Doi: https://doi.org/10.3329/ewmcj.v14i2.86295

Original Article

STABILIZATION AND FIXATION OF SPONDYLOLISTHESIS BY TRANSFORAMINAL LUMBAR INTERBODY FUSION - TLIF : A JOURNEY OF DISCOVERY

Bhuiyan SM[1], Nandi AK[2], Yasmin T[3], Shohan AKMNF[4], Islam MN[5], Rashid MH[6]

Article History:
Received: 14 December 2025
Accepted: 4 January 2026

Abstract:

Background: *Spondylolisthesis is the forward displacement of a vertebra over a lower segment due to a congenital defect or fracture in the pars interarticularis, usually of the fifth lumbar over the sacrum, or of the fourth lumbar over the fifth. Spondylolisthesis is graded based upon the degree of slippage of one vertebral body relative to the subsequent adjacent vertebral body. Sings and symptoms ranges from Lower back pain, Sciatica, Back stiffness, Difficulty walking or standing for more than a few minutes at a time, numbness, weakness or tingling in feet. Surgical techniques and instrumentation provide surgeons with the means to substantially reduce spondylolisthetic deformity and restore spinal balance. Stabilizing the spondylolytic level is accomplished by arthrodesis in our case by a transforaminal approach and achieve excessive motion at the fused segment then Allowing the bone graft to heal and form a solid bone bridge between the vertebrae.*

Methods: *A retrospective type of cohort study was done on 21 patients undergoing Transforaminal Lumbar Interbody Fusion- TLIF for spondylolisthesis with lumbar or lumbosacral spondylolisthesis in Zainul Haque Shikder Womens Medical College Hospital (ZHSWMCH), Dhanmondi, Dhaka under one Surgeon, study duration was from January 2023 to December 2024. Patient's included in the study were Patients aged 18 years or older. Have evidence on magnetic resonance imaging of grade I and grade II spondylolisthesis. Having mechanical low back pain and radicular symptoms or were unresponsive to at least 6 months of conservative treatment.*

Results: *Demographic distribution Number of male patients were 9 and female 12. Age group was ranging from 45 +- 6, hospital stay from the day of admission till discharge was 4 +- 1.2 after completion of treatment. Patients with spondylolisthesis in L4 - L5 and L5 - S1 were 10 and 11 respectively. Maximum number patients had Grade I slippage being 9 (42.86%), followed by 5 (23.81%) patients with Grade II, 4 patients with Grade III (19.05%), 2 patients with Grade IV (9.52%) and the least were with grade V being only 1 (4.76%) patient. Pre operative and post-operative VAS of back pain. Preoperatively patients VAS mean with standard deviation was 6.5+- 1.36 postoperative mean with standard deviation was 4.04+- 1.55. Preoperatively, 8 patients had severe disability according to ODI, 7 had moderate disability and 1 patient crippled disability. On the day of discharge, ODI showed 5 patients had minimal disability and 7 had moderate (there was no patient with severe or crippling disability). One week after discharge at follow up, 9 patients complained of minimal disability and 7 patients with moderate disability.*

Conclusion: *TLIF surgery is an effective and precise treatment. It substantially reduced the possibility of infection-related complications and minimal damage to the muscles. Patients on undergoing TLIF surgery required fewer nights of hospital stay before returning home & fewer dependence on analgesics and had better postoperative outcomes.*

Keywords:
Spondylolisthesis, Transforaminal Lumbar Interbody Fusion, TLIF, Outcome

EWMCJ Vol. 14, No. 2, July 2026: 202-207

1. Dr. Md. Sharif Bhuiyan, Assistant Professor , ZH Sikder Womens Medical College Hospital, West Dhanmondi, Dhaka-1209.
2. Dr. Amit Kumar Nandi. Resident, Dept. of Neurosrgery, Dhaka Medical College.
3. Dr. Tamanna Yasmin, Medical Officer, Al Noor Eye Hospital.
4. Dr. A K M Nahid Ferdous Shohan, Surgical Resident, Bangladesh Medical University,
5. Dr. Md.Nurnabi Islam. Resident, National Institute of Neurosciences and Hospital, Dhaka.
6. Dr. Md. Humayun Rashid, Assistant Professor, Department of Neurosurgery, East West Medical College & Hospital, Dhaka.

