MINIMALLY INVASIVE TRANSFORAMINAL LUMBAR INTERBODY FUSION IN DEGENERATIVE LUMBAR SPINE DISEASE

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ABSTRACT

OBJECTIVE

To assess the clinical and radiological outcomes of Minimally Invasive Transforaminal Lumbar Interbody Fusion (MI-TLIF) and to analyze the surgical outcome for degenerative lumbar spine disease.

METHODS

A multicenter retrospective analysis of 20 patients who underwent a MI-TLIF by image guidance from 1 January 2012 to April 2015. The study included 13 males and 7 females (Mean age 53 year). CT scan of operating area was done to evaluate the pedicle screw, cage placement and fusion at 6 months post operatively. Oswestry Disability Index (ODI) scores and Visual Analogue Scale (VAS) were recorded pre-operatively and at 6-month followup.

RESULTS

Eighteen (90%) patients had evidence of fusion at 6 months post operatively with a mean improvement of 34 on the ODI score. Mean length of hospital stay was 4 days. The mean operative time was 170min. One patient developed transient nerve root pain in the postoperative period which was managed conservatively and one patient developed superficial wound infection. There was no case of CSF leak.

CONCLUSION

MI-TLIF is a safe and effective surgical procedure for management of degenerative lumbar spine disease.

KEYWORDS

Transforaminal Lumbar Interbody Fusion, Minimally Invasive Spine Surgery.

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INTRODUCTION

Degenerative disc disease of the lumbar spine is a serious problem that causes varying degrees of disability and patients usually present with lower back pain, sciatica, paraesthesia, weakness and intermittent claudication due to degeneration.[1]

A variety of surgical procedures have been used for the management of the disorder; which include Posterior Lumbar Interbody Fusion (PLIF), Transforaminal Lumbar Interbody Fusion (TLIF), and posterolateral fusion and Posterior Instrumentation (PLF). In 1982, Harms and Rolinger first developed the Transforaminal Lumbar Interbody Fusion (TLIF) with the lateral approach to the disc spaces, which required reduced retraction of the thecal sac and nerve root.[2]

Minimally Invasive Transforaminal Lumbar Interbody Fusion (MI-TLIF) was first introduced by Foley et al.[3] in 2002 with the aim of reducing tissue damage associated with the exposure and approach while maintaining the ability to achieve neural decompression and adequate inter body fusion.

They reported that patients undergoing MI-TLIF had less blood loss intraoperatively; lower doses of postoperative analgesics, early mobilization in the post-operative period and a decreased length of hospital stay making MI-TLIF an attractive surgical procedure for the management of degenerative lumbar spine disease.

This technique also has disadvantages, including longer operative time and a steep learning curve compared with conventional open methods.[4,5] The purpose of this study is to report the results of MI-TLIF in patients with degenerative lumbar spine disease.

METHODS

The study compromised of 20 patients, 13 males and 7 females, whose radiological findings were consistent with degenerative lumbar spinal disease with or without lumbar radiculopathy or claudication that underwent MI-TLIF between January 2012 and April 2015. All patients were followed for a period of 6 months. Patient data were recorded prospectively in a clinical database.

Assessment of clinical outcome was done by Oswestry Disability Index (ODI) scores and Visual Acuity Scale (VAS), which were recorded for the clinical outcome preoperatively and 6 months postoperatively. Assessment of degree of bony fusion was performed with multi-planar CT scan 6 months

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postoperatively to evaluate fusion at operative site as per protocol.

All the patients were closely observed and post-operative complications were also duly noted and incidences like pedicle screw misplacement or inter-body cage malposition were assessed by post-operative CT; new neurological deficit or pain; postoperative CSF leak; post-operative superficial or deep infection; thromboembolic complications; unplanned return to surgery within 30 days and further lumbar surgery within 6 months were also recorded.

OPERATIVE TECHNIQUE

After administration of general anesthesia, the patients were placed in prone position, an intra-operative C-Arm was used to acquire on-table images and these images were used to guide placement of the implants. Each pedicle screw was placed at the junction of the transverse process and facet complex and avoided the articular surface of the facet joint.

Further, corresponding the trajectory small skin incisions were made and under the guidance of C-arm the access needle was modified and introduced followed by insertion of a k-wire through the access needle, which was then withdrawn and serial dilatation was performed to create a tunnel through the muscle and subsequently pedicle screws were placed.

MI-TLIF is a procedure which has a steep learning curve and placing screws and their extenders are not advised on the same side due to difficulty in accessing the operating field and increased intraoperative time, thus we inserted the pedicle screws on the contralateral side, and on the ipsilateral side and the pedicle was cannulated only by needle sleeves; ipsilateral screws were only inserted after placement of the interbody cage.

This allowed us to get unhampered insertion of dilators and an unobstructed view through the operating tube. Decompression and interbody fusion was performed by a 20 mm cylindrical tube with an operating microscope, as described by Park and Foley.[6]

Lordotic disc space spreaders were used to acquire intradiscal distraction at the site of procedure and sustained by insertion and fixation of a percutaneous rod through the pedicle screws on contralateral side. Once interbody fusion was complete and all the screws inserted and compressed to provide a degree of segmental lordosis and compression across the interbody cage.

