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Comparison of early outcomes of unilateral biportal endoscopic decompression and microscopic unilateral laminotomy for bilateral decompression in lumbar spinal stenosis

Ali Kaplan[1], Yaşar Ünsal[2], Demet Evleksiz Karimzade[3], Adem Doğan[4], İlker Solmaz[5]

[1]*Erbaa State Hospital, Clinic of Neurosurgery, Tokat, Türkiye*
[2]*University of Health Sciences Türkiye, Ankara Bilkent City Hospital, Department of Neurosurgery, Ankara, Türkiye*
[3]*Erol Olçok Training and Research Hospital, Clinic of Neurosurgery, Çorum, Türkiye*
[4]*Gaziantep Şehitkamil State Hospital, Clinic of Neurosurgery, Gaziantep, Türkiye*
[5]*Private Practice, Ankara, Türkiye*

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Corresponding Author:
Ali Kaplan MD, Erbaa State Hospital, Clinic of Neurosurgery, Tokat, Türkiye
alikaplan92@hotmail.com

ORCID:
orcid.org/0000-0003-1005-8524

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ABSTRACT

Aims: Unilateral biportal endoscopic (UBE) decompression is increasingly used for lumbar spinal stenosis. However, comparative evidence against microscopic unilateral laminotomy for bilateral decompression (ULBD) outside East Asian populations remains limited. This study aimed to compare the short-term clinical and perioperative outcomes of UBE and microscopic ULBD.

Methods: This retrospective two-center study included adults with single-level degenerative lumbar spinal stenosis (Schizas grade B or higher) treated with UBE at one center or microscopic ULBD at another and followed for at least six months. Patients with multilevel disease, high-grade spondylolisthesis, or prior index-level surgery were excluded. Co-primary endpoints were hemoglobin decrease and time to first mobilization. The two groups were compared, with Bonferroni-adjusted significance set at p<0.025.

Results: Of 102 patients (mean age 65.6±7.1 years; 52.9% female), 46 underwent UBE and 56 ULBD, with comparable baseline characteristics (all p>0.05). UBE yielded less hemoglobin decrease (0.46±0.14 vs. 1.06±0.20 g/dL; p<0.001), and earlier mobilization (3.93±1.10 vs. 12.73±2.70 hours; p<0.001). Operative time was longer with UBE (57.00±4.59 vs. 45.05±4.53 minutes; p<0.001), and hospital stay was shorter (1.59±0.49 vs. 1.96±0.63 days; p=0.003). At six months, back visual analog scale (VAS) favored UBE (2.15±0.91 vs. 2.89±0.92; p<0.001), whereas leg VAS (1.71±0.80 vs. 1.78±0.54; p=0.157) and Oswestry disability index (16.24±3.14 vs. 17.18±3.38; p=0.153) were comparable. Dural injury (4.3% vs. 10.7%; p=0.289) and wound discharge (2.2% vs. 5.4%; p=0.625) did not differ.

Conclusions: Both techniques improved short-term outcomes. UBE was associated with smaller hemoglobin decrease, earlier mobilization, shorter hospitalization, and lower VAS scores for back pain, with comparable functional outcomes and complications at six months.

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Introduction

Lumbar spinal stenosis (LSS) results from degenerative processes, ligamentous hypertrophy, disc pathology, and bony overgrowth, that constrict the central canal, lateral recess, or neural foramen and compress the neural elements (1,2). Its prevalence increases with age and is estimated at approximately 11% overall (3-5). Patients typically experience neurogenic claudication, radicular symptoms, and a gradual decline in function, and LSS is the leading reason for spinal surgery beyond the age of 65 (6,7).

Management spans conservative measures through to operative decompression (7). Although fusion is reserved for cases with instability, stand-alone decompression has gained favor because it retains segmental motion and lowers surgical morbidity (8,9). Within decompression-only approaches, microscopic unilateral laminotomy for bilateral decompression (ULBD) is a proven option that achieves sufficient neural release while sparing the midline structures and the contralateral facet joint (3). Unilateral biportal endoscopic (UBE) decompression is a newer minimally invasive alternative that delivers a broad operative view through two separate portals under continuous saline irrigation (10,11).

