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Outcome of minimally invasive transforaminal lumbar interbody fusion for the treatment of low grade (grade I and II) spondylolisthesis in obese patients

Anowarul Islam[1]*, Zafri Ahmed[2], Sagor Kumar Sarker[3], M. Sariful Hasan[4], A. H. M. Masiur Rahman[5], Khandoker Abdur Rahim[1]

[1]Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[2]Department of Spine Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[3]Spine Unit, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[4]Department of Orthopaedic Surgery, East West Medical College, Dhaka, Bangladesh
[5]National Institute of Traumatology & Orthopedic Rehabilitation, Dhaka, Bangladesh

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***Correspondence:**
Dr. Anowarul Islam,
E-mail: maislam.spine@gmail.com

ABSTRACT

Background: Spondylolisthesis in obese patient is one of the causes of back pain, severe morbidity, and impairment. This study examines low-grade spondylolisthesis patients' pain relief, functional improvement, fusion rates, and complications after minimally invasive transforaminal lumbar interbody fusion (MIS TLIF).
Methods: This study was conducted in the Department of Orthopedic Surgery at BSMMU, Dhaka, from July 2023 to June 2024. 30 low-grade spondylolisthesis patients were included according to selection criteria. Functional outcomes were assessed by Visual Analogue Scale score**,** Oswestry disability index, Modified Macnab's Criteria. Interbody fusion was evaluated by Bridwell interbody fusion grading system and also perioperative events were noted. Mean, standard deviation, Frequency and percentage were used to test qualitative data with chi-square. SPSS 26 data analyses will consider p-values <0.05 significant.
Results: 23.33% patients were day laborer and housewives. Most commonly involved level was L5/S1 (60%), followed by L4/L5, (40 peri-operative complications were seen in 4 (13.33%) patients where in 2 (6.67%) patients had seroma, 1(3.33%) patient had discitis and 1(3.33%) patient had foot drop. One patient had discitis and 1 patient had foot drop. VAS score and Oswestry Disability Index Score had showed significant improvement in post-operative follow up (at 6 months) compared to pre-operative status ($p<0.05$). Overall, excellent improvement was seen in 40% of cases according to modified Macnab's criteria on 6 months of post-operative follow up.
Conclusions: MIS TLIF is a safe, efficient, and cost-effective technique when performed accurately. The reduced surgical invasiveness, shortened hospital stay, and rapid return to employment represent substantial advantages of MIS TLIF.

Keywords: BSMMU, Minimally invasive transforaminal lumbar interbody fusion, MIS TLIF, Spondylolisthesis

INTRODUCTION

Obesity is defined by WHO as a BMI >30. By 2008, obesity had nearly doubled since 1980. By 2025, two-thirds of the population will be overweight or obese, attracting global attention. Obesity is a risk factor for several spinal diseases, including cervical spondylosis, lumbar disc herniation, lumbar spondylolisthesis, and

spinal canal stenosis, which makes spinal surgery harder and increases surgical complications.[1] Overweight patients are more likely to develop wound infection, deep venous thrombosis, and pulmonary embolism after surgery.[2] Revision surgery and postoperative complications increase readmission risk.

Spondylolisthesis is derived from the Greek words "spondylos" (vertebra) and "olisthanein" (to slip). The term was first described by Herbiniaux in 1782 and later named by Kilian in 1854.[3] The condition occurs due to the failure of anatomical structures such as facets, annulus fibrosus, and the posterior bony arch to resist anterior vertebral displacement. It predominantly affects the lumbar spine, with L4/L5 and L5/S1 being the most common sites.[4] Classification by Wiltse, Newman, and Macnab (1976) distinguishes multifactorial causes: dysplastic (Type 1), isthmic (Type 2), degenerative (Type 3), traumatic (Type 4), pathologic (Type 5), and iatrogenic (Type 6). Meyerding's grading system (1938) categorizes slip severity, with Grades I and II classified as low-grade and Grades III-V as high-grade.

Symptoms include low back pain, radiculopathy, neurogenic claudication, and, in severe cases, cauda equina syndrome. Non-operative treatments such as pain management, bracing, physical therapy, and epidural steroid injections are typically the first-line approach.[5] However, 10-15% of patients eventually require surgery due to persistent symptoms or neurological deterioration.[5]

MIS TLIF has become a preferred surgical approach due to reduced iatrogenic nerve complications and improved outcomes. It stabilizes the spinal segment, restores disc height, and corrects spinopelvic alignment. In a study conducted in Bangladesh It is suggested that instrumented fusion is effective in the management of lumbar spondylolisthesis, as evidenced by its superior clinical outcomes and higher fusion rates.[6] While its learning curve is steep, MIS TLIF significantly reduces blood loss, operative time, postoperative pain, and hospital stay compared to open TLIF.[7] Minimally invasive surgery preserves muscle, reduces intraoperative trauma, and speeds recovery and improves long-term function. This study examines MIS TLIF's functional outcomes for low-grade spondylolisthesis patients, focusing on pain reduction, functional improvement, fusion rates, and complications.