Address of Correspondence: Dr. Md. Sharif Bhuiyan, Assistant Professor, ZH Sikder Womens Medical College Hospital,West Dhanmondi, Dhaka-1209. Phone:+8801710254803.Email: ssquite@gmail.com. Https://orcid.org/0009-0008-6817-6463

Introduction

Spondylolisthesis is defined as the displacement of one vertebral body relative to the adjacent vertebra and may occur in anterior, posterior, or lateral directions. The condition most commonly affects the lumbar spine, particularly the L5–S1 level, where the L5 vertebra translates anteriorly over the sacrum.[1] The degree of vertebral slippage is commonly assessed using the Meyerding grading system, which classifies spondylolisthesis according to the percentage of vertebral displacement.[2] Based on etiology, spondylolisthesis is broadly classified into dysplastic, isthmic, degenerative, traumatic, pathologic, and iatrogenic types according to the Wiltse classification system.[3] Degenerative and isthmic variants represent the most frequently encountered forms in clinical practice.[1]

Clinical manifestations of spondylolisthesis range from asymptomatic disease to significant neurological compromise. Patients commonly present with low back pain, radiculopathy, neurogenic claudication, hamstring tightness, lower limb numbness, weakness, paresthesia, and limitation in walking or prolonged standing. [2] in advanced cases, neural compression may result in motor deficits or cauda equina syndrome. [2] Radiological evaluation plays a pivotal role in diagnosis and treatment planning. Standard imaging modalities include standing lumbosacral radiographs with flexion–extension views, computed tomography (CT) with three-dimensional reconstruction, magnetic resonance imaging (MRI), CT myelography, and selective nerve conduction studies when indicated. t Bone mineral density assessment may also be performed to exclude associated metabolic or pathological conditions.

Recent advances in spinal instrumentation and minimally invasive surgical techniques have significantly improved the management of symptomatic spondylolisthesis. The principal objectives of surgical treatment include decompression of neural elements, restoration of spinal alignment and disc height, stabilization of the affected motion segment, and achievement of solid arthrodesis.u Transforaminal Lumbar Interbody Fusion (TLIF) has emerged as an effective surgical technique for achieving circumferential fusion through a posterior approach while minimizing neural retraction.u The procedure involves removal of the diseased intervertebral disc, placement of an interbody cage with autologous bone graft to promote fusion, and stabilization using pedicle screw–rod instrumentation.u Additional fixation devices such as cross-links may be utilized in selected complex cases to enhance biomechanical stability. TLIF has demonstrated favorable outcomes in terms of pain relief, restoration of spinal balance, neural decompression, and long-term segmental stability in patients with symptomatic lumbar spondylolisthesis.

Materials and Methods

A retrospective type of cohort study on 21 patients had Transforaminal Lumbar Interbody Fusion (TLIF) for spondylolisthesis with lumbar or lumbosacral spondylolisthesis (Meyerding Grades I to IV) was included in the study. The study was conducted at Zainul Haque Shikder Womens Medical College Hospital (ZNSWMCH), Dhanmondi, Dhaka for a period of one year from January 2023 to December 2024 where 21 patients were included based on inclusion and exclusion criteria. As this was by design retrospective analysis and all details were collected from hospital database, so ethical clearance was not needed for the study.

Inclusion criteria:

1. Patients aged 18 years or older with
2. Have evidence on magnetic resonance imaging of grade I and gradeII spondylolisthesis
3. Having mechanical low back pain and radicular symptoms.
4. be unresponsive to at least 6 months of conservative treatment.

Exclusion criteria:

1. Previous history of trauma
2. Arachnoiditis
3. Active infection
4. Conjoined nerve roots
5. Osteoporosis

A form was made to tabulate information on patient demographics, signs and symptoms, clinical outcomes preoperative and post operatively by using the visual analog scale for back pain, Meyerding Grading System and ODI system and complications.

