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Original Research Article

Comparative Analysis of Transforaminal Lumbar Interbody Fusion versus Trans-Kambin Lumbar Interbody Fusion in Degenerative Lumbar Disease: A Prospective Study

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Abstract:

Introduction: Lumbar degenerative disease remains a significant cause of disability requiring surgical intervention. Transforaminal lumbar interbody fusion (TLIF) and trans-Kambin lumbar interbody fusion (KLIF) represent two distinct approaches for achieving spinal fusion, each with unique advantages and limitations.

Materials & Methods: This prospective comparative study enrolled 60 patients (30 TLIF, 30 KLIF) with single-level degenerative lumbar disease at a tertiary care center. Perioperative parameters, clinical outcomes (VAS, ODI scores), radiological parameters (disc height, fusion rates), and complications were evaluated over 12 months.

Results: KLIF demonstrated significantly reduced blood loss (78.3±35.1 ml vs 210.6±70.4 ml, $p<0.001$) and shorter hospitalization (2.9±0.9 days vs 4.8±1.6 days, $p<0.001$). Both techniques showed comparable VAS and ODI improvements, though KLIF exhibited superior early postoperative back pain relief. Fusion rates were similar (93.3% vs 90.0%, $p=0.56$), with lower overall complications in KLIF (10.0% vs 23.3%, $p=0.11$).

Conclusion: KLIF offers advantages of reduced surgical trauma, faster recovery, and comparable fusion outcomes to TLIF, representing a safe minimally invasive alternative for selected cases of degenerative lumbar disease.

Keywords: Degenerative Lumbar Disease, Lumbar Interbody Fusion, Minimally Invasive Spine Surgery, Trans-Kambin Lumbar Interbody Fusion, Transforaminal Lumbar Interbody Fusion.

Introduction

Lumbar degenerative disease (LDD) represents one of the most prevalent causes of chronic low back pain and disability globally, with substantial socioeconomic burden particularly in developing countries like India. The prevalence of symptomatic LDD requiring surgical intervention has been estimated at 15-40% among patients with chronic low back pain lasting beyond three months.[1] Conservative management including physiotherapy, analgesics, and activity modification remains the first-line treatment; however, surgical intervention becomes necessary when conservative measures fail to provide adequate relief or in cases of progressive neurological deficit.

Spinal fusion surgery has evolved as the gold standard for treating LDD with instability, spondylolisthesis, and intractable pain. Among various fusion techniques, transforaminal lumbar interbody fusion (TLIF), first described by Harms and Jeszenszky, has gained widespread acceptance due to its ability to achieve circumferential fusion through a single posterior approach while minimizing neural retraction.[2] TLIF allows for direct decompression, restoration of disc height, correction of sagittal balance, and achievement of solid arthrodesis. However, despite being less invasive than traditional posterior lumbar interbody fusion (PLIF), TLIF still requires significant paravertebral muscle dissection, facetectomy, and potential neural manipulation, which may contribute to postoperative pain and muscle atrophy.[3]

With the advancement of minimally invasive spine surgery techniques, the quest for procedures with reduced tissue trauma while maintaining clinical efficacy has intensified. Trans-Kambin lumbar interbody fusion (KLIF), also referred to as full-endoscopic trans-Kambin's triangle lumbar interbody fusion, represents an emerging minimally

invasive alternative that approaches the intervertebral disc through Kambin's triangle—an anatomical corridor bounded by the superior endplate caudally, the exiting nerve root cranially, and the traversing nerve root medially.[4] This approach allows cage insertion with minimal disruption of posterior spinal structures, potentially offering advantages in terms of reduced blood loss, muscle preservation, and faster recovery.

Recent literature from Japan and other Asian countries has demonstrated promising results with KLIF, showing comparable fusion rates and superior early postoperative outcomes compared to conventional TLIF.[5,6] However, data from the Indian subcontinent remains limited, with most studies focusing on conventional TLIF or minimally invasive TLIF (MIS-TLIF). A study by Kumar and Swamy from Pune, India, comparing PLIF and TLIF demonstrated that TLIF required less operative time (145±27.6 minutes) and blood loss (125±12.1 ml) compared to PLIF.[1] However, comparative studies specifically evaluating KLIF in the Indian population are scarce.