Pooled analyses of UBE versus microscopic decompression report perioperative benefits for UBE such as reduced bleeding, shorter admissions, and quicker early analgesia, with comparable long-term function and complication profiles (10-13). Several gaps nonetheless persist. Because most comparative series originate from East Asian cohorts, whether these results extend to other populations and health systems is unclear, and recent reviews have called for external validation in more diverse settings (10-13). Quantifying intraoperative bleeding in UBE is difficult, since the continuous irrigation flushes blood from the field and makes estimated blood loss (EBL) unreliable (14); the postoperative fall in hemoglobin, which captures both overt and concealed losses, is a more objective surrogate, yet it has rarely served as an endpoint in comparative work (14). In parallel, enhanced recovery after surgery (ERAS) pathways have expanded into spine surgery and frame metrics such as blood loss, time to first mobilization, and length of stay as central recovery indicators (15,16); these are seldom reported when UBE and microscopic decompression are compared, and no prior study has appraised the two techniques through an ERAS-oriented lens (10,13). Finally, although the Schizas grade for stenosis and the modified Pfirrmann score for disc degeneration are established radiological tools, pairing them to match groups at baseline has rarely been done, which may compromise cohort homogeneity (17,18).

The present two-center study was designed to close these gaps by contrasting the early clinical and perioperative outcomes of UBE decompression with those of microscopic ULBD. Given the perioperative benefits attributed to endoscopic surgery in the literature, we hypothesized that UBE would entail less blood loss and a shorter interval to first mobilization, while both procedures would achieve similar functional results at short-term follow-up. Group comparability at baseline was verified with the Schizas classification and the modified Pfirrmann grading.

Methods

Study design and participants

This retrospective two-center study included patients who underwent surgery for degenerative LSS at two centers between May and July 2025 and who had at least six months of postoperative follow-up. Center A performed UBE decompression and Center B performed microscopic ULBD. The final cohort comprised 102 consecutive patients (UBE, n=46; ULBD, n=56).

Inclusion and exclusion criteria

Eligible patients had single-level LSS of grade B or higher on the Schizas scale; disc degeneration no greater than grade VII on the modified Pfirrmann scale; symptoms typical of LSS; functional limitation of daily activity; and symptoms that had persisted despite at least six months of conservative care.

Patients were excluded if they had marked kyphotic deformity, degenerative or idiopathic scoliosis, spondylolisthesis of grade II or above, a previous operation at the treated level, spinal infection or neoplasm, or follow-up of less than six months.

Ethical approval

Approval was obtained from the Institutional Ethics Committee of Tokat Gaziosmanpaşa University (approval no: 25-MOBAEK-370; date: 25/11/2025).Because the analysis was retrospective, the requirement for individual informed consent was waived. The study complied with the Declaration of Helsinki, and reporting follows the STROBE statement for observational research.

Data collection and assessments

Recorded variables included demographics, the operated level, hemoglobin decrease time to first mobilization, perioperative complications, and length of stay. Stenosis severity was scored with the Schizas system and disc degeneration with the modified Pfirrmann system.

The hemoglobin decrease was defined as the preoperative value minus the first postoperative morning measurement taken within 24 hours of surgery. Time to first mobilization was the interval from the end of the operation until the patient first stood and walked unaided or with minimal help, as noted in nursing charts. Complications were captured as dural injury (any intraoperative cerebrospinal fluid leak seen at surgery) and wound discharge (persistent serous or serosanguinous drainage requiring monitoring or intervention within 30 postoperative

days). Additional events, including epidural hematoma, surgical-site infection, nerve-root injury, and reoperation, were tracked but occurred in neither group. Clinical scores were collected in person at scheduled visits preoperatively and at three and six months by the operating teams at each center. Because the study was retrospective, assessors could not be blinded to the technique used.

Outcome measures

Consistent with ERAS principles that stress early mobilization and minimized surgical trauma, the two primary endpoints were the hemoglobin decrease and the time to first mobilization, metrics that directly capture the recovery advantages of minimally invasive surgery yet have been inadequately compared between UBE and microscopic decompression. Secondary endpoints were operative time, complication rate, length of stay, and back- and leg-pain visual analog scale (VAS) together with the Oswestry disability index (ODI) at three and six months, chosen to test the clinical equivalence and safety of the two approaches.

Surgical technique

At each center, all operations were performed by a single spine surgeon who had already passed the reported learning curve for the technique used at that center (UBE or microscopic ULBD, respectively) (19,20). Postoperative analgesia was comparable between centers. Mobilization was patient-led: rather than a fixed institutional timetable, patients were encouraged to walk as soon as they felt able to stand and ambulate.

