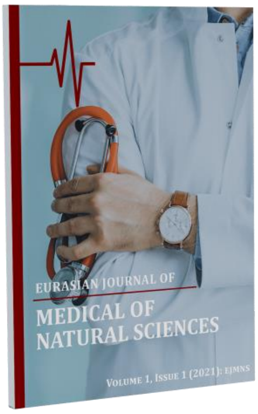
EURASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES
Innovative Academy Research Support Center
IF = 7.921
www.in-academy.uz



COMPARING POSTERIOR LUMBAR INTERBODY FUSION AND TRANSFORAMINAL LUMBAR INTERBODY FUSION IN MANAGING LUMBAR SPONDYLOLISTHESIS: A RETROSPECTIVE ANALYSIS

Safarov Jasur Temurovich
Neurosurgeon at the Bukhara Regional Multidisciplinary Hospital
Email: jasur2772@gmail.com
https://doi.org/10.5281/zenodo.14011173

ARTICLE INFO

Received: 24th October 2024
Accepted: 29th October 2024
Online: 30th October 2024

KEYWORDS

Lumbar stenosis, minimally invasive spine surgery, transforaminal lumbar interbody fusion, spondylolisthesis, transforaminal lumbar interbody fusion.

ABSTRACT

Unstable lumbar spondylolisthesis (ULS) is a leading cause for spinal surgery, requiring methods that both decompress neural structures and restore stability through fusion. Since lumbar spinal stenosis (LSS) was first categorized by Arnoldi et al. in 1976, multiple studies have evaluated ULS and other spinal conditions, showing that LSS remains a primary reason for spinal surgeries in adults over 65, despite a lack of standardized diagnostic criteria. The occurrence of such surgeries has increased significantly, with statistics indicating a rise from 10-15 per 100,000 to 30-35 per 100,000 over the past decade in some countries.

Introduction

Managing lumbar stenosis (LS) varies, often depending on patient severity, with non-surgical approaches for Grades I-II and surgical options for Grades III-IV of spondylolisthesis. Surgical decisions also involve selecting among decompression, fusion, and various interbody fusion techniques, a decision complicated by the introduction of minimally invasive spine surgery (MISS) options like microscopes, tubular retractors, and endoscopic methods. Among interbody fusion techniques, options include posterior lumbar interbody fusion (PLIF), transforaminal lumbar interbody fusion (TLIF), lateral lumbar interbody fusion, and anterior lumbar interbody fusion.

When choosing the best approach, factors such as spondylolisthesis etiology, trauma, and LSS symptoms are considered. Vertebral slippage severity, often graded using Meyerding's classification (ranging from Grade I to Grade V), also impacts treatment, with Grade III and above frequently indicating the need for surgery, particularly in cases of instability. For ULS, decompression combined with fusion generally results in higher fusion rates, deformity correction, stability, and improved clinical outcomes, especially when posterior fusion is paired with interbody fusion.

PLIF and TLIF remain the most effective techniques for lumbar interbody fusion, widely used due to their strong clinical outcomes and high fusion rates. In this paper, we provide a retrospective analysis of outcomes for patients with ULS who were treated using PLIF or MI-TLIF.

Methodology

This study reviewed 60 patients who underwent posterior lumbar interbody fusion (PLIF) or minimally invasive transforaminal lumbar interbody fusion (MI-TLIF) for lumbar spondylolisthesis (LS) between October 2021 and November 2023. Patients included had single-level Meyerding Grades I-III spondylolisthesis with significant lower back and leg pain unresponsive to conservative treatment. Those with Grades IV-V, multilevel instrumentation, or other spinal conditions (e.g., scoliosis, trauma, infection, tumor) and patients with osteoporosis were excluded. Fusion was assessed with the Bridwell grading system using CT scans.

Collected data included demographic details, symptoms, radiological LS grading, radiological assessments of fusion and instrumentation, Visual Analogue Scale (VAS) scores for lower back pain, and Oswestry Disability Index (ODI) scores. Clinical efficacy and outcomes were evaluated with the MacNab scale.

Surgical Procedure - Posterior Lumbar Interbody Fusion (PLIF)

After general anesthesia, the patient was positioned prone on a Jackson spine frame, with the iliac crest elevated by silicone rollers. A midline incision was made, and the paraspinal muscles were dissected in the subperiosteal plane. The discectomy followed a posthemilaminectomy approach, with bilateral facetectomies as needed while preserving the integrity of the cortical endplates. The disc space was prepared for fusion, ensuring a clean, bony surface by removing any residual cartilage with rongeurs. Pedicle screws were inserted, and appropriate PLIF cages were implanted bilaterally with autograft material. Pre- and postoperative CT images of the patient's spine illustrate the surgical outcomes (see Figure 1a and 1b).