The present study aims to comprehensively compare the clinical and radiological outcomes of TLIF versus KLIF in patients with degenerative lumbar disease, with specific focus on perioperative parameters, functional recovery, fusion rates, and complications. Understanding these differences is crucial for evidence-based decision-making and patient counseling, particularly in resource-limited settings where minimizing hospital stay and expediting return to functional activities hold significant importance. This study contributes to the growing body of evidence on minimally invasive fusion techniques and provides Indian-specific data on KLIF outcomes.

Materials and Methods

Study Design and Setting: This prospective comparative study was conducted at a tertiary care teaching hospital from January 2022 to December 2023. Written informed consent was obtained from all participants.

Sample Size Calculation: Based on preliminary data showing mean blood loss of 210 ml (SD±70) in TLIF and 78 ml (SD±35) in KLIF, with α=0.05 and power=0.80, a sample size of 25 patients per group was calculated. Accounting for 20% dropout, 30 patients were enrolled in each group.[5]

Inclusion Criteria: Patients aged 18-75 years with single-level lumbar degenerative disease (L3-S1) including degenerative spondylolisthesis (Meyerding grade I-II), discogenic pain with Modic changes, or spinal stenosis with segmental instability, who failed conservative management for at least 12 weeks, were included.

Exclusion Criteria: Patients with high-grade spondylolisthesis (>grade II), severe osteoporosis (T-score <-3.0), active infection, previous lumbar surgery, cauda equina syndrome requiring emergency decompression, significant medical comorbidities (ASA grade >3), or psychological disorders were excluded.

Patient Allocation: Sixty consecutive patients meeting eligibility criteria were enrolled. Group allocation was based on surgical feasibility assessment and patient preference after detailed counseling regarding both procedures. Thirty patients underwent TLIF (Group A) and 30 underwent KLIF (Group B). Baseline demographic characteristics including age, sex, BMI, diagnosis, and fusion level were recorded.

Surgical Technique - TLIF: Under general anesthesia, patients were positioned prone on a radiolucent table. A midline incision was made, and subperiosteal dissection exposed the lamina and facet joints. Pedicle screws were inserted bilaterally using fluoroscopic guidance. Unilateral facetectomy (ipsilateral to symptoms) was performed, followed by discectomy and endplate preparation. A PEEK cage filled with autograft bone from facetectomy was inserted. Compression and final tightening of the construct completed the procedure.

Surgical Technique - KLIF: After general anesthesia and prone positioning, percutaneous pedicle screws were inserted bilaterally. Under fluoroscopic guidance, an endoscopic working channel was established through Kambin's triangle using sequential dilators. Partial superior articular process resection created adequate working space (minimum 12mm). Using full-endoscopic visualization, discectomy and endplate preparation were performed. An expandable or rigid PEEK cage with bone graft was inserted through the protected corridor. The exiting nerve root was protected throughout using the cannulated system. Minimal tissue dissection characterized this approach.

Outcome Measures: Perioperative outcomes were assessed by evaluating operative time measured from skin incision to wound closure, estimated intraoperative blood loss calculated using gravimetric methods and suction canister measurements, and duration of postoperative hospital stay. In addition, all intraoperative and postoperative complications were systematically recorded and analyzed to assess the safety profile of the procedure.

Clinical Outcomes: Visual Analog Scale (VAS) scores for back and leg pain (0-10) and Oswestry Disability Index (ODI) were recorded preoperatively, at 1 week, 1 month, 3 months, 6 months, and 12 months postoperatively. Modified

MacNab criteria assessed overall satisfaction at final follow-up.

Radiological Parameters: Standing anteroposterior and lateral radiographs and CT scans evaluated disc height restoration, slip reduction, segmental lordosis, and fusion status. Fusion was defined as bridging bone across the interspace on CT at 6 months. Cage subsidence (>2mm) was recorded.

Statistical Analysis: Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean±SD and compared using independent t-tests. Categorical variables were analyzed using chi-square or Fisher's exact test. P-value <0.05 was considered statistically significant. Repeated measures ANOVA assessed temporal changes in clinical scores.

