DOI: https://doi.org/10.53350/pjmhs221610305

**ORIGINAL ARTICLE**

# A Comparison of Clinical and Radiological Outcomes between Open and Minimally Invasive Transforaminal Lumbar Interbody Fusion

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## ABSTRACT

**Objective:** To compare the clinical, radiological and functional outcomes of patients between open TLIF and minimally invasive TLIF techniques.

Study Design: Prospective cohort study

Place and duration: Study was conducted at department of neurosurgery Bakhtawar Amin Hospital, Multan from August 2021 to July 2022 in duration of one year.

**Methodology**: A total of 94 patients planned for transforaminal lumbar interbody fusion (TLIF) were enrolled in study. Main variables of study were intra operative blood loss, duration of surgery, VAS score, ODI index and functional score. SPSS version 24 was used for data analysis, t-test and chi square test were applied to see association among variables. P value less than or equal 0.05 was considered as significant.

**Results:** Oswestry disability index readings were 35.16±2.18 and 5.12±0.61 in O-TLIF and MIS-TLIF groups respectively at 3 weeks after surgery. The differences were statistically insignificant, (p>0.050). Physical component summary of both the groups at different time intervals as shown better outcomes in MIS-TLIF group, no difference was found to be statistically significant except at 6 week. Mental component summary in both the groups was almost equal, (p>0.050).

**Implications:** There was no local study on comparison of open and minimally invasive technique for TLIF, our study will fulfill the local reference gap and help the surgeons for choice of better management technique in future.

**Conclusion:** Minimally invasive surgery TLIF technique is better in immediate benefits as soft tissue injury and iatrogenic injury which is associated with better post operative pain functional recovery time. So, minimal invasive interbody fusion is a safe and reliable option for short term (blood loss, post operative pain) and long term outcomes like functional recovery.

**Keywords**: Interbody fusion, VAS score, SF-36, ODI index, TLIF Technique

## INTRODUCTION

In case of instability in lumbar spine like spondylolisthesis and lumbar canal stenosis fusion of lumbar spine or transforaminal lumbar interbody fusion (TLIF) is the standard of care[1]. Purpose of TLIF in such patients is to prevent movement at affected segment to restore the vertebral alignment and height of disc, decompression may or may not be the part of surgery[2].Primary goal of lumbar fusion is to reduce pain and limit disability in patients of lower back pain. Interbody fusion and restoration of vertebral eight with use of cage or graft have certain advantages over posterolateral fusion technique[3]. Primary outcomes can be achieved with posterior lumbar interbody fusion but this technique is associated with high incidence of complications like dural sleeve retraction and nerve injury[4].

TLIF was 1st time used by Harms and Jeszenszky in 1980s and describe its advantages over PLIF[5]. It allows decrease neural detraction which save from potential nerve injury, unilateral exposure and integrity of posterior column also remain preserved minimizing lamina, facets and pars resection which are partially removed in posterior lumbar interbody fixation[6]. Open TLIF (O-TLIF) is also a useful technique but like PLIF number of poor short and long term outcomes are associated with it due to increased muscle trauma by detachment of muscles and muscle retraction[7].

Demands for spinal fusion in adults is increasing worldwide, but increasing rate of associated morbidities like neural complications, blood loss, prolong hospital stay, infection rate and long time narcotic use has exposes the forbidden surgical risk for general population[8]. Shortcomings of O-TLIF can be reduced with minimally invasive TLIF (MIS-TLIF) by avoiding denervation of muscle while separating them in their respective planes along with achieving the primary goals of traditional techniques[9]. Foley introduced tubular retractors, inserted under radiographic guidance by dilating muscles, thence reducing soft tissue injury and extent of iatrogenic muscles[10].

No local study on comparison of open and minimally invasive technique for TLIF, our study will fulfill the local reference gap and help the surgeons for choice of better management technique in future in terms of clinical and radiological outcomes.

## METHODOLOGY

Study was prospective cohort in design conducted at department of neurosurgery Bakhtawar Amin Hospital, Multan from August 2021 to July 2022 in duration of one year. Non probability consecutive sampling technique was used and sample size was calculated by using an online software Openepi.com. The study's beginning was sanctioned by the hospital's ethics committee. After explaining the study's goals and how their data would be protected, patients signed a written consent form to participate.