Surgical Procedure: A midline skin incision was used in conventional TLIF. The fascia was incised and the paravertebral muscles were dissected from the spine. Per operative image intensifier were used to check the appropriate level. Bilateral pedicle screw rod

were inserted and laminectomy with unilateral facetectomy was performed at that level. This was followed by unilateral anulotomy, discectomy, and placement of the interbody graft. Cartilaginous material was removed from the endplates using the endplate scraper. Interbody graft was then placed anteriorly and contralateral to the annulotomy within the interbody space. For posteriorlateral arthodesis, local autogenous bone with or without bone extenders was used for bone grafting. The wound was copiously irrigated and closed in layers.

Results: Demographic distribution of the patients showed in table I depicts that number of male patients were 9 and female 12, Age group ranged from 45 +- 6, hospital stay from the day of admission till discharge was 4 +- 1.2. Patients with spondylolisthesis in L4 - L5 and L5 - S1 were 10 and 11 respectively.

Table-I

Demographic distribution of the patient N=21

Gender (M/F)	Age (years)	Hospital stays (days)	Site (L4/L5)	Sites (L5/S1)
9/12	45+-6	4-1.2	10	11

Meyerding Grading System of 21 patient showed in table II. Maximum number patients had Grade I slippage being 8, followed by 5 patients with Grade II, 4 patients with Grade III, 2 patients with Grade IV and the least was with grade V being only 1 patient.

Table-II

Meyerding Grading	No. of paitents (n=21)	Percentage (%)
I	9	42.86
II	5	23.81
III	4	19.05
IV	2	9.52
V	1	4.76

In table III, pre operative and post operative VAS of back pain were analyzed. Preoperatively patients VAS mean with standard deviation was 6.5+- 1.36 and postoperative mean with standard deviation was 4.04+- 1.55.

Table-III

Pre operative and Post operative Visaul Analogue Scale (VAS) score

	Preoperative (mean+-SD)	Post operative VAS (mean+-SD)
Score	6.85+-1.36	4.04-+1.55

In table IV, the preoperative and postoperative Oswestry Disability Index (ODI) scores were analyzed. Table IV demonstrates the distribution of patients according to the Oswestry Disability Index (ODI) before surgery, before discharge, and at the 1-week follow-up. Preoperatively, 8 patients were categorized as having minimal disability, 7 as having severe disability, and 1 as having crippling disability. Before discharge, 5 patients remained in the minimal disability category, while 7 patients continued to have severe disability; no patients were reported in the crippling disability category. At the 1-week follow-up, the number of patients with minimal disability increased to 9, whereas only 2 patients remained in the severe disability category, and no patients were classified as having crippling disability. These findings suggest an overall improvement in functional status following surgery, with a shift of patients from higher disability categories toward lower disability categories during the early postoperative period.

Table-IV

Oswerty Disability Index (ODI) score

	Pre-Op discarge	Before follow up	At 1 week
Minimal disability	8	5	9
Moderate disability	7	7	2
Severe diability	0	0	0
Crippling disability	1	0	0

Discussion

The present study demonstrated that Transforaminal Lumbar Interbody Fusion (TLIF) is a safe and effective minimally invasive surgical technique for the management of lumbar spondylolisthesis. The procedure enabled effective decompression, stabilization, and symptomatic improvement in the majority of patients while minimizing tissue trauma and postoperative morbidity. Recent studies have reported that minimally invasive and endoscopic TLIF techniques provide favorable clinical outcomes with shorter operative duration, reduced blood loss, and lower complication rates compared with conventional open procedures. v In the current study, the operative duration ranged from approximately 1–2 hours, which is shorter than many conventional lumbar fusion procedures described in previous literature. The use of a small incision measuring approximately 7–10 mm substantially reduced soft tissue injury and the risk of postoperative infection. Recent evidence has demonstrated that endoscopic TLIF techniques are

associated with faster recovery, shorter hospitalization, and earlier mobilization due to minimal paraspinal muscle disruption. w The average duration of hospital stay in the present study was 4 ± 1.2 days, which is comparable to outcomes reported in recent prospective cohort studies evaluating minimally invasive TLIF procedures. x