Results

Baseline Characteristics: Sixty patients completed the study with no dropouts. Baseline characteristics were comparable between groups (Table 1). Mean age was 56.8±9.4 years in TLIF and 58.2±8.7 years in KLIF (p=0.48). The male-to-female ratio was similar (18:12 vs 17:13, p=0.79). Degenerative spondylolisthesis was the predominant diagnosis (73.3% TLIF, 70.0% KLIF). The L4-L5 level was most commonly treated, followed by L5-S1, with comparable distribution between groups (p=0.59). Preoperative VAS and ODI scores showed no significant differences, indicating similar baseline severity.

Table 1: Demographic and Baseline Characteristics

Variable	TLIF (n=30)	KLIF (n=30)	p-value
Mean Age (years ± SD)	56.8 ± 9.4	58.2 ± 8.7	0.48
Sex (M/F)	18/12	17/13	0.79
BMI (kg/m²)	26.4 ± 2.9	25.8 ± 3.2	0.42
Diagnosis – Degenerative Spondylolisthesis (%)	73.30%	70.00%	0.75
Diagnosis – Discogenic Pain (%)	16.70%	20.00%	0.68
Diagnosis – Spinal Canal Stenosis (%)	10.00%	10.00%	—
Fusion Level (L4–L5 / L5–S1)	20/10	22/8	0.59
Preoperative VAS Back Pain	7.4 ± 1.0	7.2 ± 1.1	0.51
Preoperative VAS Leg Pain	6.8 ± 1.3	6.9 ± 1.2	0.79
Preoperative ODI (%)	58.2 ± 10.6	57.5 ± 11.2	0.81

Intraoperative and postoperative parameters: KLIF demonstrated significant advantages in perioperative parameters (Table 2). Mean operative time was marginally shorter in KLIF (155.8±22.4 min) compared to TLIF (165.4±25.3 min), though not statistically significant (p=0.08). However, intraoperative blood loss was dramatically lower in KLIF (78.3±35.1 ml) versus TLIF (210.6±70.4 ml, p<0.001), representing a 63% reduction. Hospital stay was significantly shorter in the KLIF group (2.9±0.9 days vs 4.8±1.6 days, p<0.001), facilitating earlier discharge and reduced healthcare costs.

Table 2: Intraoperative and postoperative parameters

Parameter	TLIF	KLIF	p-value
Operative Time (min)	165.4 ± 25.3	155.8 ± 22.4	0.08
Blood Loss (mL)	210.6 ± 70.4	78.3 ± 35.1	**<0.001**
Hospital Stay (days)	4.8 ± 1.6	2.9 ± 0.9	**<0.001**
Conversion to Open Surgery	1 (3.3%)	0 (0%)	0.31
Dural Tear	2 (6.7%)	0 (0%)	0.15
Exiting Nerve Root Irritation	1 (3.3%)	2 (6.7%)	0.55
Infection (Superficial/Deep)	2 (6.7%) / 0	0 / 0	0.15
Average Follow-up (months)	12.3 ± 3.8	12.0 ± 3.2	0.74

Clinical outcomes: Both surgical techniques resulted in significant improvement in pain and functional outcomes at all postoperative intervals (Table 3). In the TLIF group, mean VAS for back pain decreased from 7.4 ± 1.0 preoperatively to 2.0 ± 0.9 at 6 months ($p < 0.001$), while in the KLIF group it decreased from 7.2 ± 1.1 to 1.2 ± 0.7 ($p < 0.001$). VAS for leg pain improved from 6.8 ± 1.3 to 1.5 ± 0.7 in TLIF and from 6.9 ± 1.2 to 1.0 ± 0.5 in KLIF ($p < 0.001$ for both). The mean ODI score improved from 58.2 ± 10.6 to 25.2 ± 6.6 in TLIF and from 57.5 ± 11.2 to 20.1 ± 5.8 in KLIF at 6 months ($p < 0.001$ each). Although both groups showed substantial functional recovery, KLIF patients demonstrated faster early improvement at 1 and 3 months postoperatively. According to the modified MacNab criteria, 86.7% of KLIF and 80.0% of TLIF patients achieved an excellent or good outcome at final follow-up.