UBE decompression surgeries were performed under general anesthesia with the patient prone. After the target level was localized fluoroscopically, two working channels were established about 5 mm off the midline to permit independent viewing and instrument handling. A 30° rigid endoscope under continuous saline irrigation was used for the entire case. The ipsilateral side was decompressed by laminotomy and flavectomy, adding foraminotomy or discectomy when required, and the contralateral side was addressed by tilting the endoscope over the midline and undercutting the base of the spinous process and the ligamentum flavum.

ULBD surgeries were performed under general anesthesia with the patient prone. The target level was confirmed fluoroscopically, an approximately 4-5 cm midline incision was made and the paraspinal muscles were elevated subperiosteally. Under the microscope, the ipsilateral side was decompressed via laminotomy and flavectomy, supplemented by partial medial facetectomy and foraminotomy as needed; the opposite side was reached by angling the microscope and undercutting the spinous process base and ligamentum flavum.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, NY, USA). Continuous data are reported as mean ± standard deviation or as median (range), and categorical data as counts and percentages. The Shapiro-Wilk test checked distributional normality. Groups were compared with the independent samples t-test or the Mann-Whitney U test according to distribution, and categorical variables with the chi-square or Fisher's exact test.

To account for the two primary endpoints (hemoglobin drop and time to first mobilization), a Bonferroni-adjusted threshold of $p<0.025$ was used for them, whereas $p<0.05$ defined significance for secondary endpoints. Longitudinal changes in VAS and ODI were tested with the Friedman test (with post-hoc pairwise comparisons) and with repeated-measures ANOVA, respectively.

A sensitivity power analysis indicated that, for the available sample (n=46 vs. n=56) at a Bonferroni-corrected α of 0.025 and 80% power, the smallest detectable effect was Cohen's d=0.621. A responder analysis quantified the proportion reaching the minimum clinically important difference (MCID) at six months, using Copay et al.'s (21) thresholds of 1.2 (back VAS), 1.6 (leg VAS), and 12.8 (ODI); responder rates were compared with Fisher's exact test.

Results

Of 149 patients who underwent surgery for degenerative LSS at the two centers between May and July 2025, 47 were excluded because of multilevel surgery (n=10), previous lumbar surgery (n=7), grade II or higher spondylolisthesis (n=8), modified Pfirrmann grade greater than VII (n=9), follow-up shorter than six months (n=9), or incomplete data (n=4). The final study population comprised 102 patients, including 46 who underwent UBE at Center A and 56 who underwent microscopic ULBD at Center B. No patients were lost to follow-up (Figure 1).

Baseline characteristics

Table 1 summarizes demographics and preoperative imaging. The mean age was 65.6±7.1 years, and women constituted 52.9% of the cohort. There were no significant differences between the groups in age, sex (female: 52.2% vs. 53.6%), operated level, or stenosis grade according to the Schizas and modified Pfirrmann systems (all $p>0.05$). L4-L5 was the segment most often involved in both arms, consistent with comparable baseline characteristics.

Primary outcomes

Perioperative measures differed markedly between techniques (Table 2), and both primary endpoints remained significant after

Table 1. Demographic and preoperative characteristics

Variable	UBE (n=46)	ULBD (n=56)	p-value
Age (years), mean ± SD	66.91±6.81	64.46±7.23	0.084[a]
Sex, n (%)			0.888[b]
Female	24 (52.2)	30 (53.6)	
Male	22 (47.8)	26 (46.4)	
Operated level, n (%)			0.920[b]
L2-L3	2 (4.3)	4 (7.1)	
L3-L4	15 (32.6)	18 (32.1)	
L4-L5	18 (39.1)	23 (41.1)	
L5-S1	11 (23.9)	11 (19.6)	
Schizas classification, n (%)			0.088[b]
B	4 (8.7)	8 (14.3)	
C	25 (54.3)	37 (66.1)	
D	17 (37.0)	11 (19.6)	
Modified Pfirrmann grade, n			0.989[b]
Grade III	7	8	
Grade IV	15	19	
Grade V	14	16	
Grade VI	8	11	
Grade VII	2	2	

