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Original Research Article

# Outcome of TLIF for Degenerative Disc Disease and Spondylolisthesis of Lumbar Spine

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**Abstract**

**Introduction**: Degenerative Disc Disease and lumbar instability are common disorders which lead to low back pain and radicular leg pain. Instrumented TLIF provides various advantages including load sharing, maintaining the disc height, formation of three-column stability, with allowance for wider decompression, prevention of graft dislodgment, and improved fusion rate. Consequently, rods can be contoured to preserve or restore physiological lumbar lordosis.

**Materials and Methods**: It is a prospective clinical study of 15 consecutive patients, who underwent one level instrumented transforaminal lumbar interbody fusion surgery, with single cage and local bone graft. The duration of study is for one year (July 2023 to June 2024). The indications of surgery are massive disc prolapse, lumbar canal stenosis, clinical and radiological features of instability with PIVD and spondylolisthesis. Clinical outcome is assessed using Oswestry Disability Index and Visual analog score. The radiological outcome is assessed using intervertebral disc height and Modified Lee's criteria of fusion.

**Results**: Out of 15 patients, 10 were males and 5 females, with the mean age of 42.66 years. Clinically the preoperative and postoperative ODI score, VAS score and JOA score improved and are statistically significant $p<0.0001$ (the result is significant at $p \leq 0.05$). The surgery restored the disc height and at a mean follow up of 6 months 93.33% shows possible fusion and 6.67% shows possible pseudoarthrosis.

**Conclusion**: A single cage with local bone graft are adequate for one level fusion. Transforaminal lumbar interbody fusion is a safe technique to alleviate pain arising out of instability and segmental degeneration of the lumbar spine.

**Keywords:** Transforaminal Lumbar Interbody Fusion, Spinal Instability, Local bone graft.



## Introduction

Low back pain (LBP) is an important clinical, social, economic, and public health problem affecting the population indiscriminately. It is a disorder with many possible etiologies, occurring in many groups of the population, and with many definitions. In accordance with the report of World Health Organization in 2002, LBP constituted 37% [1] of all occupational risk factors which occupies first rank amongst the disease complications caused by work. Such high prevalence of complications at international levels has made the World Health Organization to name the first decade of the third millennium as the "decade of campaign against musculoskeletal disorders (as the silent epidemic)" (WHO, 2005) [1]. Harms and Jeszenskky [2] described in details the transforaminal lumbar interbody fusion (TLIF) technique with cage in 1998 for treatment of spinal instability, degenerative disc disease and spondylolisthesis. When interbody fusion techniques are combined with discectomy in degenerative conditions, it is known to relieve pain [3-5]. TLIF has gained popularity and has been performed as either open or minimally invasive approaches. With the advent in pedicle screw instrumentation, instrumented TLIF provides various advantages including load sharing, maintaining the disc height, formation of three-column stability, with allowance for wider decompression, prevention of graft dislodgment, and improved fusion rate.6 Consequently, rods can be contoured to preserve or restore physiological lumbar lordosis. [7] Although TLIF is a unilateral procedure, it is usually combined with bilateral pedicle screw support4or with fixation [3,5]. The "gold standard" for achieving a solid fusion is autograft cancellous bone, regardless of which cage device or intervertebral spacer is used [8]. Although autologous iliac crest bone graft results in

good fusion, there are various complication like donor site infection and persistent pain. [9] Using cage with local bone graft provides less operating time and blood loss. [10] There are various studies using local bone graft with 100% successful fusion rate. [11]

## Materials and Methods

A prospective study was carried out for a total of 15 cases of low back pain between 18 yrs. - 60 yrs. attending Department of Orthopaedics, Silchar Medical College who are willing to do a minimum follow up of 6 months and meet inclusion and exclusion criteria outlined below and gave written consent to participate in the study.