Table 3: Clinical outcomes (Mean ± SD)

Outcome	Pre-op	1 Month	3 Months	6 Months	12 Months	p-value (6 mo vs pre)
VAS Back Pain – TLIF	7.4 ± 1.0	4.1 ± 1.2	2.7 ± 1.0	2.0 ± 0.9	1.9 ± 0.8	**<0.001**
VAS Back Pain – KLIF	7.2 ± 1.1	3.0 ± 1.0	1.8 ± 0.9	1.2 ± 0.7	1.1 ± 0.6	**<0.001**
VAS Leg Pain – TLIF	6.8 ± 1.3	3.5 ± 1.3	2.1 ± 0.9	1.5 ± 0.7	1.3 ± 0.6	**<0.001**
VAS Leg Pain – KLIF	6.9 ± 1.2	2.8 ± 1.0	1.5 ± 0.8	1.0 ± 0.5	0.9 ± 0.5	**<0.001**
ODI (%) – TLIF	58.2 ± 10.6	42.3 ± 9.8	30.8 ± 7.4	25.2 ± 6.6	22.8 ± 6.4	**<0.001**
ODI (%) – KLIF	57.5 ± 11.2	38.1 ± 8.6	26.4 ± 6.8	20.1 ± 5.8	18.9 ± 5.6	**<0.001**

Radiological parameters: At the 6-month follow-up, the fusion rate was **93.3%** in the KLIF group and **90.0%** in the TLIF group (p = 0.56). Disc height restoration and slip reduction were comparable between groups (3.6 ± 0.7 mm vs 3.2 ± 0.8 mm, and 74.8 ± 9.8% vs 72.4 ± 10.5%, respectively). Cage subsidence occurred in 3.3% of KLIF and 6.7% of TLIF cases, without clinical consequence. Segmental lordosis improved similarly in both groups (KLIF: 13.2° ± 3.0°; TLIF: 12.8° ± 3.4°, p = 0.63) (Table 4).

Table 4: Radiological parameters at 6 months

Parameter	TLIF	KLIF	p-value
Fusion Rate (%)	90.0	93.3	0.56
Disc Height Restoration (mm)	3.2 ± 0.8	3.6 ± 0.7	0.08
Slip Reduction (%)	72.4 ± 10.5	74.8 ± 9.8	0.42
Cage Subsidence (%)	6.7	3.3	0.55
Segmental Lordosis (°)	12.8 ± 3.4	13.2 ± 3.0	0.63

Complications: Overall complication rates were 23.3% in TLIF and 10.0% in KLIF (p = 0.11). All KLIF complications were minor and transient, with no cases of reoperation. There were no major vascular, bowel, or ureteral injuries in either group. The KLIF approach demonstrated a lower incidence of dural tears and infections compared with TLIF (Table 5).

Table 5: Complications

Complication	TLIF (n, %)	KLIF (n, %)	p-value
Exiting Nerve Root Irritation	1 (3.3%)	2 (6.7%)	0.55
Dural Tear	2 (6.7%)	0 (0%)	0.15
Infection (Superficial)	2 (6.7%)	0	0.15
Cage Migration/Subsidence	2 (6.7%)	1 (3.3%)	0.55
Hematoma	0	0	—
Total Complication Rate	23.3%	10.0%	0.11

Discussion

This prospective comparative study provides valuable insights into the relative merits of TLIF versus KLIF for treating degenerative lumbar disease. Our findings demonstrate that while both techniques achieve satisfactory clinical and radiological outcomes, KLIF offers distinct advantages in perioperative parameters including reduced blood loss, shorter hospitalization, and potentially faster early recovery with comparable fusion rates and complication profiles.

Perioperative Outcomes and Surgical Trauma: In the present study, KLIF was associated with significantly lower intraoperative blood loss than TLIF (78.3 ml vs 210.6 ml, p<0.001), consistent with international literature. Ao et al. reported comparable findings, with significantly less blood loss in PE-TLIF (KLIF) compared to MIS-TLIF.[7] Similarly, a meta-analysis by Zhu et al. confirmed that PE-TLIF significantly reduces blood loss, operative time, and hospital stay relative to MIS-TLIF.[8] This advantage is likely due to better preservation of posterior musculoligamentous structures, minimal epidural venous plexus disruption, and a smaller working corridor. In the present study, Hospital stay was also significantly shorter in the KLIF group (2.9 vs 4.8 days), in line with observations by Han et al.[9] In the Indian healthcare setting, this nearly 40% reduction in hospital stay has important economic implications. Compared with Indian data reported by Kumar and Swamy for PLIF and TLIF, KLIF appears to offer superior perioperative recovery even relative to conventional minimally invasive techniques.[1]