[a]: Independent samples t-test, [b]: Chi-square or Fisher's exact test, UBE: Unilateral biportal endoscopic, ULBD: Unilateral laminotomy for bilateral decompression, SD: Standard deviation

Table 2. Perioperative outcomes, sensitivity analysis (ANCOVA), and perioperative complications

Variable	UBE (n=46)	ULBD (n=56)	Mean difference (95% CI)	Cohen's d (95% CI)/F	p-value
Primary outcomes					
Hemoglobin decrease (g/dL)	0.46±0.14	1.06±0.20	-0.60 (-0.67 to -0.53)	3.42 (2.81 to 4.03)	**<0.001[a]***
Time to mobilization (hours)	3.93±1.10	12.73±2.70	-8.80 (-9.58 to -8.02)	4.12 (3.44 to 4.81)	**<0.001[a]***
Secondary outcomes					
Operative time (min)	57.00±4.59	45.05±4.53	11.95 (10.17 to13.73)	2.62 (2.09 to 3.15)	**<0.001[b]**
Hospital stay (days)	1.59±0.49	1.96±0.63	-0.37 (-0.59 to -0.15)	0.65 (0.25 to 1.05)	**0.003[a]**
Sensitivity analysis (ANCOVA)-time to first mobilization					
Unadjusted, mean ± SD	3.93±1.10	12.73±2.70	—	—	**<0.001**
Adjusted[c], EMM (95% CI)	3.93 (3.30-4.56)	12.73 (12.16-13.30)	—	F=395.754	**<0.001**
Perioperative complications					
Dural injury, n (%)	2 (4.3)	6 (10.7)	—	—	0.289[d]
Wound discharge, n (%)	1 (2.2)	3 (5.4)	—	—	0.625[d]
Epidural hematoma, n (%)	0 (0)	0 (0)	—	—	—
Surgical site infection, n (%)	0 (0)	0 (0)	—	—	—
Nerve root injury, n (%)	0 (0)	0 (0)	—	—	—
Reoperation, n (%)	0 (0)	0 (0)	—	—	—

Mean difference = UBE minus ULBD. [a]: Mann-Whitney U test, [b]: Independent samples t-test, : Bonferroni-corrected threshold for primary outcomes p<0.025, [c]: ANCOVA adjusted for age (F=0.125, p=0.725), sex (F=1.526, p=0.220) and Schizas classification (F=0.340, p=0.561); model R^2=0.813. [d]: Fisher's exact test, EMM: Estimated marginal mean, CI: Confidence interval, SD: Standard deviation, UBE: Unilateral biportal endoscopic, ULBD: Unilateral laminotomy for bilateral decompression