In all patients reduction was attempted trying to preserve lordosis. In the follow-up period, post-operative CT was performed in all patients to assess the degree of reduction of the spondylolisthesis and bony fusion. Degree of fusion was graded based on previously published grading systems.[7,8]

RESULTS

From January 2012 to April 2015, 20 patients underwent MI-TLIF. The pre-operative mean ODI score was 52 and the post-operative mean score 18. The mean change in ODI score was an improvement of 34 points. The mean length of hospital stay in post-surgery was 4 days and mean time of surgery was 170 min. Follow-up CT after 6 months revealed evidence of bony fusion in 18/20 (90%) of patients.

This was deemed complete in 15 patients with bridging bone and trabecular remodelling, presence of bridging bone, but incomplete fusion was seen in 4 patients and lack of fusion with evidence of endplate osteolysis in one patient.

Entity	Outcome
Number of Patients	20
Age Range	45-67 (Mean 53 years)
Sex	
Male	13
Female	7
Clinical Evaluation	
Visual Analog Scale (VAS)	
Preop	6.6 (Mean 4-9)
Post Op – 2 weeks	2.8 (Mean 2-6)
Post Op – 6 months	1.6 (Mean 1-4)
ODI	
Mean – Pre-op	52 (Range 14-76)
Mean – Post-op	18 (Range 0 - 56)
Change Mean	34 (Range 8 - 76)
Indication	
Spondylolisthesis with radiculopathy/ canal stenosis	13
Radiculopathy without spondylolisthesis	7
Level of Fusion	
L3/4	2
L4/5	11
L5/S1	7
Fusion Rate	
Grade I	15
Grade II	4
Grade III	1
Length of Hospital Stay	
Mean	4
Median	3
Range	3-10 days
Operative Time	170 mins (Range 120 - 220)

Table 1: Patient demographics and surgical details

COMPLICATIONS

Post-operative complications included three malpositioned screws (Two lateral pedicle breaches, and one superior pedicle breach); both detected on the end-of-case C-arm images and revised prior to waking the patient. One patient developed a transient unilateral L5 nerve root pain related to reduction of a grade two spondylolisthesis.

DISCUSSION

The TLIF procedure was pioneered by Harms and Jeszenszky, who published results of 191 patients reported excellent results in isthmic and degenerative spondylolisthesis.[2] MI-TLIF has significant advantages over other procedures, a unilateral approach with decreased neural retraction and lateral angle of approach to the disc space avoids midline scar tissue and thus helpful in revision, if interbody fusion is incomplete. The short intraoperative period, decreased neural injury and better outcomes make this a procedure of choice.[9]

Foley et al.[3] in 2002 described MI-TLIF. Henceforth, many well-structured studies have compared and concluded that MI-TLIF has reduced blood loss, decreased operative time, fewer complications and better fusion with a small period of post-operative stay. Schizas et al.[10] prospectively compared

patients undergoing MI-TLIF and open TLIF and concluded the same findings mentioned above but differences in ODI scores, operative time and postoperative analgesic requirements.

Villavicencio et al.[11] and Peng CW et al.[12] have also demonstrated a lower blood loss and shorter length of stay with MI-TLIF when compared to open TLIF. Dhall et al.[13] retrospectively compared MI-TLIF and open TLIF and demonstrated a lower blood loss (194 cc vs. 505 cc), shorter length of stay (3.0 days vs. 5.5 days), and a higher rate of hardware- related complications with MI-TLIF.

In our study, we assessed the results of MI-TLIF in 20 consecutive patients with degenerative disc disease or spondylolisthesis. The mean post-operative ODI score was 18 with a mean improvement of 34 points. With regard to fusion, at 6 months only one patient failed to achieve fusion, which results in a fusion rate of 95% which is comparable to the results of a well-designed meta-analysis on previous studies which have reported fusion rates of 94.8% for minimally invasive procedures in comparison to 90.9% with open procedures.[14]

Our findings are also in accordance to these previous studies. The only limitation to our study is that it is retrospective and not randomized and performed by two surgeons in two different hospitals. We did not consider variables like BMI and incidence of smoking in the study. Moreover our average period of follow-up was long enough to sufficiently validate the effect of minimally invasive lumbar fusion on the outcomes such as adjacent segment degeneration.

CONCLUSION

Our results further support that MI-TLIF is an effective mode of management for lumbar degenerative disc disease. It produces good benefit to risk ratio, comparable to data from previous studies, results in decreased intra-operative time, less blood loss and a shorter hospital stay and with good rates of solid bony fusion in the follow-up period.

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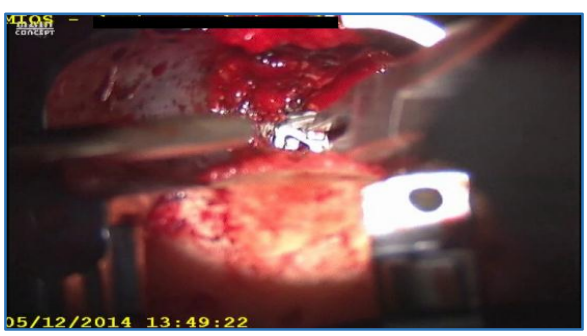
Intraoperative image of Pedical screw Insertion



Intraoperative image of T-LIF Insertion