Clinical Outcomes and Functional Recovery: In the present study, both techniques resulted in significant improvement in VAS and ODI scores,

with KLIF demonstrating superior early postoperative back pain relief. This finding is consistent with Yin et al., who reported significantly lower VAS back pain at 1 week in PE-TLIF compared to PLIF.[10] The early benefit is likely due to reduced muscle trauma and preservation of posterior structures. By 12 months, outcomes were comparable, indicating similar long-term efficacy. In the present study, Excellent-to-good outcomes by MacNab criteria were slightly higher with KLIF (86.7%) than TLIF (80.0%) and comparable to published series. Ishihama et al. reported 80% excellent-to-good outcomes with endoscopic trans-Kambin's LIF,[5] while Lin et al.'s meta-analysis found similar satisfaction rates between OLIF and TLIF.[11] These results support that KLIF maintains clinical effectiveness while offering minimally invasive advantages.

Radiological Outcomes and Fusion Biology: In the present study, fusion rates were comparable between KLIF (93.3%) and TLIF (90.0%), addressing concerns that minimally invasive techniques may compromise fusion biology. Similar high fusion rates with KLIF have been reported by Morimoto et al. in their systematic review.[12] Adequate fusion in KLIF is likely related to effective endoscopic endplate preparation, appropriate use of biologics, and restoration of disc height creating a favorable biomechanical environment. In the present study, disc height restoration, slip reduction, and maintenance of segmental lordosis were comparable between groups, indicating effective indirect decompression with KLIF. These findings are consistent with Xue et al., who showed that PE-TLIF provides radiological correction similar to MIS-TLIF with less surgical trauma.[13]

Safety Profile and Complications: In the present study, KLIF demonstrated a lower overall complication rate than TLIF (10.0% vs 23.3%), although the difference was not statistically significant. Notably, no dural tears or surgical site infections occurred in the KLIF group, whereas both were observed with TLIF. The trans-Kambin's triangle approach in KLIF minimizes direct dural manipulation, thereby reducing this risk. In the present study, Transient nerve root irritation was slightly more frequent with KLIF (6.7% vs 3.3%), consistent with reports for transforaminal endoscopic procedures.[12] All cases resolved with conservative management within 2 weeks. As emphasized by Sairyo et al., adequate foraminoplasty and careful protection of the exiting nerve root are key to minimizing this complication.[6] The absence of major complications in both groups further supports the safety of posterior and transforaminal approaches compared with lateral techniques, which carry a small but recognized risk of vascular and visceral injury.[11]

Learning Curve and Technical Considerations: In the present study, although favorable outcomes were achieved with KLIF, the technique has a recognized learning curve. Morimoto et al. reported exiting nerve irritation in their initial KLIF case, which did not recur with increasing experience.[12] Similarly, our first KLIF case was associated with transient nerve symptoms. Key technical requirements include adequate foraminoplasty, optimal endoscopic visualization, and meticulous neural protection, all of which demand specific training in endoscopic spine surgery. In the Indian setting, where endoscopic spine surgery is still developing, structured training programs and proctorship are crucial for safe adoption of KLIF. Initially, the technique may be best suited for selected cases such as single-level disease or grade I spondylolisthesis, with gradual expansion as surgical expertise increases.

Economic Implications for Indian Healthcare: The shorter hospital stays and reduced blood loss associated with KLIF have important economic implications in resource-limited Indian healthcare settings. Given average inpatient costs of ₹2,000–5,000 per day, the 1.9-day reduction in hospital stay corresponds to savings of approximately ₹3,800–9,500 per patient. Lower blood loss further reduces transfusion-related costs. At high-volume centers, adoption of KLIF could therefore result in substantial annual cost savings while enhancing patient turnover and resource utilization.

Comparison with Other Fusion Techniques: Within the spectrum of lumbar fusion techniques, KLIF offers distinct advantages. Compared with lateral approaches (OLIF, XLIF), it avoids psoas and lumbar plexus injury and does not require intraoperative repositioning.[11] Unlike ALIF, KLIF eliminates risks of retroperitoneal vascular injury and retrograde ejaculation and does not require an access surgeon. Compared with TLIF and PLIF, KLIF minimizes muscle trauma, enabling faster recovery while achieving comparable clinical outcomes. Nonetheless, KLIF has limitations, including technical complexity, a steep learning curve, higher equipment costs, and restricted indications. Careful patient selection is essential, with optimal results seen in grade I spondylolisthesis, foraminal or lateral recess stenosis without severe central stenosis, discogenic pain, and patients seeking early functional recovery.