Inclusion criteria: Aged between 18 and 60 yrs, patients not responding to conservative management for 6 weeks, patients who gave consent for surgery, patients suffering from chronic low back-ache with or without radiculopathy due to degenerative disc disease with massive disc prolapse and lumbar spinal stenosis, spondylolisthesis and clinical and radiological features of instability with PIVD. Exclusion criteria: Aged <18 years and >60years, who did not give consent for MRI and surgery, patient with contraindication to MRI (pacemakers and metal implant), psychiatric diseases, infection like-osteomyelitis, epidural abscess, tumor like-metastasis, primary spinal tumor, Inflammation – osteoarthritis, sacroilitis, metabolic spinal diseases like osteoporosis, congenital anomalies of spine. A neutral radiograph of Lumbosacral spine and functional radiograph of lumbosacral spine in flexion and extension are taken to detect any instability by using Dupuis et al [12] measurement technique of instability. Functional radiograph is taken in lateral decubitus position.

The height of the intervertebral disc space was calculated as the mean of the sum of the vertical distances between the anterior and posterior edges of the vertebral endplates in lateral view. [13] MRI of Lumbosacral spine is done to confirm the diagnosis. All patients took 6 weeks of conservative therapy before being considered for operation.

**Table 1. Patient demographic data**

| Case | Age /sex | Occupation | Fused level |
|---|---|---|---|
| 1 | 45/M | Heavy worker | L4-L5 |
| 2 | 49/M | Moderate worker | L4-L5 |
| 3 | 45/M | Moderate worker | L4-L5 |
| 4 | 38/F | Sedentary | L4-L5 |
| 5 | 42/M | Moderate worker | L1-L2 |
| 6 | 50/M | Moderate worker | L4-L5 |
| 7 | 50/F | Sedentary | L1-L2 |
| 8 | 42/M | Sedentary | L1-L2 |
| 9 | 25/F | Heavy worker | L5-S1 |
| 10 | 55/F | Sedentary | L5-S1 |
| 11 | 40/M | Moderate worker | L4-L5 |
| 12 | 36/M | Heavy worker | L4-L5 |
| 13 | 35/F | Moderate worker | L4-L5 |
| 14 | 50/M | Sedentary | L4-L5 |
| 15 | 38/M | Moderate worker | |

**Technique:** The skin and subcutaneous tissue is infiltrated with 30ml 2% lignocaine+ adrenaline (1:200000) diluted with 60ml normal saline. A 5 cm posterior midline skin incision is made and extended if necessary. The dissection is carried down into the subcutaneous tissue, lumbo-dorsal fascia, and the supraspinous ligament longitudinally up to the tip of the spinous processes. Self-retaining retractors are used to maintain tension on soft tissues during exposure. The posterior surface of the laminae and the articular facets of the spine are exposed subperiosteally from distal to proximal using electrocautery and periosteal elevators and packed with a sponge soaked in lignocaine-adrenaline diluted solution immediately after exposure to lessen bleeding. The same technique is used on the other side. To confirm the correct level, a Kocher clamp is placed along the interspinous ligaments and lateral view is taken using C-arm. Using a Rongeur and Kerrison punch a grill decompression is performed by resecting the spinous processes and lamina until ligamentum flavum has been freed and excised. The pedicle entry point is made by intersection technique using a burr or 2mm k-wire and confirmed using AP and lateral views using C-arm. Then the pedicle awl is advanced anteriorly and medially simultaneously into the pedicle. The awl is directed more medially at the lower lumbar vertebrae, usually 20-30 degree at L5 and 0-10 degree at L1 vertebra. The cephalad to caudal orientation is guided by the C-arm. The awl is advance to anterior third of the body. A small ball-tipped probe is used to sound the pedicle in all the