Patients of lumbar spine instability, degenerative or lytic listhesis and planned for lumbar interbody fusion and who required single level TLIF were enrolled in the study. Patients were divided into two groups (O-TLIF and MIS-TLIF were) by lottery method. Patients in group O-TLIF were operated with open transforaminal interbody fusion and in group MIS-TLIF were operated with minimal invasive transforaminal interbody fusion technique. Sample size of 94 patients was calculated by using an online software openepi.com and following statistics; 95% confidence interval, power of study 80% and VAS score at 6 month follow up in MI-TLIF group 3.5 ± 1.03 and in O-TLIF 4.14 ± 0.86.

Patients who complained of low back discomfort and radiculopathy were evaluated clinically and radiographically. Lumbar spine MRI and x-rays (both flexed and extended) were taken before the operation.Lumbar instability was labeled when angulation of ≥10° or dynamic anterior-posterior translation of 4 mm was seen on both flexion and extension films. Patients were given a trial of medicines in combination of steroids and anti-inflammatory along with daily exercises for duration of 3 months as conservative management.Patients of spondylolisthesis grade 3 or

above, multilevel TLIF, acute trauma, revision surgeries, tumor and infectious pathology were excluded from the study.

Patients were advised for follow up until one year and evaluated radiologically and functionally on every follow up. Pre-operative, Oswestry Disability Index (ODI), Visual Analogue Score (VAS) and Short form (SF-36) score were noted and then same outcomes were measured at first and sixth week, 3 and 6 month and 1 year after surgery by an interviewer who is unaware of study purpose. Intraoperative measures like blood loss, duration of surgery, post operative hemoglobin and blood transfusion were noted. Adverse incidence like dural tear, neural injury, cerebrospinal fluid leak, neurological deficit, recurrence of radicular pain, surgical site infection, redo surgery were also noted.

We used SPSS version 24 to enter and analyse our data, calculating means and standard deviations for numerical data like ages, and frequencies (in percent) for categorical variables like genders. A T-test (for quantitative variables) and a chi-square test (for qualitative variables) were used to examine the correlation between the various measures of success. When the probability level was less than 0.05, it was considered.

## RESULTS

Overall, 94 patients were included in our study. Half of the patients treated with open TLIF and half of the patients treated with MI TILF. The average age, gender distribution and average visual analogue scale of both the groups were shown in table. I. The differences were not statistically significant, (p>0.050). (Table. I).

Table-1: Demographic and visual analogue scaleof the study groups

| Characteristic | Open TLIF N (%) | MI TLIF N (%) | p-value |
|---|---|---|---|
| Age (years) | 45.89±4.25 | 46.08±3.43 | 0.811 |
| Gender | | | |
| Male | 31 (66.0%) | 28 (59.6%) | 0.522 |
| Female | 16 (34.0%) | 19 (40.4%) | |
| Duration of MIS-TLIF procedure (hour) | 2.55±0.65 | 2.71±0.46 | 0.205 |
| Intraoperative blood loss (ml) | 267.32±13.02 | 262.87±14.52 | 0.122 |
| Visual analogue scale (VAS) | | | |
| 1 Pre-operative | 7.03±0.66 | 7.25±0.55 | 0.088 |
| week post-operative | 5.33±0.39 | 5.18±0.46 | 0.0.087 |
| 3 weeks post- operative | 5.05±0.59 | 5.12±0.61 | 0.546 |
| 6 weeks post- operative | 3.92±0.87 | 4.31±0.76 | 0.025 |
| 3 months post- operative | 3.46±0.26 | 3.47±0.25 | 0.905 |
| 6 months post- operative | 2.21±0.29 | 2.09±0.28 | 0.067 |

Table-2: Oswestry Disability Index readings at different times of the study groups

| Time | Open TLIF N (%) | MI TLIF N (%) | p-value |
|---|---|---|---|
| Pre-operative | 51.94±2.73 | 52.74±3.06 | 0.186 |
| week post-operative | 43.74±3.52 | 43.87±3.72 | 0.865 |
| 3 weeks post- operative | 35.16±2.18 | 34.87±1.96 | 0.350 |
| 6 weeks post- operative | 30.91±3.11 | 31.19±3.52 | 0.445 |
| 3 months post- operative | 24.77±4.67 | 25.68±4.76 | 0.329 |
| 6 months post- operative | 20.38±2.11 | 20.04±2.17 | 0.715 |

Table-3: Physical component summary at different times of the study groups

| Time | Open TLIF N (%) | MI TLIF N (%) | p-value |
|---|---|---|---|
| Pre-operative | 31.24±3.54 | 30.58±2.92 | 0.329 |
| week post-operative | 38.36±4.44 | 38.68±3.99 | 0.715 |
| 3 weeks post- operative | 40.19±1.86 | 40.33±1.95 | 0.718 |
| 6 weeks post- operative | 46.39±3.62 | 44.54±3.71 | 0.016 |
| 3 months post- operative | 51.26±3.25 | 50.81±2.52 | 0.448 |
| 6 months post- operative | 52.58±1.84 | 52.31±2.42 | 0.543 |

Oswestrydisability index readings of both the groups at different time intervals were shown in table II. The differences were statistically insignificant, (p>0.050). (Table. II). Physical component summary of both the groups at different time intervals represented in table III. No difference was found to be statistically significant except at 6 week. (Table. III). Mental component summary in both the groups was almost equal, (p>0.050). (Table. IV).

