



FUNCTIONAL OUTCOME ANALYSIS OF TRANSFORAMINAL LUMBAR INTERBODY FUSION USING TRANSPEDICLE SCREWS AND RODS IN THE MANAGEMENT OF SYMPTOMATIC LUMBAR SPONDYLOLISTHESIS AND SPONDYLOLYSIS

Orthopedics

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ABSTRACT

Background: of the various surgical modalities for treating spondylolysis and spondylolisthesis, transforaminal lumbar interbody fusion (TLIF) is considered the best. **Objective:** To assess the functional outcome in symptomatic lumbar spondylolisthesis and spondylolysis patients treated by TLIF using transpedicle screws and rods in terms of complications, changes in Visual Analog Score (VAS) and Oswestry disability index (ODI) among them. **Methods:** 20 patients (09 male, 11 female) admitted with isolated symptomatic lumbar spondylolisthesis of any grade with or without spinal canal stenosis, treated with Transforaminal Lumbar interbody fusion were included in the study. **Results:** Most commonly affected age group was 40-50 years, degenerative type of spondylolisthesis is more common than isthmic and traumatic types of spondylolisthesis. The mean of disc height was 8.96 mm pre-operatively and 10.69 mm postoperatively. Mean Visual analog score (VAS) for Leg pain pre-operatively was 7.50 ± 1.05 , with the post-operative VAS being 2.20 ± 1.19 . Pre-operative ODI score was 59.11 ± 8.65 , and post-operative ODI score was 39.10 ± 9.69 . In situ transforaminal lumbar interbody fusion and posterior decompression significantly reduced the pain and functional disability in patients. **Conclusion:** Transforaminal lumbar interbody fusion with transpedicular screws along with posterior decompression is safe and effective in achieving good functional outcome. It provides better functional outcome by providing pain relief and improving quality of life in the patients.

KEYWORDS

Spondylolisthesis, Transforaminal Lumbar Interbody Fusion, Transpedicle Screws

INTRODUCTION:

Transition to an upright posture has resulted in the pelvis becoming a key structure within the human motor apparatus. Structures around the pelvis have undergone various modifications during course of development and are prone for various degenerative changes. Spondylolisthesis is one among them which is defined as slip of a vertebra in relation to an adjacent vertebra. Spondylolisthesis is a common cause for lower-back pain, radiculopathy and neurological claudication among the adult population. The treatment of spondylolysis and spondylolisthesis can be conservative or surgical, but the therapeutic objectives remain similar. [1-3] The three main treatment objectives recognized are bone healing, pain relief and optimization of physical function. Various surgical modalities have been described like Posterior Lumbar Interbody Fusion (PLIF), Transforaminal Lumbar Interbody Fusion (TLIF), Anterior Lumbar Interbody Fusion (ALIF) etc. [4-5] TLIF is a procedure that fuses the anterior and posterior columns of the spine through a posterior approach. A bone graft and interbody spacer stabilize the anterior portion while the posterior is locked in place with pedicle screws, rods and bone graft. [6] TLIF is considered the best because of less paraspinal muscle dissection, less removal of bony structures (unilateral laminectomy and unilateral facetectomy), and less injury to dural sac. [7]

OBJECTIVE:

- To assess the functional outcome in symptomatic lumbar spondylolisthesis and spondylolysis patients treated by TLIF using transpedicle screws and rods in terms of complications, changes in Visual Analog Score (VAS) and Oswestry disability index (ODI) among them.

MATERIALS AND METHODS:

This study was conducted at Department of Orthopaedics, P E S Institute of Medical Sciences & Research between August 2013 and August 2014. Study participants were 20 patients admitted with isolated symptomatic lumbar spondylolisthesis of any grade with or without spinal canal stenosis, treated with Transforaminal Lumbar interbody fusion by transpedicle screws and rods.

Inclusion criteria- Patients aged 20 years and above with isolated symptomatic lumbar spondylolisthesis of any grade with or without spinal canal stenosis.

Exclusion criteria- Patients with severe osteoporosis and vertebral pathologies.

Indications for transforaminal interbody fusion include:

- Intractable pain.
- Progressive slip.
- Slip $\geq 25\%$ on presentation.
- Neurological deficit- Claudication.
- Significant gait disturbance.
- Cosmetic or postural disturbance.
- Significant motion in dynamic X-rays.

Procedure of Transforaminal interbody fusion:

1. Surgical Technique:

- Transforaminal Lumbar Interbody Fusion with Transpedicular Screws and Rods and Autologous Bone Graft or Interbody Cage.