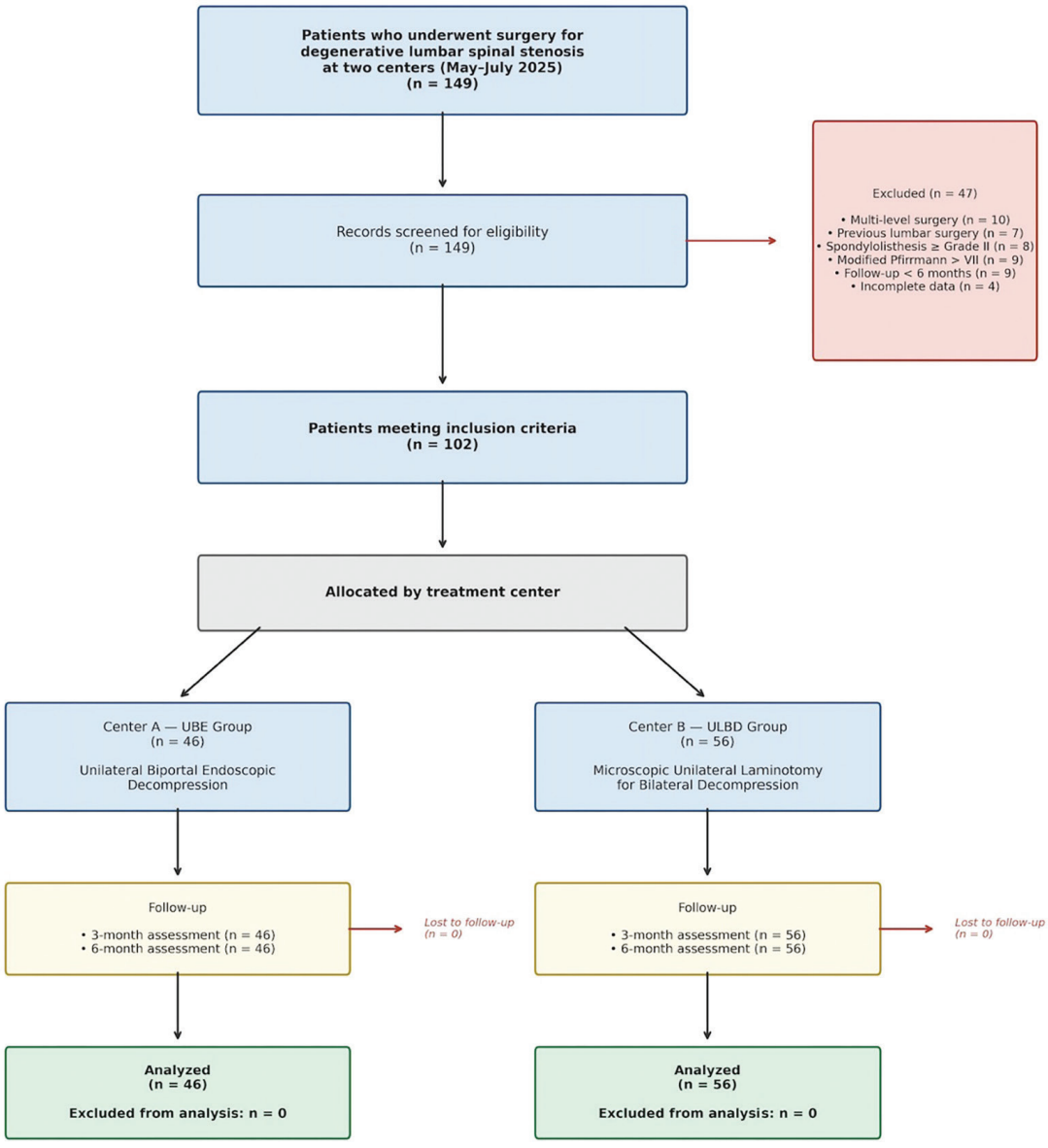


Figure 1. STROBE flow diagram illustrating the patient selection process and follow-up assessments
UBE: Unilateral biportal endoscopic, ULBD: Unilateral laminotomy for bilateral decompression

Bonferroni correction (threshold p<0.025). The hemoglobin drop was smaller with UBE than ULBD [0.46±0.14 vs. 1.06±0.20 g/dL; mean difference -0.60, 95% confidence interval (CI) -0.67 to -0.53; Cohen's d<3.42; p<0.001], and time to first mobilization was shorter with UBE (3.93±1.10 vs. 12.73±2.70 hours; mean difference -8.80, 95% CI -9.58 to -8.02; Cohen's d=4.12; p=0.001).

Secondary outcomes

For the secondary endpoints, UBE required a significantly longer operative time (57.00±4.59 vs. 45.05±4.53 minutes; mean difference: 11.95, 95% CI: 10.17 to 13.73; Cohen's d=2.62; p<0.001). Length of hospital stay was significantly shorter in the UBE group (1.59±0.49 vs. 1.96±0.63 days; mean difference: -0.37, 95% CI: -0.59 to -0.15; Cohen's d=0.65; p=0.003) (Table 2).

An ANCOVA sensitivity analysis for the primary endpoint of time to first mobilization included age, sex, and Schizas grade as covariates. After adjustment, surgical technique remained the only significant predictor of mobilization time (F=395.754, p<0.001), while none of the covariates were statistically significant (all p>0.05). The model explained 81.3% of the total variance (R^2=0.813) (Table 2).

Preoperative back VAS, leg VAS, and ODI scores were comparable between groups (all p>0.05), indicating similar baseline symptom severity (Table 3). Both groups showed significant improvement in these scores over the follow-up period (all p<0.001).

Back VAS scores at 3 and 6 months were significantly lower than preoperative values in both groups, with no significant

difference between the two postoperative time points within either group (Table 3). Between-group comparison showed significantly lower back VAS scores in the UBE group at both 3 months (2.29±1.03 vs. 2.86±0.64; p=0.009) and 6 months (2.15±0.91 vs. 2.89±0.92; mean difference: -0.74, 95% CI: -1.10 to -0.38; Cohen's d=0.81; p<0.001).

