



## MANAGEMENT OF DEGENERATIVE LUMBAR SPINE SPONDYLOLISTHESIS WITH MINIMALLY INVASIVE TRANSFORAMINAL LUMBAR INTERBODY FUSION.

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### ABSTRACT

**Background:** Open Transforaminal Lumbar Interbody fusion (TLIF) is the conventional modality of treatment for Degenerative Lumbar spine spondylolisthesis. In conventional open TLIF surgery, muscles are dissected with monopolar cautery and stripped off the lamina and the facet joints. This causes significant muscle atrophy leading to postoperative back pain. Also significant bleeding occurs during the surgery. This needs blood transfusion and prolongs the hospital stay. To minimize these complications, a Minimally Invasive approach for TLIF (MIS –TLIF) has gained popularity in recent years. In this technique the muscles are not cut but split by serial dilators to access the pathology, thus reducing the amount of iatrogenic muscle and soft tissue damage. The aim of this study is to analyze the outcome of MIS-TLIF for Degenerative lumbar spine spondylolisthesis.

**Methods:** The study was conducted at our institute between February 2013 to November 2015. Patients with degenerative lumbar spine disease with Grade I or Grade II spondylolisthesis, with predominantly unilateral radicular leg pain with or without back pain and having Progressive neurological deficit not responding to conservative modalities of treatment were included. We have excluded patients with spondylolisthesis due to other reasons than degeneration and patients presenting with bilateral leg pain. 33 patients included in the study underwent MIS TLIF surgery under general anaesthesia. Patients were assessed pre operatively, at 24 hrs. postoperatively, at 1 month, 3 months, 6 months, 12 months and 24 months postoperative follow up. Functional outcomes Was assessed with visual analog score (VAS) and Oswestry Disability Index (ODI). Statistical analysis was done using 'paired T test' and 'chi square test'.

**Results:** 33 patients who fulfilled inclusion criteria were followed up till the minimum of 2 years. 3 Patients lost follow up after one year of regular follow up. Hence data of 30 patients was available for the evaluation of clinical outcome. The disability due to backache and leg pain was assessed using the Oswestry Disability index (ODI). The mean ODI in pre-operative period was 70.17(±9.24) and 1 month after surgery Mean ODI was 10 (±11.14) at 3 months and at six months mean ODI was 8.67(±14.79). At one and two year follow up mean ODI was 6.00(±13.29). 28 (93.33%) patients showed excellent results after surgery and 2 (6.66%) patients showed good results.

**Conclusions:** Our study observations showed that the advantages of MIS-TLIF are more than disadvantages. Hence MIS-TLIF is a viable, safe and effective modality of treatment in carefully selected patients of Degenerative Lumbar spondylolisthesis.

**KEYWORDS :** Minimally Invasive, Transforaminal fusion, Lumbar spondylolisthesis.

### Introduction:

Degenerative Lumbar spondylolisthesis with persistent unilateral radiculopathy, not responding to conservative modalities of treatment for six weeks, needs surgical management.<sup>1</sup> The goal of surgery is to decompress the affected nerve root and achieve spinal stability by solid interbody fusion, while restoring good disc height and vertebral alignment.<sup>2</sup> Open Transforaminal Lumbar Interbody Fusion (TLIF) is the conventional modality of treatment for Degenerative Lumbar spondylolisthesis.<sup>3,4</sup> In conventional open TLIF surgery, muscles are dissected with monopolar cautery and stripped off the lamina and the facet joints. This causes significant muscle atrophy leading to postoperative back pain. Also significant bleeding occurring during surgery needs blood transfusion and prolongs the hospital stay.<sup>5-8</sup>

To minimize these complications, a Minimally Invasive approach for TLIF (MIS TLIF) was first proposed by Foley et al<sup>9</sup> In this technique the muscles are not cut but split by serial dilators to access the pathology, thus reducing the amount of iatrogenic muscle and soft

tissue damage. The paraspinous approach used in this technique saves the posterior midline musculature.<sup>9</sup> The aim of this study is to analyze the outcome of MIS-TLIF for Degenerative Lumbar spondylolisthesis and to assess the advantages and disadvantages of the technique.

### Materials and methods:

In this prospective study conducted at our institute between February 2013 to November 2015, patients with degenerative lumbar spine disorder with Grade I or Grade II spondylolisthesis, with predominantly unilateral radicular leg pain with or without back pain, with Progressive neurological deficit not responding to conservative modalities of treatment were included. We have excluded patients with spondylolisthesis due to other reasons than degeneration and patients presenting with bilateral leg pain. All patients and their relatives were explained the nature of the study and benefits and risks associated with the study. 33 Patients were willing to participate in the study and gave written informed consent. The study was approved by the Institutional Review Board.

Procedures followed are in accordance with the ethical guidelines laid down for Medical research on human participants.

All patients were assessed clinically for their symptoms. A thorough clinical and radiological examination was done. All routine blood investigations, chest x-ray and ECG were done which are required for pre anesthetic checkup. The procedures were performed under general anesthesia with strict aseptic precautions. Patient was placed in prone position over two bolsters, one under the chest and other one under the iliac crests, to keep the abdomen free and hanging. Both legs were supported with pillows to keep knees in some flexion.