METHODS

The BSMMU, Dhaka Department of Orthopedic Surgery conducted the research from March 2022 to September 2024 including patients of BMI >30 according to WHO criteria of obesity. The study was prospective observational. Thirty patients were recruited using inclusion and exclusion criteria. The study included 20-80-year-olds with Grade I or II symptomatic lumbar spondylolisthesis of a single spinal segment. They had neurological claudication and were unresponsive to conservative treatment for three months. Patients with high-grade spondylolisthesis (Grade III-V), multi-segment involvement, previous lumbar spine surgeries, spinal infections, metabolic bone diseases, tumors, or acute spinal trauma were excluded from the study. To determine if the patient was suitable for minimally invasive transforaminal lumbar interbody fusion, the research team performed a thorough preoperative evaluation, including radiographic and MRI checks. The surgery was performed under general anesthesia with fluoroscopic guidance to ensure accurate implant placement. Postoperative assessments used validated measures like VAS, ODI, Modified Macnab's Criteria, and Bridwell interbody fusion grading. These tests assessed pain, function, and spinal fusion. To track recovery and fusion, patients were followed at 1, 3, 6, 12, and 15 months after surgery. SPSS version 26 (IBM®) was used for statistical analyses to ensure results reliability. Quantitative data was tested with t-tests and qualitative data with chi-square tests.

RESULTS

Total 30 patients with low grade (Grade I and II) spondylolisthesis in obese patients underwent minimally invasive transforaminal lumbar interbody fusion with the fulfillment of all inclusion and exclusion criteria were taken as study population. All the data were compiled and sorted properly, analyzed statistically and placed in Tables. Total number of patients was 30 in this study. Age range was found between 20-70 years (Table 1). Table 1 shows that the mean age of the patients was 53.4±8.26 years, where maximum case belonged to 50-59 years of age (46.67%).

Table 1: Age and gender distribution of patients (n=30).

Demographic	Frequency	Percentage (%)
Age (years)		
20-29	1	3.33
30-39	1	3.33
40-49	7	23.33
50-59	14	46.67
60-70	7	23.33
Total	30	100.0
Mean±SD	53.4±8.26	Range (20-70)
Gender	**Frequency (N)**	**Percentage (%)**
Male	11	36.67
Female	19	63.33
Total	30	100.0

Table 1 shows that the greater part of the patients were female 19 (63.33%) with a female: male ratio 1.7:1. Table 1 shows the gender distribution of the study population. Table 1 shows that the most commonly involved level was L5/S1 (60%), followed by L4/L5, (40%). Table 1 shows the level of disc space involvement of the study population.

Figure 1 shows that 100% patients had back pain with radiculopathy and motor weakness. 27 patients (90%) had sensory symptoms (hypoesthesia). 24 patients (80%) had paresthesias and 23 patients (76.66%) had numbness. Figure 1 shows different clinical manifestation of the study population.

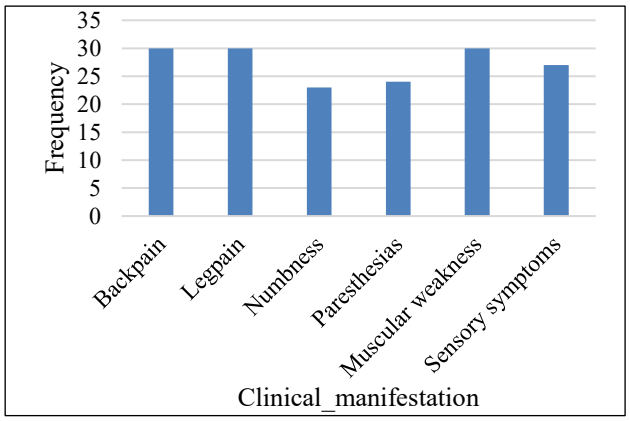

Figure 1: Clinical manifestations of the study population (n=30).

Table 2: Peri-operative complications (n=30).

Peri-operative complications	Frequency (N)	Percentage (%)
Seroma	2	6.67
Superficial wound infection	1	3.34
Foot drop	1	3.34
Total	4	13.33

Table 2 shows that 4 patients (13.33%) experienced peri-operative complications, including two (6.67%) who developed seroma, one (3.33%) who developed discitis, and one (3.33%) who experienced foot drop. One patient had foot drop, and another had discitis.