Fiure 1. (a) Preoperative sagittal computed tomography (CT) spine of the patient exhibiting profound unstable lumbar spondylolisthesis; (b) Postoperative sagittal CT spine of a patient displaying bilateral posterior lumbar interbody fusion cage implantation

Transforaminal Lumbar Interbody Fusion (TLIF)

The MI-TLIF technique follows similar patient preparation and positioning as PLIF, with key differences in surgical exposure. A 1 cm lateral incision was made over the facet joint using fluoroscopic guidance, facilitating a unilateral approach. Through tubular retractors, a microscope was used for unilateral facetectomy, laminotomy, and partial resection of the pars interarticularis. Once the nerve root and thecal sac were clearly visible, a thorough discectomy was performed to remove cartilage from the endplates. After mirroring PLIF's trial and insertion steps, the MI transpedicular screw was implanted.

Postoperative imaging with anteroposterior and lateral X-rays assessed the segmental angle at the stabilization level and adjacent segments. CT scans were used for follow-up evaluations of fusion progress based on the Bridwell grading scale (see Figure 2).

Figure 2. (a) Preoperative and (b) postoperative direct anteroposterior and lateral X-rays of a patient's spine to visualize the segment angle at the level of stabilization and adjacent segments, where (b) demonstrates bilateral minimally invasive transforaminal lumbar interbody fusion implantation.

Results

Sixty patients with lumbar spondylolisthesis (LS) underwent surgery, with 33 patients (55%) receiving PLIF (14 male and 19 female) and 27 patients (45%) receiving MI-TLIF (11 male and 16 female). The majority of surgeries (87%) were performed at the L4–5 or L5–S1 levels (see Table 1). No postoperative complications or reoperations were reported across the patient group.

Table 1.

Summary of patient demographics, grade of LS, and spinal level of intervention

Intervention	Meyerding's classification grade			Average±SD age (years)	L1–2, L2–3	L3–4	L4–5	L5–S1
	I	II	III					
PLIF	17	11	5	53.4±4.1	2	5	11	15
TLIF	18	8	1	49.7±3.8	1	3	10	13

SD - Standard deviation; PLIF - Posterior lumbar interbody fusion; TLIF - Transforaminal lumbar interbody fusion; LS - Lumbar stenosis

Both PLIF and MI-TLIF effectively reduced VAS scores, with the MI-TLIF group showing slightly more relief, though the difference was not statistically significant. The reduction in ODI scores followed a similar trend, as MI-TLIF showed a faster rate of improvement (see Table 2 and Figure 3). After 24 months, outcomes were assessed using the MacNab scale to evaluate patient satisfaction and functional recovery (see Figure 4).

Table 2.

Summary of comparative results between transforaminal lumbar interbody fusion and posterior lumbar interbody fusion cohorts detailed in the study

EURASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES
Innovative Academy Research Support Center
IF = 7.921
www.in-academy.uz

Result	TLIF (%)	PLIF (%)
Good	84.6	63.8
Satisfactory	8.0	15.0
Unsatisfactory	7.4	21.2

PLIF - Posterior lumbar interbody fusion; TLIF - Transforaminal lumbar interbody fusion