2. Anesthesia and prophylactic Antibiotics:

- All patients received a single dose of broad spectrum antibiotics (Inj. Ceftriaxone, Inj. Amikacin). All patients were operated under general anaesthesia with adequate muscle relaxation.

3. Patient positioning:

- All patients were placed prone with bolsters under chest and pelvis after urinary catheterization. Care is taken to allow the abdomen entirely free.

4. Localization and skin incision:

- Level of surgery is localized using surface land marks like sacral fossa, posterior superior iliac spine and confirmed radiologically with C-Arm machine.
- Skin incision is marked with needle and infiltrated with lignocaine (1%) with or without adrenaline (1 in 1,00,000). A midline longitudinal incision is given over the spinous processes, extending from the spinous process above to the spinous process below the pathologic level.
- The incision is deepened through fat and fascia in line with the skin incision until the spinous process is reached. Dissection is done in the internervous plane lies between the two paraspinal muscles (erector spinae) to expose spinous process and lamina.
- Dissection is continued laterally, stripping the facet joint capsule from the descending and ascending facets exposing the facet joints and the transverse process.

5. Transpedicular screw placement:

- There are three techniques for localization of the pedicle namely:

(1) the intersection technique, (2) the pars interarticularis technique, and (3) the mammillary process technique.

- Entry point into the lumbar pedicle has been studied and described by various authors – Roy-Camille, Magerl, Weinstein etc.
- In the Roy-Camille method, the entry point is located by the intersection of the mid-transverse process line and the midline of the superior facet.
- The other technique occasionally employed is the pars interarticularis technique. The pars interarticularis is the area of bone posteriorly where the lamina and the pedicle are connected to each other.
- These bony land marks are easily identified during surgery. Entry points are identified under C-Arm guidance and screws are placed through the pedicle into the body. Mono axial and poly axial screws are used for instrumentation.
- Sacral screws are placed parallel to sacral end plate with bicortical purchase. Unilateral Laminectomy and Unilateral Facetectomy was done. Osteotomy of inferior and superior articular process without violating the pedicle above and below is done.
- Ligamentum Flavum is removed and then existing and traversing nerve roots are identified and protected. Disc space is identified.

6. Complete Discectomy:

- Using intervertebral distractor and nerve root distractor, disc is approached through transforaminal route and complete discectomy is performed.
- End plates are thoroughly scraped.

7. Reduction:

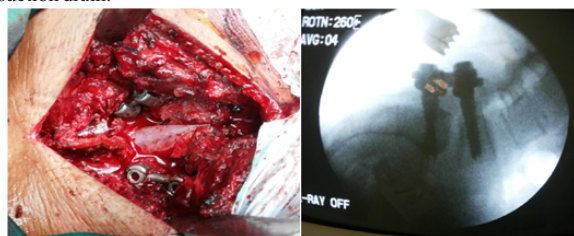
- Adequate reduction is attempted by distraction after placing Titanium rod and by lifting the upper body in a cranial and posterior direction with rotator movements.

8. Interbody Fusion:

- Bone graft harvested from the spinous process and lamina is made into small pieces and placed in the interbody space so that they fit snugly or Titanium cages placed in the interbody space.

9. Closure:

Closure is performed in multiple layers - Paraspinal muscle fascia and subcutaneous tissue with vicryl; and skin with ethylon under a negative suction drain.



Transpedicular screws & rods fixation

C-Arm image

Post-operative protocol:

- Early mobilisation from the bed with lumbosacral belt application.
- Muscle strengthening exercise as soon as pain subsides.
- Avoid bending and twisting movements for 3 months.
- Lumbosacral belt application for 3 months.

Post-operative follow-up:

All patients were followed-up at regular intervals post-operatively on OPD basis after 3rd month, 6th month and 1 year. At every follow-up, neurological assessment, assessment of pain, activity restriction and radiological assessment was done.

In the present study, the ODI and VAS were the primary functional outcome measures used. Pre-operative measurements were corroborated with post-operative measurements and compared to study the effectiveness of the surgery.

RESULTS:

In our study,

- Most commonly affected age group was 40-50 years.