Leg VAS scores at 3 and 6 months were significantly improved compared with preoperative values in both groups (all p<0.001) (Table 3). There were no significant differences between the two postoperative time points or between groups at any follow-up (3 months: 1.90±0.75 vs. 2.02±0.81, p=0.183; 6 months: 1.71±0.80 vs. 1.78±0.54; mean difference: -0.07, 95% CI: -0.34 to 0.20; Cohen's d=0.11; p=0.157).

ODI scores at 3 and 6 months were significantly lower than preoperative values in both groups (all p<0.001), and further improvement was observed between the 3 and 6 month evaluations (Table 3). No significant differences were detected at either time point between the groups (3 months: 21.30±4.06 vs. 22.36±3.71, p=0.175; 6 months: 16.24±3.14 vs. 17.18±3.38; mean difference: -0.94, 95% CI: -2.21 to 0.33; Cohen's d=0.29; p=0.153). The confidence intervals for between-group differences in leg VAS and ODI crossed zero at all time points (Table 3).

A significant group-by-time interaction was observed for back VAS (F=6.883, p=0.001), indicating differing trajectories of back pain improvement between groups over time (Table 3, Figure 2). No statistically significant interactions were found for leg VAS (F=0.911, p=0.404) or ODI (F=1.047, p=0.353), indicating similar recovery patterns between groups (Figure 2).

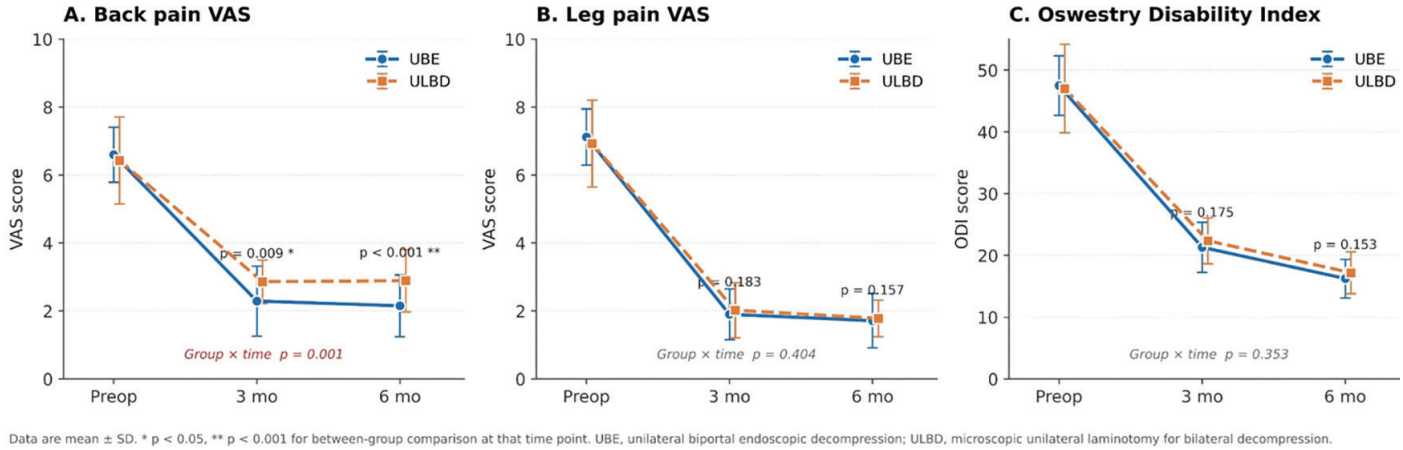
A responder analysis was carried out using established MCID thresholds for lumbar spine surgery (back VAS: 1.2 points; leg VAS: 1.6 points; ODI: 12.8 points) (21). At six months, MCID achievement rates for back VAS were 97.8% (45/46) in the UBE group and 94.6% (53/56) in the ULBD group (p=0.625). For leg VAS, responder rates were 100% (46/46) and 98.2% (55/56), respectively (p=1.000). For ODI, responder rates were 100% (46/46) and 98.2% (55/56), respectively (p=1.000). There were no significant differences between groups in MCID achievement rates for any clinical outcome measure (all p>0.05).