Table 3 shows that all patients had a mean VAS score of 7.07±0.87 (6-9) prior to surgery, but after 1, 3, and 6 months of follow-up, the VAS score was significantly lower than it was before the procedure (3.50±1.25, 2.47±1.57, and 1.73±1.72 respectively; p value <0.001).

Table 3: Mean VAS score of back pain in all patients at different time points (n=30).

VAS back pain	Mean±SD	Range (min-max)	P value
Pre-op	7.07±0.87	(6-9)	
1 month	3.50±1.25	(2-7)	<.001[s]
3 months	2.47±1.57	(1-6)	<.001[s]
6 months	1.73±1.72	(0-7)	<.001[s]

s= significant; p value reached from Wilcoxon Matched-Pairs Signed Ranks Test

Table 4 shows that all patients had a mean VAS score of 8.1±0.88 (6-10) prior to surgery, but after 1, 3, and 6 months of follow-up, the VAS score dropped significantly from pre-operative status to post-operative status (3.5±1.25, 2.4±1.59, and 1.37±1.15, respectively; p value <0.001).

Table 4: Mean VAS score of leg pain in all patients at different time points (n=30).

VAS leg pain	Mean±SD	Range (min-max)	P value
Pre-op	8.1±0.88	6-10	
1 month	3.5±1.25	2-7	<.001[s]
3 months	2.4±1.59	1-6	<.001[s]
6 months	1.37±1.15	0-7	<.001[s]

s= significant

Table 5: ODI score in all patients at different time points (n=30).

VAS leg pain	Mean±SD	Range (min-max)	P value
Pre-op	37.63±2.53	30-43	
1 month	30.63±2.63	25-35	<.001[s]
3 months	22.87±2.04	19-29	<.001[s]
6 months	12.20±2.43	08-19	<.001[s]

s= significant

Table 5 shows in comparison to pre-operative status, the ODI score was 37.63±2.53 (30-43) before surgery, but it significantly decreased after 1, 3, and 6 months of follow-up (30.63±2.63, 22.87±2.04, and 12.20±2.43 respectively) (p value <0.001). Overall functional improvement was assessed by Modified Macnab's criteria, excellent improvement was seen in 12 patients on 6 months of post-operative follow up.

Table 6: Modified Macnab's criteria in all patients at different time points (n=30).

Modified Macnab's criteria	Number of patients	Percentage (%)
Excellent	12	40
Good	13	43.33
Fair	4	13.33
Poor	1	3.33
Total	30	100

Table 6 shows that according to Modified Macnab's criteria, 12 (40%) patients had excellent outcomes and 13 (43.33%) had good outcomes. Four (13.33%) patients had fair and one (3.33%) poor outcome.

Figure 2 showing the pre-operative MRI of lumbosacral spine T2 weighted film sagittal section showing anterolisthesis grade I L4 over L5 with redundant disc at the level of L4/L5.

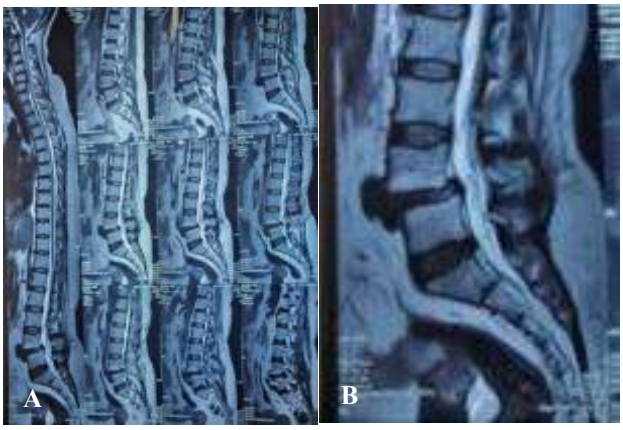

Figure 2 (A and B): Pre-operative MRI of lumbosacral spine.

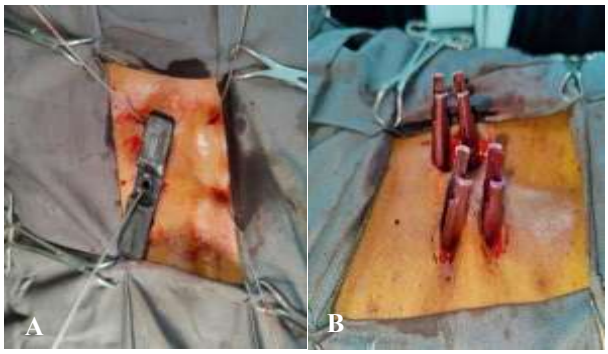

Figure 3 (A and B): Per-operative imaging.