four quadrants and to palpate the vertebral body laterally and anteriorly to make sure there are no cortical breaches. The largest diameter screw the pedicle will accept is typically placed. The C-arm is adjusted to obtain an "end on" view of the screw to confirm radiographically that the screw is within the pedicle. The remaining screws are placed in similar fashion. The screw rod assembly is tightened. A facetectomy is then performed. A window is formed on the disc, with care taken to protect the exiting and traversing nerve roots. The window is enlarged using a combination of box osteotomes and Kerrison rongeurs. A window that is a minimum of 10 mm in size facilitates disc space preparation. Disc space preparation is performed using a combination of curettes, pituitary rongeurs, and end-plate preparation tools. Thorough disc-space preparation is critical for obtaining a solid fusion. The disc space is sized for an appropriate interbody cage. Bone cage of appropriate size is filled with a local morselized bone graft composed of the lamina, parts of articular process and the spinous process obtained during posterior decompression, and were devoid of all soft tissue attachments. The local bone chips were prepared into the size of 3–5 mm in all dimensions and were inserted into anterior third of the disc space. [20] Then the bone cage is inserted into the disc space, and more graft is packed and tamped behind it. Before wound closure, any free bone graft fragment pressing on neurological structures was removed. Drain is put and wound is closed in layers. Passive leg rising exercises started on day1 postoperative. All patient are mobilized out of bed on the 2nd or 3rd postoperative day depending on the compliance of the patient using lumbosacral belt and walker. The patients are discharged and called for follow up and suture removal at 10- 14th post-operative day. Bending, sitting, squatting, lifting weights were allowed at 3 to 4 months. The patient demographic data (table 1), clinical outcome assessed by ODI, VAS and radiological fusion by Modified Lee's clinical outcome assessed by ODI, VAS and radiological fusion by Modified Lee's fusion and related complication were analysed.