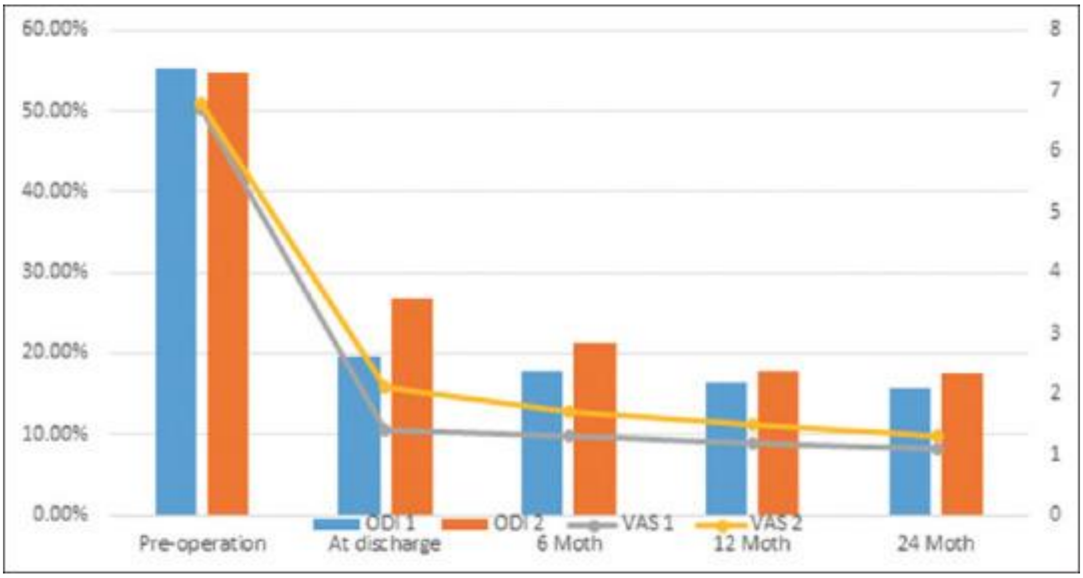


Figure 3. Graphical representation of the VAS and Oswestry Disability Index scores exhibited in the transforaminal lumbar interbody fusion and posterior lumbar interbody fusion cohorts, denoted groups 1 and 2, respectively

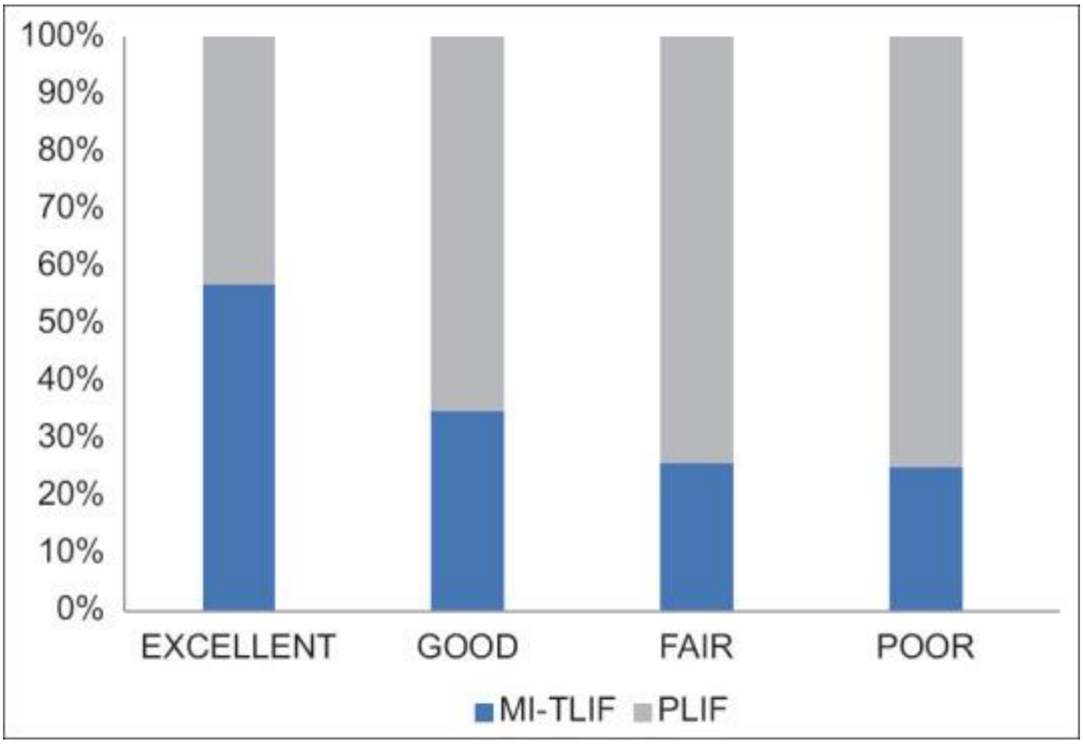


Figure 4. Graphical depiction of the MacNab Scale outcomes per the minimally invasive transforaminal lumbar interbody fusion and posterior lumbar interbody fusion cohorts. MI-TLIF - Minimally invasive transforaminal lumbar interbody fusion, PLIF - Posterior lumbar interbody fusion

Patients who underwent PLIF were statistically more likely to have poorer outcomes compared to those who received MI-TLIF. While lower back pain was reduced in both groups, some patients reported hyperesthesia in the legs, leading to unsatisfactory results. Specifically, seven PLIF patients and two MI-TLIF patients experienced significant discomfort with mobility as a result (see Table 3).

Table 3.