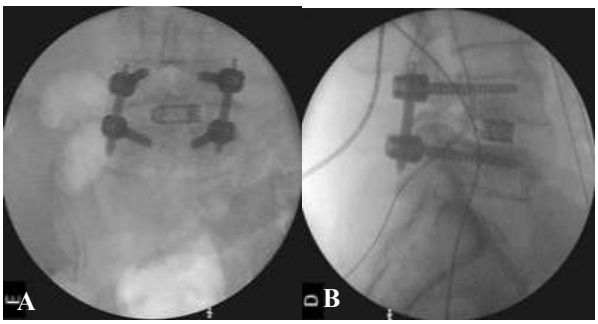

Figure 4 (A and B): Per-operative fluoroscopy imaging.

DISCUSSION

This study assesses the functional outcomes of minimally invasive transforaminal lumbar interbody fusion (MIS TLIF) in patients with low-grade spondylolisthesis, emphasizing pain alleviation, functional enhancement, fusion rates, and complication profiles. The average patient age in this study was 53.4±8.26 years, with 46.67% in the 50-59 age group, similar to findings by (50.12 years).[8] Females comprised the predominant portion, aligning with, though some studies noted male predominance.[9,10] The mean BMI was 32.7±1.43 kg/m² (range 30-35), which corresponds to the findings of (34.48±4.39 kg/m²).[10] The most affected level was L5/S1 (60%), followed by L4/L5 (40%), matching (mostly L5/S1 involvement).[11] The mean operative time was 187.5±9.35 min (range 170-210), although lower duration was noted in (156min).[12] The blood loss during operative procedure was averaged 191.5±11.6 ml (range 170-220), similar to, but in another study[12] reported 264 ml.[3] The mean hospital stay was 3.23±0.43 days (range 3-4), but a more duration of hospital stay was found in (10.6 days) also differing from[8] (1.92±0.52 days).[12]

VAS score for back pain improved significantly from 7.07±0.87 preoperatively to 3.50±1.25 at 1 month, 2.47±1.57 at 3 months, and 1.73±1.72 at 6 months ($p<0.001$), similar to (2.62±3.82 at one year) and (1.3±0.6 at final follow-up).[10,11] VAS for leg pain also decreased significantly from 8.1±0.88 preoperatively to 3.5±1.25 at 1 month, 2.4±1.59 at 3 months, and 1.37±1.15 at 6 months ($p<0.001$), aligning with (3.35±4.77 at one year).[10] ODI improved significantly from 37.63±2.53 preoperatively to 30.63±2.63 at 1 month, 22.87±2.04 at 3 months, and 12.20±2.43 at 6 months ($p<0.001$), comparable to (pre-op 37±6, final 11±6) and (pre-op 41.1±10.3, final 18.2±5.9).[11]

Perioperative complications occurred in 4 patients (13.3%): 2 cases of seroma (6.67%) resolved after aspiration, 1 superficial wound infection (3.34%) improved with antibiotics, and 1 case of foot drop required re-exploration, revealing an epidural hematoma with residual disc material. No surgical site infections were observed. Wang et al reported 2 superficial infections treated with antibiotics and 2 dural tears requiring no additional intervention.[11] The limitations of the study were that the study's participants may not be representative of the community because the sample size was small. Bias may have influenced the results because the sample was purposefully selected. Strengths includes the study tracks patients over time so that MIS TLIF results may be thoroughly evaluated. Ensuring a comprehensive evaluation of the efficiency of the operation, the study assesses pain reduction (VAS), functional improvement (ODI, Macnab's Criteria), and fusion success (Bridwell grading). Patients underwent preoperative evaluations as well as several postoperative intervals (1, 3, 6, 12, and 15 months), so offering a strong longitudinal study of recovery and complications. Conducted at a major orthopedic center (BMU, Dhaka), the study shows sensible, pragmatic results pertinent to the local healthcare environment. This study has several limitations. The small sample size (n=30) limits the generalizability of the findings to the broader population. As a single-center study with purposive sampling, selection bias may have influenced the outcomes. Additionally, the lack of a control group restricts comparative evaluation.

CONCLUSION

MIS-TLIF is a secure and efficacious surgical option for lumbar fusion in morbidly obese individuals, exhibiting minimal peri-operative complications. An optimal surgical outcome can be attained through minimal tissue damage,

reduced blood loss, abbreviated surgical duration, shorter hospital stays, and expedited postoperative recovery, resulting in superior neurological and functional outcomes at final follow-up.

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Ethical approval: Not applicable

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