Conclusion

Both TLIF and KLIF provided effective decompression and fusion with substantial improvement in pain and disability scores. However, KLIF demonstrated the advantages of significantly reduced blood loss, shorter hospitalization, and comparable fusion success, indicating that KLIF may represent a safe and minimally invasive

alternative to conventional TLIF for selected cases of degenerative lumbar disease.

References

1. Kumar HS, Swamy A. Comparison of posterior lumbar interbody fusion and transforaminal lumbar interbody fusion in degenerative spondylosis and disc disease. Int J Res Orthop. 2020;6(4):730-734
2. Harms J, Rolinger H. A one-stager procedure in operative treatment of spondylolistheses: dorsal traction-reposition and anterior fusion. Z Orthop Ihre Grenzgeb 1982 May 1;120(3):343-7.
3. 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 Dec;1(1):2-18.
4. Kambin P, Sampson S. Posterolateral percutaneous suction-excision of herniated lumbar intervertebral discs. Clin Orthop Relat Res. 1986;(207):37-43.
5. Ishihama Y, Morimoto M, Tezuka F, Yamashita K, Manabe H, Sugiura K, Takeuchi M, Takata Y, Sakai T, Maeda T, Nagamachi A. Full-endoscopic trans-kambin triangle lumbar interbody fusion: surgical technique and nomenclature. J Neurol Surg A Cent Eur Neurosurg. 2022;83(4):308-3.
6. Sairyo K, Morimoto M, Yamashita K, Tezuka F, Sugiura K, Takeuchi M, et al. Full-endoscopic trans-Kambin's triangle lumbar interbody fusion: technique and review of literature. J Minim Invasive Spine Surg Tech. 2021;6(Suppl 1):S123–S129.
7. Ao S, Zheng W, Wu J, Tang Y, Zhang C, Zhou Y, Li C. Comparison of preliminary clinical outcomes between percutaneous endoscopic and minimally invasive transforaminal lumbar interbody fusion for lumbar degenerative diseases in a tertiary hospital: is percutaneous endoscopic procedure superior to MIS-TLIF? A prospective cohort study. Int J Surg. 2020 Apr 1;76:136-43.
8. Zhu L, Cai T, Shan Y, Zhang W, Zhang L, Feng X. Comparison of clinical outcomes and complications between percutaneous endoscopic and minimally invasive transforaminal lumbar interbody fusion for degenerative lumbar disease: a systematic review and meta-analysis. Pain Physician. 2021;24(6):441-452
9. Han Q, Meng F, Chen M, Lu X, Zhao D, Wu D, Wang T, Qin R. Comparison between PE-TLIF and MIS-TLIF in the treatment of middle-aged and elderly patients with single-level lumbar disc herniation. J Pain Res. 2022 Apr 29:1271-82.
10. Yin P, Ding Y, Zhou L, Xu C, Gao H, Pang D, Hai Y, Yang J. Innovative percutaneous endoscopic transforaminal lumbar interbody fusion of lumbar spinal stenosis with degenerative instability: a non-randomized clinical trial. J Pain Res 2021 Dec 2:3685-93.
11. Lin GX, Xu WB, Kotheeranurak V, Chen CM, Deng ZH, Zhu MT. Comparison of oblique and transforaminal approaches to lumbar interbody fusion for lumbar degenerative disease: an updated meta-analysis. Frontiers in Surgery. 2023 Jan 16;9:1004870.
12. Morimoto M, Wada K, Tamaki S, Soeda S, Sugiura K, Manabe H, Tezuka F, Yamashita K, Sairyo K. Clinical outcome of full endoscopic trans kambin's triangle lumbar interbody fusion: A systematic review. World Neurosurgery. 2023 Oct 1;178:317-29.
13. Xue YD, Diao WB, Ma C, Li J. Lumbar degenerative disease treated by percutaneous endoscopic transforaminal lumbar interbody fusion or minimally invasive surgery-transforaminal lumbar interbody fusion: a case-matched comparative study. J Orthop Surg Res 2021 Nov 27;16(1):696.