Dural injury affected 2 UBE patients (4.3%) and 6 ULBD patients (10.7%), a non-significant difference (p=0.289), while wound discharge occurred in 1 (2.2%) and 3 (5.4%) patients, respectively, again without significance (p=0.625), indicating comparable safety. No epidural hematoma, surgical-site infection, root injury, or reoperation was recorded during the six-month follow-up (Table 2).

Discussion

This study showed that both UBE and microscopic ULBD provided substantial short-term improvements in pain and disability in patients with single-level degenerative lumbar spinal stenosis. Compared with microscopic ULBD, UBE was associated with less hemoglobin decrease, earlier mobilization, shorter hospitalization, and lower postoperative back pain, although operative time was longer. Leg pain relief, functional improvement, clinically meaningful response rates, and complication rates were comparable between the two techniques at six months.

Earlier reports describe lower EBL with UBE than with microscopic surgery (13,22); however, EBL is unreliable under UBE because continuous irrigation dilutes and clears blood from the field, and hidden-blood-loss estimates suggest the true perioperative loss is considerably greater (10). The 0.60 g/dL difference in hemoglobin we observed suggests genuinely



Data are mean ± SD. * p < 0.05, ** p < 0.001 for between-group comparison at that time point. UBE, unilateral biportal endoscopic decompression; ULBD, microscopic unilateral laminotomy for bilateral decompression.

Figure 2. Changes in clinical outcomes over time in the UBE and ULBD groups. (A) Back pain VAS scores, (B) leg pain VAS scores, and (C) ODI measured preoperatively and at 3 and 6 months postoperatively. Both groups showed significant improvement over time. Back VAS scores were significantly lower in the UBE group at 3 and 6 months, with a significant group×time interaction (p=0.001), showing a different trajectory of improvement between techniques. In contrast, leg VAS and ODI scores showed no significant between-group differences or interaction effects. Values are presented as mean ± SD

Table 3. VAS and ODI scores at preoperative and postoperative follow-up, with repeated-measures ANOVA effects

Variable	UBE (n=46)	ULBD (n=56)	p (between groups)	MD (95% CI)	Cohen's d (95% CI)
Back VAS					
Preoperative	6.60±0.81	6.43±1.28	0.364[a]	—	—
Postop 3 months	2.29±1.03	2.86±0.64	**0.009**[a]	—	—
Postop 6 months	2.15±0.91	2.89±0.92	**<0.001**[a]	-0.74 (-1.10 to -0.38)	0.81 (0.40 to 1.21)
p (within group, time)	**<0.001**[b]	**<0.001**[b]			
Leg VAS					
Preoperative	7.12±0.83	6.93±1.28	0.381[a]	—	—
Postop 3 months	1.90±0.75	2.02±0.81	0.183[a]	—	—
Postop 6 months	1.71±0.80	1.78±0.54	0.157[a]	-0.07 (-0.34 to 0.20)	0.11 (-0.29 to 0.50)
p (within group, time)	**<0.001**[b]	**<0.001**[b]			
ODI					
Preoperative	47.48±4.82	46.98±7.16	0.689[c]	—	—
Postop 3 months	21.30±4.06	22.36±3.71	0.175[c]	—	—
Postop 6 months	16.24±3.14	17.18±3.38	0.153[c]	-0.94 (-2.21 to 0.33)	0.29 (-0.11 to 0.68)
p (within group, time)	**<0.001**[c]	**<0.001**[c]			
Repeated-measures ANOVA: time, group, interaction					
Back VAS	Time F=614.857, **p<0.001**	Group F=10.560, **p=0.002**	G×T F=6.883, **p=0.001**		
Leg VAS	Time F=1219.928, **p<0.001**	Group F=0.001, p=0.972	G×T F=0.911, p=0.404		
ODI	Time F=1500.712, **p<0.001**	Group F=0.661, p=0.418	G×T F=1.047, p=0.353		

Values are mean ± SD; between-group p compares UBE and ULBD at each time point; MD and Cohen's d reported for the 6 month comparison only. [a]: Mann-Whitney U test, [b]: Friedman test, [c]: Repeated-measures ANOVA. VAS: Visual analog scale, ODI: Oswestry disability index, MD: Mean difference, CI: Confidence interval, SD: Standard deviation, UBE: Unilateral biportal endoscopic, ULBD: Unilateral laminotomy for bilateral decompression

less tissue disruption with UBE rather than merely less visible bleeding. Our mobilization findings echo prior evidence of earlier ambulation after UBE than after microscopic decompression (12,22,23), and the ANCOVA showed that this difference was not explained by age, sex, or stenosis grade. Because technique and center completely overlap in this design, however, the ANCOVA cannot separate the effect of the technique from center- and surgeon-related factors.