Back scrubbing and painting was done with 10% Povidone Iodine solution. Draping was done in three layers. Level of instability in lumbar vertebrae was marked under fluoroscopy control. Tracts were prepared for the unaffected side of radiculopathy for percutaneous pedicle screws with the help of 11 gauge Jamshidi needle under fluoroscopy control. Decompression was started on the side of radiculopathy. Around one and half inch incision was taken over the facet joint just medial to the medial pedicle line at the affected level of instability. Blunt dissection with index finger was performed through the muscle mass to palpate the facet joint and the first dilator was inserted.<sup>10</sup> Position was checked in lateral view to confirm that it is lying exactly over the disc space parallel to it.

Serial dilatation was done till final tube retractor was docked over the facet and its position was confirmed in AP and lateral views. The tubular retractor was finally locked in position by fixing it to the table. The exposed operative field is now visualized through Operating Microscope.<sup>2</sup> The facet joint was exposed and Facetectomy was done using 10mm osteotomy and hammer. The adjacent lamina was nibbled out with the Kerrison Rongeur till midline was reached. The overlying ligamentum flavum was removed and the traversing nerve root was exposed. The Kambins triangle was identified and any epidural blood vessels were coagulated with a bipolar. The laminectomy was carried out superiorly to expose the exiting nerve root which was then traced laterally to mark the lateral border of the kambin's triangle. Laminectomy was then continued medially till the base of spinous process to complete ipsilateral decompression.<sup>2</sup>

A rectangular annular incision was taken over the annulus between the exiting and traversing nerve roots. Complete discectomy was performed with the help of straight and up-angled disc forceps. Cartilage over Endplates was removed with box curettes to expose subchondral bone.<sup>10</sup>

Thorough washing of the disc space was done with normal saline. Bone grafts obtained from the facet and the lamina was then inserted into the anterior part of the disc space and some filled inside the interbody cage. We used a Titanium Bullet cage. Cage was inserted under C-arm guidance and final position was confirmed.<sup>2,10</sup> Tracts for MIS screws on the side of decompression were made in similar way as described previously. Once the guide wires were inserted, partial tapping was done and appropriate length (usually 40mm or 45mm long) 6.5mm diameter cannulated screw were inserted over the guide wire. Once the screw partially inside the vertebral body, the guide wire was removed and then the screw was advanced. Check x-ray was done at the end of fixation. Skin infiltration was done with long acting local anesthetic agent such as bupivacaine to prevent postoperative pain caused by skin stretching and dilators. Closure was done in layers after giving thorough wash.

Antibiotics and Anti-inflammatory drugs were given for 3 to 5 days after surgery. Patients were allowed to take oral fluids after 6 hours of surgery. Patients were mobilized on the next day of surgery with Lumbosacral frame type belt and were discharged on postoperative day 3. All patients were advised follow up on postoperative day 12 for suture removal. Patients were advised not to bend forward, not to lift heavy weights, not to sit down on ground. Physiotherapy was

started with Back muscle exercises, Abdominal muscle exercises, Makenzie's exercises Iliopsoas exercises, Hamstring exercises and Hip range of motion exercises. Patients were assessed for post-operative state of radicular leg pain and neurology.



**Figure 1: A) showing guide wires inserted for a two level MIS TLIF case. b) Tubular retractor. C) use of microscope for decompression. D) Microscopic view in MIS TLIF.**

Post-operative x-rays were done to assess the proper placement of implants and to check the reduction. Patients were assessed pre operatively, 24 hrs. post-operatively, 1 month, 3 months, 6 months, 12 months and 24 months postoperative follow up. The tools used for assessing the functional outcomes were visual analog score (VAS) and Oswestry Disability Index (ODI).<sup>11</sup> Statistical analysis was done using 'paired T test' and 'chi square test' and showed positive results.



**Figure 2: A) & B) Preoperative flexion and extension lateral X Rays showing unstable listhesis at L4 L5 level. C) Postoperative X Ray showing decompression and fixation. D) Clinical postoperative photograph.**

#### Results:

33 patients who fulfilled inclusion criteria were followed up till the minimum of 2 years. 3 Patients lost follow up after one year of regular follow up. Hence data of 30 patients was available for the evaluation of clinical outcome. In our study, youngest patient was a 30 year old female and oldest patient was a 77 year old male. Most commonly affected age group was 51 to 70 years (22 cases-73.33%). Mean age was 58.6 years. 17 (56.67%) were females while 13 (43.33%) were males and the Male:Female ratio = 1:1.30.

1 (3.33%) patient had Degenerative Lumbar spine Instability at L2-L3 level, 2 (6.67%) at L3-L4 level at L4-L5 level in 14 (46.67%) patients and at L5-S1 level 13 (43.33%) patients.