The demographic profile of the patients in this study demonstrated a slightly higher prevalence among female patients compared with males. This finding may be attributed to the increased incidence of osteoporosis and degenerative spinal changes among postmenopausal women, which predispose them to vertebral instability and slippage. y The majority of patients belonged to the middle-aged and postmenopausal age group, with a mean age of approximately 45 ± 6 years. Similar demographic patterns have been reported in recent epidemiological studies of degenerative lumbar spondylolisthesis.y

The most frequently affected spinal levels in this study were L4–L5 and L5–S1. These segments are subjected to substantial mechanical stress due to increased mobility, repetitive flexion-extension movements, and rotational loading, making them particularly vulnerable to degenerative changes and vertebral slippage.[1]p This observation is consistent with previously published studies reporting that L4–L5 represents the most common level of degenerative spondylolisthesis, whereas L5–S1 is more frequently associated with isthmic pathology.[1]p

With regard to severity grading, the majority of patients presented with Grade I spondylolisthesis, followed by Grade II and Grade III disease, while Grade IV and Grade V cases were less common. This distribution is comparable to findings reported in recent literature where low-grade slips constitute the majority of surgically treated cases. v Low-grade spondylolisthesis generally demonstrates more favorable postoperative outcomes and lower complication rates following minimally invasive fusion procedures.

Pain assessment using the Visual Analog Scale (VAS) demonstrated significant postoperative clinical improvement. The mean preoperative VAS score was 6.5 ± 1.36, which decreased to 4.04 ± 1.55 postoperatively following surgical intervention. These findings indicate satisfactory pain relief after decompression and stabilization. Comparable improvements in postoperative VAS scores have been documented in recent studies evaluating minimally invasive TLIF and endoscopic spinal fusion procedures. x [11] The reduction in pain severity observed in this study may be attributed to adequate neural decompression, restoration of disc height, and stabilization of the pathological motion segment.

Functional outcome assessment using the Oswestry Disability Index (ODI) also revealed marked postoperative improvement. Preoperatively, most patients had severe or moderate disability, whereas postoperative evaluation demonstrated a shift toward minimal and moderate disability categories with no patients remaining in the severe or crippled disability group. At one-week follow-up, the majority of patients continued to demonstrate improvement in functional status. Recent studies have similarly reported significant postoperative ODI improvement following minimally invasive TLIF, indicating enhanced quality of life and functional recovery after surgical treatment. [11]

All patients underwent postoperative follow-up evaluations, which demonstrated satisfactory short-term outcomes without major perioperative complications. The reduced tissue disruption associated with TLIF may contribute to lower postoperative pain, earlier ambulation, and faster rehabilitation. w However, long-term follow-up studies with larger patient populations are still required to evaluate fusion rates, adjacent segment degeneration, implant longevity, and sustained functional outcomes.

Overall, the findings of the present study support the growing evidence that TLIF with pedicle screw fixation is an effective minimally invasive treatment option for lumbar spondylolisthesis. The technique provides satisfactory neural decompression, spinal stabilization, pain reduction, and functional recovery with minimal surgical morbidity and shorter hospitalization. Further multicenter prospective studies with long-term follow-up are recommended to establish standardized surgical protocols and evaluate long-term clinical efficacy.

Conclusion

The findings of the present study demonstrate that Transforaminal Lumbar Interbody Fusion (TLIF) is an effective and reliable surgical technique for the management of symptomatic lumbar spondylolisthesis. The procedure resulted in significant postoperative improvement in pain intensity and functional disability, as evidenced by improved Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) scores. TLIF also provided satisfactory spinal stabilization, adequate neural decompression, and early postoperative recovery with minimal perioperative morbidity. The minimally invasive nature of the procedure contributed to reduced tissue trauma, shorter hospital stays, lower postoperative analgesic requirement, and improved short-term clinical outcomes. Therefore, TLIF may be considered a safe and effective treatment option for selected patients with lumbar and lumbosacral spondylolisthesis who fail to respond to conservative management.