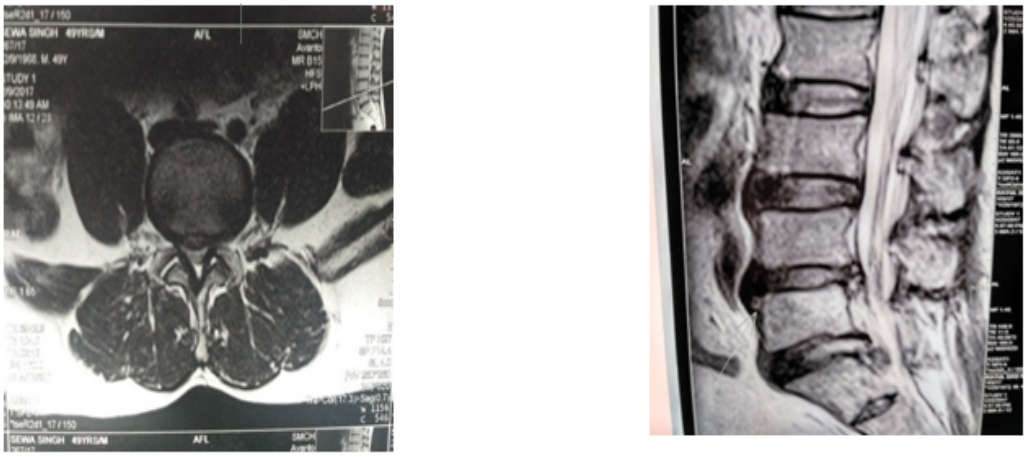

**Figure 1: T2W MRI sagittal and axial view showing L4-L5 disc occluding more than 50 % canal diameter**

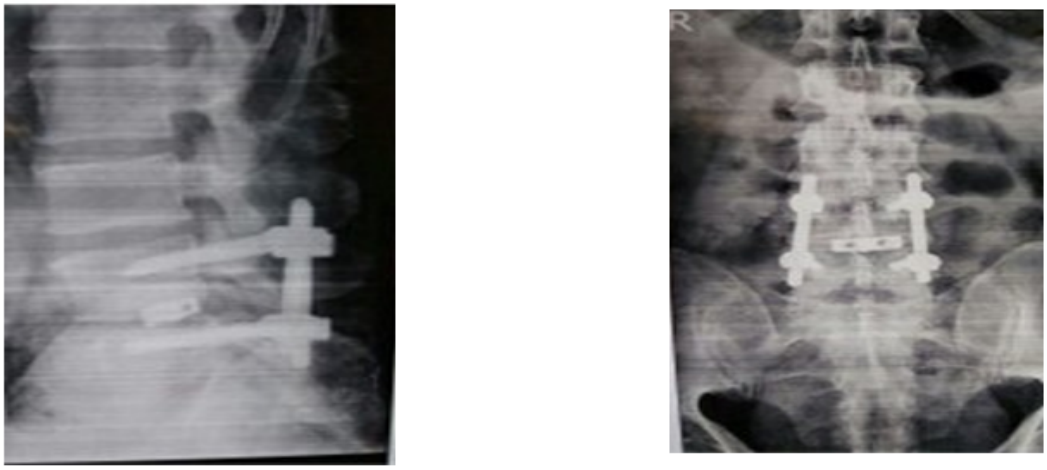

**Figure 2: Immediate post op X-ray AP and lateral Views**

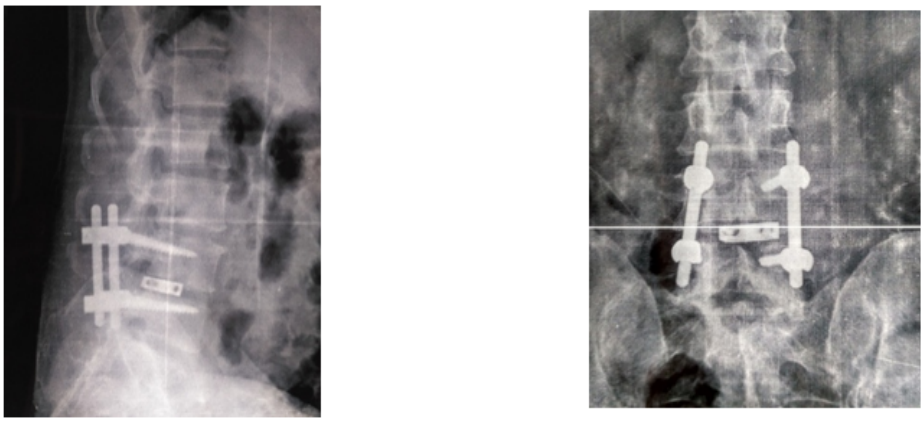

**Figure 3: X-ray at 9 months follow up showing possible fusion**

**Results and Observations**

The youngest patient was 25 years of age and the oldest was 55 years of age. The mean age is 42.66 years. The male to female ratio was found to be 2:1 for the study population. The mean body mass index in our study is 23.65 kg/m$^2$ with a standard deviation of 1.63 (range is 21.5 to 26.5. 60% of the patient had fusion at the level of L4-L5, 20% at L5-S1, 13.33% at L1-L2 and 6.67% at L3-L4 respectively. The mean blood loss during was 487 ml. The blood loss ranges from 350 ml- 650 ml. The mean duration of operation was 137.67 minutes, with the range of 120-150 minutes. The mean duration of hospital stay was 12.66 days (10-14 days)

All the patients were followed up for a minimum period of 6 months (range 6- 10 months).

**Clinical Outcome:**

a) The mean preoperative Oswestry Disability Index score is 70.02% and at 6 months postoperative it is 27.06%. The difference in the preoperative ODI and postoperative at 6months ODI are statistically significant (t value is 25.46 and p value is < 0.00001, significant at $p \leq 0.05$). The mean preoperative VAS score was 81 and at 6 months VAS score is 18. The difference in the preoperative VAS and postoperative at 6months follow up are statistically significant (t value is 35.46, p value is < 0.00001, significant at $p \leq 0.05$).