These functional outcomes were measured in the form of following scoring systems:

1. VAS (Visual Analogue Scale) for leg pain.
2. VAS for back pain.
3. Oswestry disability index.

Pre-operative leg pain VAS score was mean VAS= 8.033(SD ±1.671). There was an initial rapid decrease in the leg pain scores from 8.033 in the pre-operative period to 0.6 (SD±1.003) 24 hrs. after surgery. On follow up at one month the mean leg pain VAS score 0.367(SD =±0.964). At three month follow up, the mean leg pain VAS score was 0.200(SD=±0.925). The mean leg pain VAS score was 0.300(SD=±1.466) at six months follow up. At one-year and two year follow-up almost all patients had no reading on VAS scale. We used "paired t test" for statistical analysis and, we conclude that there is statistically significant improvement in the VAS score post operatively.

Pre-operative back pain VAS score was mean VAS= 8.200(SD ±0.551). There was an initial rapid decrease in the back pain scores from 8.033 in the pre-operative period to 4.233(SD±0.679) at 24 hrs. On follow up at one month the mean back pain VAS score 0.600(SD =±0.894). At three month follow up, the mean back pain VAS score was 0.333(SD=±0.7111). The mean back pain VAS score was 0.1333(SD=±0.434) at six months follow up. At 1 year and 2 year follow-up almost all patients had no reading on VAS scale. We used "paired t test" for statistical analysis and, we conclude that there is statistically significant improvement in the VAS score post operatively.

The disability due to backache and leg pain was assessed using the Oswestry Disability Index (ODI). The mean ODI in pre-operative period was 70.17(±9.24) and 1 month after surgery Mean ODI was 10 (±11.14) at 3 months and at six months mean ODI was 8.67(±14.79). At one and two year follow up mean ODI was 6.00(±13.29). Thus there was significant improvement noted in the functional outcome in all patients. At the end of 3 month all patients resumed their original job.

One patient developed opposite sided radicular leg pain. The opposite sided leg pain was transient and the patient recovered completely by giving conservative treatment after two weeks. Postoperative incision site pain was experienced by six patients. This was recovered in 7 days after giving oral Non Steroidal Anti Inflammatory drugs. No patient had other complications like dural tears, Screw misplacement, Postoperative neurologic deficit, deep wound infection and pseudo arthrosis. 28 (93.33%) patients showed excellent results after surgery and 2 (6.66%) patients showed good score.

#### Discussion:

TLIF surgery is associated with significant morbidities due to extensive muscle stripping and retraction during the surgical approach. Studies have documented the deleterious effects of extensive and prolonged muscle ischemia adversely affecting both short and long-term patient outcomes.<sup>12-15</sup> Minimally invasive (MIS) TLIF surgery have gained popularity in recent times due to lesser morbidity and lesser complications.<sup>6,16,17</sup> This is made possible with the advancements in spinal instrumentation and radiological imaging. Foley et al.<sup>8</sup> first described this novel technique which utilized tubular retractors inserted serially under radiological guidance via a muscle-dilating approach, thus reducing the amount of iatrogenic muscle and soft tissue injuries.

Minimally invasive TLIF has many advantages over Conventional open TLIF such as<sup>6,16-20</sup>

1. Minimally invasive approach surgery.
2. Less blood loss.
3. As the procedure is performed through Transforaminal approach, therefore posterior ligamentous and bony structures are protected.
4. Due to less tissue trauma and structure damage, MIS TLIF may reduce the amount of iatrogenic injury while still safely accomplishing the goals of the conventional open TLIF.
5. Including less paravertebral muscle injury.
6. Early mobilization.
7. Decreased reported incidence of surgical site infections.

8. Requires less hospital stay, thus reduces treatment cost for the patient.
9. Less postoperative pain.
10. Better cosmetic results (small scar)

MIS-TLIF is a viable alternative and has received increased interest. With the same fusion technique, MIS-TLIF promises smaller skin incisions and less muscle dissection. postoperative evaluation is critical to understand the success of the procedure. There is still a need for more studies to ascertain the benefits and risks of MIS vis-a-vis open TLIF. We hope to contribute to this by our study.

However there are some Disadvantages of MISTLIF such as-

1. There is a steep learning curve.
2. Requirement of expensive instruments like microscope, MIS instrumentations, etc.

We have done prospective analysis of functional outcomes of MIS TLIF in patients of Degenerative Lumbar spondylolisthesis with unilateral radicular leg pain. Our study results demonstrated

1. MIS –TLIF in adult degenerative lumbar spondylolisthesis allows adequate and safe decompression leading to significant reduction of symptoms and disability.

2. It causes less complications.

28 (93.33%) patients with poor pre-operative results showed excellent post-operative ODI score. 2(6.66%) patients with pre-op poor score showed postop good score. These patients returned to their routine daily activities, resumed their work, were able to sit crossed legged and squat 3 months after surgery.

#### Conclusions:

Our study observations showed that the advantages of MIS-TLIF are more than disadvantages. Hence MIS-TLIF is a viable, safe and effective modality of treatment in carefully selected patients of Degenerative Lumbar spondylolisthesis.

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