Summary of Visual Analog Scale for lower back pain and Oswestry disability index for sustained disability in both posterior lumbar interbody fusion and transforaminal lumbar interbody fusion cohorts

	VAS			**ODI**			***P***
	Preoperative	**Discharge**	**6 months**	**Preoperative**	**Discharge**	**6 months**	
PLIF	6.8±1.7	2.1±1.4	1.3±1.0	54.7±6.8	26.7±4.4	17.6±1.4	<0.001
TLIF	6.7±1.9	1.4±1.1	1.1±0.8	55.2±6.9	19.6±4	15.7±1.3	<0.001

PLIF - Posterior lumbar interbody fusion; TLIF - Transforaminal lumbar interbody fusion; VAS - Visual analogue scale; ODI - Oswestry Disability Index. Table 3 VAS AND ODI in patients TLIF VS PLIF REPRESENTATION PRE AND POST OPERATORY DISACHARGE

The postoperative lumbar lordosis angles differed, with PLIF patients averaging 29.1° ± 5.60° and TLIF patients achieving 37.3° ± 5.80°. Fusion success rates, evaluated with the Bridwell interbody fusion grading system on CT scans, showed an average of 89.3% for both procedures within a year. The average surgery duration for PLIF was 115.4 ± 16.5 minutes, compared to 98.2 ± 12.5 minutes for MI-TLIF. Blood loss was notably different, with PLIF patients averaging 315 ± 55.0 ml, while TLIF patients had significantly less at 75.7 ± 15.0 ml. Additionally, TLIF patients could mobilize approximately 8 hours after surgery, whereas PLIF patients required a full day for mobilization.

Discussion

PLIF remains a popular choice among neurosurgeons and orthopedic surgeons for spinal root decompression, particularly for lumbar hernias or vertebral disc displacements caused by aging or trauma. Introduced by Cloward in the 1940s, PLIF transformed interbody fusion by combining nerve root decompression with anterior stabilization, though it often requires posterior pedicle support to prevent failure. Harms and Rolinger's translaminar approach later offered an alternative, allowing anterior fusion with reduced blood loss and less need for dural sac and nerve root retraction, thus minimizing soft-tissue trauma.

The shift toward TLIF and MI-TLIF has furthered the evolution of spinal surgery techniques for degenerative diseases, demonstrating improved efficacy for stabilizing, fusing, and fixing lumbar stenosis compared to conventional single-take procedures. The Wiltse technique, involving minimal blood loss and shorter procedure times, has proven suitable for these methods, which place minimal traction on vascular and neural structures, particularly at higher lumbar levels. This study found MI-TLIF patients showed superior improvements in VAS, ODI, and MacNab scores, supported by satisfactory fusion rates measured by the Bridwell grading system.

However, PLIF's advantages should not be overlooked. It allows greater exposure and visibility for the surgeon, simplifying nerve root and thecal sac access and offering stable decompression. Despite its benefits, PLIF often involves extensive paravertebral muscle dissection, which can lead to increased postoperative discomfort and potential muscle atrophy. Additionally, the retraction needed for PLIF cage placement can lead to persistent radiculopathy if not carefully managed, highlighting the growing preference for minimally invasive techniques.

Our research aligns with previous studies; for instance, a meta-analysis involving 16 trials with 1,502 patients found TLIF to be statistically superior to PLIF in terms of shorter operating times, reduced blood loss, and improved postoperative VAS and ODI scores. Although the fusion rates were similar, the study highlighted that TLIF had a lower incidence of nerve root damage and dural tears. For lumbar spondylolisthesis (LS) Grades I-II, we proceeded cautiously. For Grade III cases, we performed thorough preoperative assessments to determine the best surgical approach to optimize patients' motor function for daily activities.

Conclusion

1. Based on the findings from this retrospective comparative observational study, along with a comprehensive review of recent literature, several conclusions were drawn:
2. This study confirmed the advantages of TLIF over PLIF, aligning with existing research in the field. For stabilizing lumbar spondylolisthesis (LS) following spinal decompression, TLIF, MI-TLIF, and PLIF have proven effective options.
3. Conservative treatments provided pain relief for Grades I and II LS, while Grades III and IV with instability indicated a need for surgical intervention. Patients who underwent TLIF showed improved psychomotor responses and quicker return to physical activities with reduced postoperative stress.
4. Given these outcomes, we recommend minimally invasive (MI) techniques for treating unstable lumbar spondylolisthesis (ULS), benefiting both surgeons and patients by optimizing recovery and mobility outcomes.