- Females were most commonly affected than males. (Female:Male ratio = 11:9)
- Most common mode of presentation was Low Backache in all the 20 patients (100%).
- Radiculopathy was present in 14 patients (70%).
- Claudication was present in 07 patients (35%).
- Co-morbid conditions were seen among a total of 06 study subjects:
 - Diabetes Mellitus- 02 patients (10%);
 - Hypertension- 03 patients (15%);
 - Hypothyroidism- 01 patient (5%).
- Degenerative type of spondylolisthesis (30%) was more common at L4 L5, and Isthmic was more common (30%) at L5 S1.
- Mean duration of symptoms at the time of presentation was 24 months.
- Level of slip was more common at L5-S1 (55%) than L4-L5 (45%).
- Percentage of grade-2 slip was more common (70%).
- The mean of disc height was 8.96 pre-operatively and 10.69 postoperatively.
- Bone graft was used as Spacer in 15 patients (75%).
- Titanium cage was used in 05 patients (25%).
- Fusion was achieved in 18 patients (90%).
- Pseudoarthrosis was seen in 2 patients (10%).
- Mean rate of fusion was 4.85 months.
- Mean pre-operative VAS for leg pain was 7.5 which improved to 2.20 post-operatively.
- Mean pre-operative ODI was 59.11 which improved to 33.10 post-operatively.
- The mean slip score pre operatively was 44.65 which improved to 18.75 post-operatively.

Table 1: Evaluation of the outcome variables pre-op and postoperative follow-up:

Variables	Pre-Op	Post-Op
VAS	7.50±1.05	2.20±1.19
ODI	59.11±8.65	33.10±9.69
Slip %	44.65±15.01	18.75±7.52
Disc height	8.96±0.17	10.69±0.18

Graph 1: VAS and ODI scores pre-operative and post-operative:

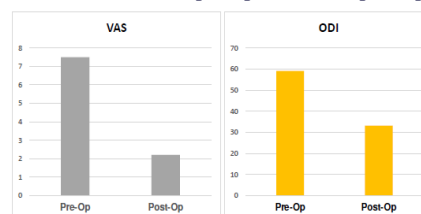


Table 2: Complications following the TLIF procedure:

Complications	Number	Details
Implant related	01	Back out of single screw
Infection	02	Surgical site infection
Others	03	Intraoperative dural tear = 01 Non-union = 02
No complications	14	-

DISCUSSION:

Although many surgical options exist for the treatment of degenerative spondylolisthesis, it generally is agreed that in most cases non-operative treatment should be attempted before surgical intervention is pursued. Most patients will not require surgery. Of the non-operative options, none are conclusively superior to the others and all have a role in the treatment of symptomatic patients. Lumbar fusion is the procedure for managing back instability.

Pedicle screw fixation with interbody fusion as a fusion procedure provides several advantages. The most important of them are:

- Increase in the fusion rate compared to others.

- 2) It allows early mobilization of patients and obviates the need for heavy orthoses in the post-operative period.

Age and Sex Distribution:

1. In our study, most commonly affected age group is between 40-50 years. Youngest patient in our study is of 35 years and the oldest patient is of 56 years. The cause of spondylolisthesis in the youngest patient was due to trauma.
2. The male : female ratio in our study is 1:1.2. In the Framingham study, the ratio of male : female in isthmic spondylolisthesis was 1 : 2.125. The overall male : female ratio was 1:1.1.
3. In degenerative spondylolisthesis, the ratio of male : female is 1 : 1.4. In isthmic variety, our male : female ratio is 1.3 : 1.

Hence, in our study, females are most commonly affected by degenerative spondylolisthesis and males are most commonly affected by isthmic spondylolisthesis.

Type of Spondylolisthesis:

1. Soren and Waughin their study of 105 patients had around 37% isthmic and 63% degenerative among the 84 patients with actual listhesis.

2. That of degenerative spondylolisthesis was 13.6% which was 62.4% of the overall occurrence of spondylolisthesis. In our study, degenerative spondylolisthesis (60%) is more common than isthmic (35%) and traumatic (5%) type of spondylolisthesis.

Level of Slip:

In our study, the level of spondylolisthesis was at L5-S1 in 11 patients (55%). L4-L5 spondylolisthesis occurred in the rest 09 patients (45%). In this context, the commonest level in the Framingham study with respect to isthmic listhesis was at the L5-S1 level in 73% of the patients followed by L4-L5 in 20%. In contrast in degenerative spondylolisthesis the commonest level encountered in that study was at the L4-L5 level in 44% of patients. The second commonest level involved was L5-S1 in 40%.