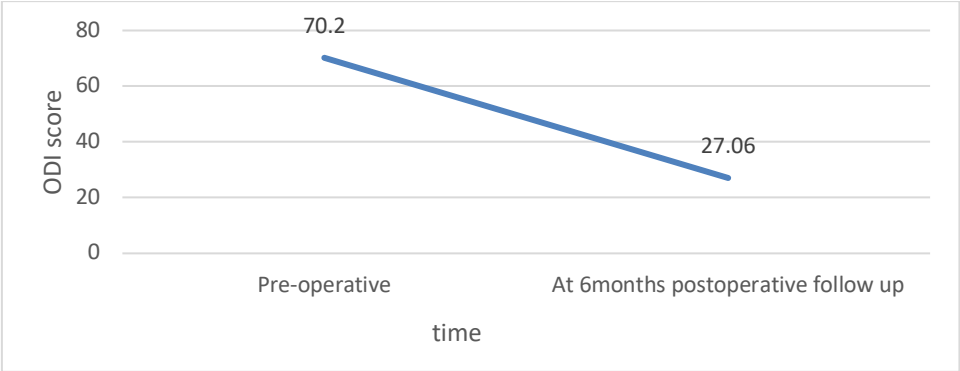


**Figure 4: Line diagram showing improvement in ODI**

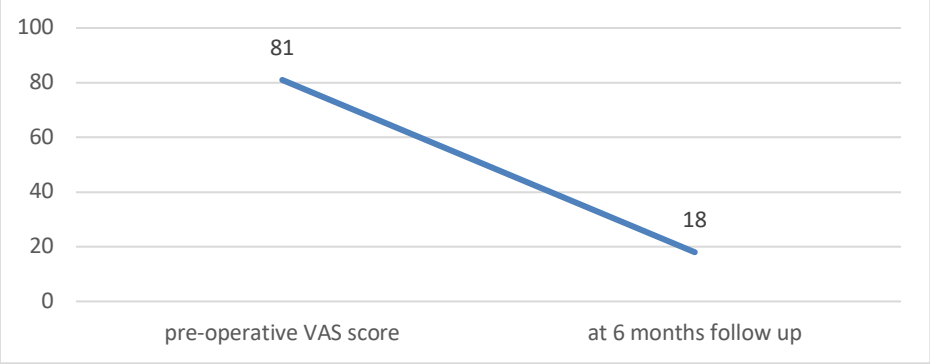


**Figure 5: Line diagram showing improvement in VAS**

**Radiological outcome:**

a. Disc height (in millimeter**):** the mean preoperative disc height at the involved segment had increased from 5.98+0.64 mm, to 7.11+0.61mm at immediate postoperative examination but dropped to 6.97+0.58 mm at 6 months follow up. The difference in the preoperative and at 6months postoperative follow up are statistically significant,( t value is 11.37 and p value is<0.00001significant at $p \leq 0.05$).

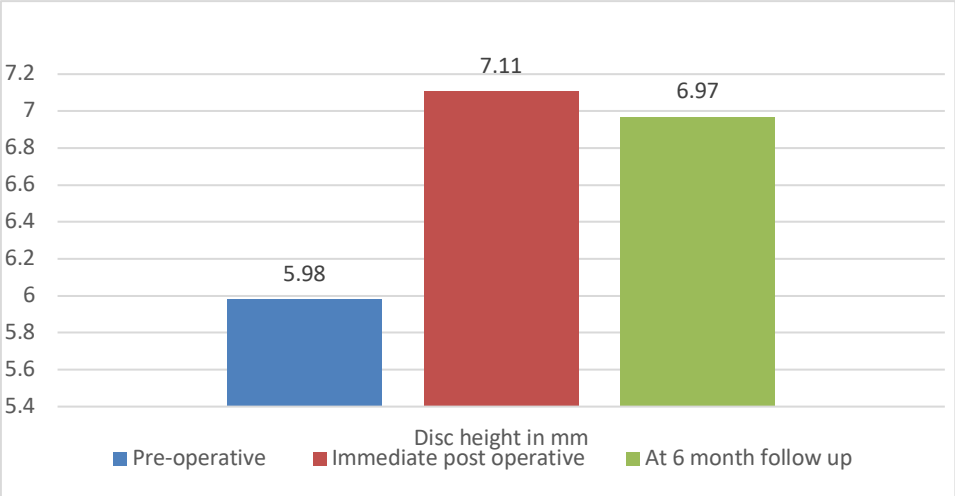


**Figure 6: Bar diagram showing increase in disc height**

b) Modified Lee's criteria of fusion: At a mean follow up of 6 months, 14 patients (93.33%) shows possible fusion and 1 patient (6.67%) shows possible pseudoarthrosis. Out of 15 cases operated, only 4 cases were followed up for a period of 9 months postoperatively.