References:

1. Arnoldi CC, Brodsky AE, Cauchoix J, Crock HV, Dommisse GF, Edgar MA, et al. Lumbar spinal stenosis and nerve root entrapment syndromes. Definition and classification. Clin Orthop Relat Res. 1976;115:4–5. doi: 10.1097/00003086-197603000-00002/ [PubMed] [Google Scholar]
2. Kerimbaev TT, Aleinikov VG, Urunbaev EA, Tuigynov ZhM, Kenzhegulov EN, Abishev NB, et al. Comparative analysis of the results of surgical treatment of PLIF and TLIF methods for spinal instability in the lumbosacral spine 2022 616.711: 611.835.3.01-66 [Google Scholar]
3. Wu L, Cruz R. StatPearls. Treasure Island (FL): StatPearls Publishing; 2022. [[Last updated 2022 Aug 22]]. Lumbar spinal stenosis. Available from: https://www.ncbi.nlm.nih.gov/books/NBK531493/ [Google Scholar]

4. Kerimbaev TT, Aleinikov VG, Urunbaev EA, Tuigynov ZhM, Kenzhegulov EN, Abishev NB, et al. Comparative analysis of the results of surgical treatment of PLIF and TLIF methods for spinal instability in the lumbosacral spine. 2022;01:4–5. [Google Scholar]
5. Kalichman L, Cole R, Kim DH, Li L, Suri P, Guermazi A, et al. Spinal stenosis prevalence and association with symptoms: The Framingham study. Spine J. 2009;9:545–50. doi: 10.1016/j.spinee.2009.03.005. [DOI] [PMC free article] [PubMed] [Google Scholar]
6. Wessberg P, Frennered K. Central lumbar spinal stenosis: Natural history of non-surgical patients. Eur Spine J. 2017;26:2536–42. doi: 10.1007/s00586-017-5075-x. [DOI] [PubMed] [Google Scholar]
7. Zaina F, Tomkins-Lane C, Carragee E, Negrini S. Surgical versus non-surgical treatment for lumbar spinal stenosis. Cochrane Database Syst Rev 2016. 2016 doi: 10.1002/14651858.CD010264.pub2. CD010264. [DOI] [PMC free article] [PubMed] [Google Scholar]
8. Mobbs RJ, Phan K, Malham G, Seex K, Rao PJ. Lumbar interbody fusion: Techniques, indications and comparison of interbody fusion options including PLIF, TLIF, MI-TLIF, OLIF/ATP, LLIF and ALIF. J Spine Surg. 2015;1:2–18. doi: 10.3978/j.issn.2414-469X.2015.10.05. [DOI] [PMC free article] [PubMed] [Google Scholar]
9. Spiker WR, Goz V, Brodke DS. Lumbar interbody fusions for degenerative spondylolisthesis: Review of techniques, indications, and outcomes. Global Spine J. 2019;9:77–84. doi: 10.1177/2192568217712494. [DOI] [PMC free article] [PubMed] [Google Scholar]
10. Kang YN, Ho YW, Chu W, Chou WS, Cheng SH. Effects and safety of lumbar fusion techniques in lumbar spondylolisthesis: A network meta-analysis of randomized controlled trials. Global Spine J. 2022;12:493–502. doi: 10.1177/2192568221997804. [DOI] [PMC free article] [PubMed] [Google Scholar]
11. Rezk EM, Elkholy AR, Shamhoot EA. Transforaminal lumbar interbody fusion (TLIF) versus posterior lumbar interbody fusion (PLIF) in the treatment of single-level lumbar spondylolisthesis. Egypt J Neurosurg. 2019;34:26. [Google Scholar]
12. Ahsan K, Khan SI, Zaman N, Ahmed N, Montemurro N, Chaurasia B. Fusion versus nonfusion treatment for recurrent lumbar disc herniation. J Craniovertebr Junction Spine. 2021;12:44–53. doi: 10.4103/jcvjs.JCVJS_153_20. [DOI] [PMC free article] [PubMed] [Google Scholar]
13. Nicoletti GF, Umana GE, Chaurasia B, Ponzo G, Giuffrida M, Vasta G, et al. Navigation-assisted extraforaminal lumbar disc microdiscectomy: Technical note. J Craniovertebr Junction Spine. 2020;11:316–20. doi: 10.4103/jcvjs.JCVJS_146_20. [DOI] [PMC free article] [PubMed] [Google Scholar]
14. Ahsan MK, Hossain MR, Khan MS, Zaman N, Ahmed N, Montemurro N, et al. Lumbar revision microdiscectomy in patients with recurrent lumbar disc herniation: A single-center prospective series. Surg Neurol Int. 2020;11:404. doi: 10.25259/SNI_540_2020. [DOI] [PMC free article] [PubMed] [Google Scholar]
15. Ahsan K, Hasan S, Khan SI, Zaman N, Almasri SS, Ahmed N, et al. Conservative versus operative management of postoperative lumbar discitis. J Craniovertebr Junction Spine. 2020;11:198–209. doi: 10.4103/jcvjs.JCVJS_111_20. [DOI] [PMC free article] [PubMed] [Google Scholar]