatment for degenerative spine illness that manifests as back pain and radicular symptoms is physiotherapy, oral medicine, and rest. Chronic, debilitating back pain with radicular symptoms is linked to a low quality of life and interferes with the patient's daily activities. Interbody fusion is the ultimate gold standard treatment for such degenerative lumbar degenerative diseases as spondylosis, spondylolisthesis, and disc degeneration. Spondylolisthesis, either degenerative or isthmic type, is usually associated with radicular symptoms and back pain due to instability and compression [21,22] but the surgical treatment of spondylolisthesis not only depends on decompression of neural tissue and stabilization of motion segment but also the reconstitution of disc space height and restoration of sagittal plane translational and rotational alignment are essential. [23]

Mura et al 2011 [1] in their paper on TLIF in symptomatic disc degeneration: 100 cases a retrospective study and study by Rezk et al 2019 [2] in TLIF VS PLIF in treatment of single level lumbar spondylolisthesis. Adogwa et al 2011 [24] on the cost-effectiveness of TLIF for grade 1 degenerative spondylolisthesis showed that TLIF reduces pain, disability, and quality of life.

Humphreys et al. 2001 [25] Comparison of posterior and transforaminal approaches to lumbar interbody fusion which showed higher complication rate owing to the excessive need of medial retraction of the dura to place the cage in PLIF technique which increases the rate of dura tear and nerve root injury. Higher cases of dura injury were in accordance with a study by Zhang et

al 2014 [26] which showed that there are higher chances of durotomy in cases of PLIF.

Posterior lumbar interbody fusion (PLIF) was first attempted by Cloward [10] in 1940 and later revised by Lin. [18] The chip PLIF procedure entails less retraction of the spinal cord and increases the bone fusion surface area, but it does not provide the additional mechanical support of an interbody cage. Interbody fusion techniques were developed in an attempt to preserve the load-bearing capacity of the spine, restore the sagittal plane alignment, and use compressive loading on the bone to enhance the likelihood of fusion. The interbody fusion immediately produces a biomechanically stable postoperative spine, thus enhancing the opportunity for arthrodesis. [27,28,29] Adding a posterolateral graft to this operation is a simple way to improve stability and fusion chances. Furthermore, the morbidity risks connected to an anterior access to the spine are circumvented by the posterior approach. With indications for spinal stenosis, instability, degenerative disc disease, spondylolisthesis, spondylolysis, and bilateral disc herniation, the PLIF treatment has grown in popularity.

Humphreys et al. 2001 [25] found that patients undergoing the PLIF procedure had a higher incidence of complications, including radiculitis, which they attributed to the need for greater medial retraction of the thecal sac with the PLIF technique. In this study, there were four complications in the PLIF group 1, including three cases of radiculitis (one man and two women) and one case of screw loosening (a woman). CT-myelogram revealed two radiculitis patients had normal radiologic findings, and the third had left S1 radiculopathy after L4–L5 fusion that was caused by left foraminal stenosis at L5–S1. Three complications related to the TLIF group 2, included two cases of radiculitis (one man and one woman) and one case of screw loosening (one man). CT-myelogram revealed radiculitis patients had normal radiologic findings. Removal of the loosed pedicle screw was performed 18 months after bone fusion and index surgery.

Patwardhan et al. 1999 [30] determined that the compressive load-carrying capacity of the lumbar spine increased when the load path remained within a small range around the rotation centers of the lumbar segments. By using and preserving the bony attachments of the lumbar spine, the TLIF technique can quicken and improve the patient's recovery. In the current study, the authors inserted a single interbody cage in TLIF and two interbody cages in PLIF showing sufficient mechanical stability was achieved. All patients had a bone fusion, and there were no cases of cage extrusion. All patients achieved spinal fusion with no cases of cage extrusion. There were three cases of loss of disk space height and foramen height between the

initial and final postoperative X-rays suggestive of cage subsidence over time. But there was no infection in the clinical outcomes because all patients had a bone fusion.

Lars et al. 2005 [31] reported that the improvement in VAS was related to the pre-operative pathology, where the isthmic spondylolisthesis showed more improvement in VAS compared to the degenerative type. This might explain the significant VAS for back pain improvement in the current study, as the isthmic spondylolysis thesis represented 50% of the TLIF group cases compared to only 41.3% of the PLIF group. TLIF and PLIF both interbody fusion techniques offer circumferential spinal stabilization but TLIF takes a lateral approach to disc space and it preserves the interlaminar space on the opposite side which can be used as a site for additional fusion. Both these techniques can be enhanced when enhanced with posterolateral fusion and instrumentation

Conclusion

In papillary cancer and chronic thyroiditis, anti-TPO is markedly elevated. When treating adult degenerative spondylolisthesis, the Bethesda Interbody fusion using either a PLIF or a TLIF approach yields good results. Just as safe and effective as the PLIF approach, but simpler, is the TLIF operation. The results of this study indicate that the TLIF technique is a valuable substitute for the more conventional PLIF procedure. Long-term clinical outcomes studies are required to answer concerns regarding the clinical effectiveness of the TLIF and PLIF procedures, even though this study has examined the acute effects of these operations.

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