Recommendation

Further prospective multicenter studies with larger sample sizes and longer follow-up duration are recommended to evaluate long-term fusion rates, implant stability, recurrence of symptoms, and adjacent segment degeneration following TLIF surgery. Comparative studies between conventional open TLIF and minimally invasive or endoscopic TLIF techniques may provide additional evidence regarding clinical efficacy, complication profile, and cost-effectiveness. Standardized postoperative rehabilitation protocols and long-term radiological assessment should also be incorporated in future research to optimize patient outcomes and establish evidence-based surgical guidelines.

Strengths of the study

This study provides valuable clinical insight into the effectiveness of TLIF surgery in the treatment of lumbar spondylolisthesis in a tertiary care hospital setting. The study utilized established and widely accepted clinical outcome measures, including the Visual Analog Scale (VAS), Oswestry Disability Index (ODI), and Meyerding grading system, which enhanced the reliability of postoperative outcome assessment. In addition, all surgical procedures were performed under a single experienced surgical team, thereby reducing inter-operator variability and ensuring procedural consistency. The study also demonstrated practical short-term outcomes regarding pain relief, functional recovery, and duration of hospital stay following TLIF surgery.

Limitations of the study

The study had several limitations. Firstly, the sample size was relatively small, which may limit the generalizability of the findings. Secondly, the retrospective design of the study may have introduced selection and information bias. Thirdly, the duration of postoperative follow-up was relatively short, which restricted evaluation of long-term fusion outcomes, recurrence, adjacent segment disease, and implant-related complications. Furthermore, the study lacked a control group or comparative arm with other surgical techniques, limiting direct comparison of outcomes. Larger prospective randomized studies with long-term follow-up are therefore necessary to validate the findings of the present study.

Conflict of interest:

None to declare.

Ethical approval:

Due to retrospective design of the study, ethical approval was not needed from IRB.

References:

1. Spondylolisthesis. StatPearls Publishing. Available from: https://www.ncbi.nlm.nih.gov/books/NBK430767/
2. Koslosky E, Gendelberg D. Classification in Brief: The Meyerding Classification System of Spondylolisthesis. Clin Orthop Relat Res. 2020;478(5):1125-1130.
3. Wiltse LL, Newman PH, Macnab I. Classification of spondylolisis and spondylolisthesis. Clin Orthop Relat Res. 1976;117:23-29.
4. Spondylolisthesis, Spondylolysis, and Spondylosis Workup. Medscape. Available from: https://emedicine.medscape.com/article/1266860-workup
5. Bouras T, Korovessis P. Surgical treatment of high-grade spondylolisthesis: Technique and results. J Orthop. 2020;22:91-96.
6. Sai Preeth S, Vijayanand B, Rishab C, Robin A, Dhasarathy S. Prospective assessment of transforaminal lumbar interbody fusion in spondylolisthesis: radiological and functional outcome study. Cureus. 2024;16(8):e67880.
7. Wang YY, Chung YH, Huang CH, et al. Comparison of minimally invasive transforaminal lumbar interbody fusion and midline lumbar interbody fusion in patients with spondylolisthesis. J Orthop Surg Res. 2024;19:286.

8. Song Z, Zhang Z, Zheng J, et al. Short-term and mid-term evaluation of minimally invasive lumbar fusion surgery for degenerative spondylolisthesis. Sci Rep. 2024;14:4320.
9. Li HM, Zhang RJ, Shen CL, et al. Clinical characteristics and surgical outcomes of degenerative lumbar spondylolisthesis in middle-aged and elderly patients. Front Surg. 2023;10:1115823.
10. Shi J, Wu H, Li F, et al. Meta-analysis of the efficacy and safety of OLIF and TLIF in degenerative lumbar spondylolisthesis. J Orthop Surg Res. 2024;19:242.
11. Qin R, Zhu M, Zhou P, Guan A. Outcomes of minimally invasive transforaminal lumbar interbody fusion in low-grade lumbar spondylolisthesis: a systematic review and meta-analysis. Front Med (Lausanne). 2024;11:1350064.

Peer-Review History:
The peer review history for this paper can be accessed here: https://ewmch.com/review/