Duration of symptoms and its relation to relief of symptoms in the post-operative period:

1. Clinically all the 20 patients evaluated had low backache. 14 of the 20 patients had Sciatica associated with low back pain (70%). In comparison, in the cross-sectional study of 111 patients by Moller et al. 62% had low back pain with sciatica; 7% had sciatica alone and 31% had low back pain alone. In the study by Zagra et al, 35% presented low back ache and 65% had associated Sciatica. Hence low back pain is the commonest complaint of patients and is in 2/3rd of the cases associated with Sciatica. 14 of the 20 patients in our study (70%) had radiculopathy and 7 of the 20 patients (35%) had claudication.
2. In all our cases, we have performed laminectomy and discectomy for adequate decompression. Irrespective of duration of symptoms, all the patients achieved symptomatic relief even on long-term follow-up suggesting that solid bony fusion of the listhetic segment is the treatment of choice for symptomatic relief in terms of back pain and leg pain. In a study done by Martin B. Komblum, benefits of a successful arthrodesis over pseudoarthrosis were demonstrated with respect to back and lower limb symptomatology. 47 patients were available for review at a range of follow-up from 5-14 years. Average follow-up was 7 years 8 months. Clinical outcome was excellent to good in 86% of patients with a solid arthrodesis and in 56% of patients with a pseudoarthrosis.

Treatment- in situ transforaminal lumbar interbody fusion with transpedicular screws and rods with posterior decompression:

Despite the enormous number of published studies, the treatment of lumbosacral spondylolisthesis remains controversial due to lack of absolute success with any one modality or technique of treatment. Surgery is an accepted treatment of all forms of spondylolisthesis. It is the choice of treatment in high grade of listhesis. In symptomatic degenerative spondylolisthesis, instrumented transforaminal lumbar interbody fusion is the standard of care. In other forms of listhesis, surgery is indicated by failure of adequate attempt at conservative management for at least 6 weeks to 3 months. Two randomized control trials that deal with the question of conservative versus operative treatment of patients with low back pain due to various causes, i.e., one by Moller and Hedlund studying

isthmic spondylolisthesis and the other by Fritzell et al. studying low back pain both showed a significant better outcome with transforaminal lumbar interbody fusion in situ as compared to exercise program.

Aim of surgery in a patient with spondylolisthesis is 4-fold:

1. To relieve pain.
2. Remove the cause of neurological deficits.
3. Improve the stability.
4. To prevent progression.

Debate still rages on whether to fuse in situ or to reduce and fuse, whether fusion alone serves the purpose or whether adding instrumentation gives better overall results, and as to which form of fusion is ideal for any particular patient. We used instrumented transforaminal lumbar interbody fusion in all patients. Instrumentation consisted of pedicle screws placed across the affected segments connected by connecting rods.

Advantages of TLIF:

1. Less nerve root damage
2. Less chances of dural puncture. [8,9]

TLIF is better than posterolateral fusion. Watkins in 1953 described a technique which consists of decorticating spinous process, transverse process, pars and facets and application of bone grafts using iliac bone strips over decorticated areas [10]. The main disadvantage of PLF was pseudoarthrosis. Pseudoarthrosis rates range from 14 to 70%. Reoperation and disability rates are 24% and 25%, respectively. Thus to increase the fusion rates and thereby to decrease the pseudoarthrosis rates and reoperation rates nowadays Interbody fusion is used in spondylolisthesis. [11]

Various studies demonstrated efficacy of TLIF in relation to pain, Yan D et al comparing PLIF with TLIF for lytic listhesis the mean VAS score for pain improved from 7.2 to 2.8. In another study by Yahya et al. of 30 patients the VAS score for low back pain decreased from 7.0 to 2.1 and that for leg pain decreased from 6.4 to 2.0, whereas the ODI decreased from 69.3% to 11.8%. [12,13]

In our study, according to the Meyerding's classification of the degree of slip, grade 2 slip is the most common followed by grade 3. In our study, pre-operatively, the slip percentage was 44.65 ± 15.01 (Mean $\pm$ Standard Deviation) and post-operatively, the slip percentage was reduced. (18.75 ± 7.52).

This fusion technique was described first by Harms and Rolinger in the 1982. They used cage packed with bone graft which was inserted into intervertebral disc space through transforaminal route and it was termed as "transforaminal lumbar interbody fusion" (TLIF). TLIF provides pain relief and improves the quality of life in the patients. [14]

CONCLUSION:

Transforaminal lumbar interbody fusion with transpedicular screws along with posterior decompression is safe and effective and achieves good functional outcome in a short to moderate duration of follow-up. It provides better functional outcome by providing pain relief and improving the quality of life in the patients.

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