**Complications:** 2 cases of intra-operative dural tear without postoperative complications and 1 case of superficial infection with a total of 20% rate.

## Discussion

Interbody fusion techniques have been developed to preserve the load bearing capacity of the spine, restore sagittal plane alignment and proper disc height, all of which enhance the potential for fusion4. The advantage of posterior approach to the spine includes the ability to simultaneously decompress and stabilise the spine with instrumentation. The goal of a fusion of the lumbar spine thus is to obtain a primary solid arthrodesis in order to alleviate pain. Further in their studies of symptomatic spondylolisthesis OwoichoAdogba et al [14], Lauber et al [15] and Deng lu yan [16] found TLIF to be superior then other fusion approaches in treatment of spondylolisthesis. In our clinical study we performed a single level instrumented TLIF using single bone cage with local bone graft through the unilateral approach, in symptomatic cases of lumbar spinal instability, spondylolisthesis and degenerative disc disease (massive disc prolapse with lumbar spinal stenosis). This study was conducted to examine the short term results, particularly early clinical and radiological outcome. The maximum numbers of cases were between 41 to 50 years, with the mean age of 42.66 years. The age incidence of the present study is comparable with lauber et al [15] and zhou et al [19] study in which the mean age was found to be 48.1 and 50.9 yrs respectively. In our study we found preponderance of lumbar disc prolapse in male patients. The male to female ratio was found to be 2:1. The incidence of sex observed in our study is comparable with lowe et al [20] and lauber et al [15] study where both fund that males outnumber females. The mean body mass index in our study is 23.65 kg/m2. The range is 21.5-26.5kg/m2. It is comparable with Topuz K et al (2016) [17] study where the mean was around 25.9Kg/m2.In our study majority of the patients had massive disc prolapse at the level of L4-L5 level (60%) which is comparable with choi HS et al (2013) [21] and Jeon Ch et al (2013) [18] thus concluding that disc prolapse is most commonly encountered at L4-L5 level.

In our study, the mean preoperative ODI was 70.2 which improved to 27.06 at 9 months follow up, and preoperative VAS was 81 which improved to 18 at 9 months post-operative follow up. The results are comparable with neelanand et al (2007) [22], Dennis Crandell et al (2011) [23] and Er Zhu Yang et al (2014) [24 studies. The Disc height(in millimetre) increased from 5.98+0.64 mm preoperative to 6.97+0.58 mm at 9 months post-operative follow up in our study which is comparable with Deng Lu Yan et al(2008) [16] and Jian Zhou et al(2011) [19] study. In our study 14 cases showed probable fusion and one case showed possible pseudoarthrosis giving a fusion rate of 93.33% according to Modified Lee's criteria of fusion which is comparable with Satyanarayana et

al(2015) [25] study. However since definitive fusion takes more than a year to mature which was reconfirmed by the Satyanarayana et al [25] study in which the mean fusion time was 16 months, we could not get definitive fusion in our study as the duration was too short ( 9 months).

**Conclusion:**

From this clinical study we conclude that transforaminal lumbar interbody fusion is a safe technique to alleviate pain arising out of instability and segmental degeneration of the lumbar spine. The ideal patient for this procedure is one with chronic mechanical back pain with or without a significant radicular component unresponsive to aggressive non-operative treatment. A sound biomechanical construct is achieved with a large surface area for achieving a successful fusion. Improved segmental lordosis and reduction of occurrence of spondylolisthesis is also provided by this technique. This approach also has the advantage of decompressing the cauda equina and exiting nerve root. Transforaminal lumbar interbody fusion technique can thus be safely used in treatment of cases of degenerative disc disease, lumbar spinal instability and spondylolisthesis because of less violation to the spinal canal, less time consumption and decreased morbidity to achieve interbody fusion.

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