Table-4: Mental component summary at different times of the study groups

| Time | Open TLIF N (%) | MI TLIF N (%) | p-value |
|---|---|---|---|
| Pre-operative | 35.01±2.87 | 34.08±3.84 | 0.189 |
| week post-operative | 42.54±4.25 | 42.88±4.64 | 0.707 |
| 3 weeks post- operative | 44.09±3.61 | 44.36±3.02 | 0.695 |
| 6 weeks post- operative | 46.04±4.08 | 47.58±4.06 | 0.069 |
| 3 months post- operative | 52.93±3.92 | 51.35±3.56 | 0.054 |
| 6 months post- operative | 55.62±5.01 | 56.76±4.02 | 0.229 |

## DISCUSSION

Primary goal of MI-TLIF is to achieve same outcomes as in traditional procedures but with minimal muscle trauma and neurological Injuries. Advantage of MIS-TLIF includes contralateral musculatures remains intact and serial dilation of muscle instead of striping and splitting of muscles[11]. In our study 94 patients were enrolled in two groups mean age of patients in O-TLIF group was 45.89±4.25 years and in MI-TLIF group mean age was 46.08±3.43 years. A study was conducted by Balasubramanian et al[12] in 2019; mean age of patients in his study was 48.4 ± 11.44 years and mean duration of surgery was 2.71±0.46 in MI-TLIF and 2.55±0.65 in open group.

In our study intraoperative blood loss lesser in MI-TLIF group as compared to O-TLIF group, 262.87±14.52 ml and 267.32±13.02 ml respectively. In a study conducted by Dhal et al[13] similar findings were reported as a significant reduced amount of blood loss was observed in MIS-TLIF group. Wang et al[14] also reported increased postoperative drainage volume in open TLIF group as compared to MIS-TLIF.Fluoroscopy time and post operative recovery time were also compared in his study but these are not our study variables.

In our study mean VAS score, Oswestry score and physical fitness (FS-36) status score was found decreased in both group when compared with baseline measures and follow up at 6 weeks and 1 year but values were not statically significant. Peng et al[15] conducted a study on 58 patients and observed improvement in ODI, VAS and FS-36 score without statistical significance. Another study Lee et al[16] observed contrast results to given study and our findings that improvement in VAS, ODI and SF-36 was statistically significant in both groups. Decrease in VAS, ODI and SF-36 in MI-TLIF group is greater as compare to O-TLIF.

Schizas et al[17] conducted a study on 36 patients in 2009 and reported MIS-TLIF technique is superior in complication rate as reduced hospital stay, blood loss and post operative infection is lesser in this group but regarding ODI and VAS score there is not statistically significant difference. Villavicencio et al[18] also reported results in favor of MIS-TLIF group as total operative time is greater in open TLIF group and difference is statistically significant. In our study duration of surgery is lesser in O-TLIF but difference was not significant statistically.

Greater improvement in visual analogue score and three time lesser blood loss was also reported by Kim et al[19], similarly functional recovery time was also less in MIS-TLIF group; these results are comparable to our study findings. Kepler et al[20] conducted a study on this topic and reported MIS-TLIF technique is superior as compared to open TLIF technique in all aspects (hospital stay, intraoperative blood loss) except fluoroscopy time.

Zairi et al[21] conducted a similar study on 100 patients, among them 60 patients were operated with open techniques and 40 patients were operated with MIS-TLIF technique. At the end of study results shows MIS-TLIF is superior in blood loss measure and VAS, ODI score in post operative follow ups. Difference was statistically significant among both groups.

## CONCLUSION

Results of our study reveal that minimally invasive surgery TLIF technique is better in immediate benefits as soft tissue injury and iatrogenic injury which is associated with better post operative pain functional recovery time.So, minimal invasive interbody fusion is a safe and reliable option for short term (blood loss, post operative pain) and long term outcomes like functional recovery.

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