Operative time was longer for UBE, as in previous series, reflecting the technical demands of endoscopy, portal creation, spatial orientation, and an irrigation-dependent workflow. The small standard deviations in both arms point to consistent performance with little case-to-case variation. Length of stay was shorter after UBE, again matching meta-analyses that report faster postoperative recovery (10,13,23).

All clinical measures improved significantly and durably in both groups across follow-up. Most functional gains appeared between the preoperative and 3 month assessments, with only slight further improvement from 3 to 6 months—a plateau widely documented in the LSS surgery literature (24,25).

Leg VAS and ODI were equivalent between groups at every postoperative point, indicating that both techniques accomplish effective neural decompression—consistent with reports of comparable radicular relief and functional recovery for UBE and ULBD at 3 and 6 months (13,22,23). On the MCID responder analysis, most patients in each group reached clinically meaningful improvement, implying similar clinical benefit overall and locating the key difference in the perioperative recovery profile rather than the final functional endpoint.

Back VAS, by contrast, was lower with UBE at both 3 and 6 months, and the significant group-by-time interaction shows that the pain-reduction trajectory diverged, with UBE improving progressively across follow-up. Although some systematic reviews find no back-pain difference, our results support the "muscle-sparing" argument of Zhang et al. (26), who contend that UBE, by preserving multifidus attachments through a percutaneous route, limits iatrogenic muscle atrophy and thereby curbs axial back pain more effectively than tubular or microscopic surgery. That said, while the 6 month back VAS difference was statistically significant, it fell short of the 1.2-point

MCID for lumbar surgery (21), likely because both groups improved substantially from high baselines, leaving only a small residual gap below the level patients perceive as meaningful.

Complication rates were similar between groups, consistent with reports that UBE carries a safety profile on par with conventional ULBD (12,13,22). The numerically lower dural-tear rate with UBE did not reach statistical significance and should not be read as evidence of a protective effect, although the magnified, fluid-distended endoscopic view may render the dural plane easier to identify (19).

Several methodological strengths support the reliability of our findings. Using the hemoglobin drop provided an objective index of perioperative bleeding and circumvents the acknowledged unreliability of EBL in irrigation-based UBE (14). Time to first mobilization was captured as a patient-driven endpoint that more faithfully mirrors surgical trauma and physiological readiness to recover, an ERAS tenet, rather than a protocol-fixed discharge criterion (15,16). The single-center-per-technique design ensured that each procedure was performed by a surgeon already in the mastery phase of the learning curve, and the ANCOVA showed that mobilization time was not explained by age, sex, or stenosis grade. This design is, however, also the principal limitation of the study and is examined in detail below. Lastly, because most UBE outcome data derive from East Asian cohorts, our series adds external validation from a different geographic and health-care setting, strengthening the generalizability of endoscopic decompression across care settings.

The 6 month horizon of this study should be interpreted in context. In both groups VAS and ODI improved most between the preoperative and 3 month assessments, with only modest change between 3 and 6 months, a plateau consistent with evidence that most functional recovery occurs within the first 3 months after decompression (27). Nevertheless, 6 month data cannot answer several important long-term questions. The SPORT trial, still the largest prospective study of surgical outcomes in LSS, recorded reoperation rates of 10% for recurrent stenosis and 18% overall at 8 years, with the advantage of surgery over conservative care narrowing between 4 and 8 years of follow-up (28); the Swedish spinal stenosis study similarly noted 14% radiological restenosis at the operated level at 2 years after decompression alone (29). In addition, differences in facet-joint preservation between approaches carry biomechanical implications for segmental stability that a 6 month window cannot assess. Longer follow-up is therefore needed to establish whether these early differences translate into durable clinical benefit.

Study Limitations

The most important limitation is that each center exclusively performed one surgical technique. Most importantly, each center exclusively performed one surgical technique, with UBE undertaken at Center A and microscopic ULBD at Center B. Surgical technique, operating surgeon, and institution therefore overlap completely, and no statistical adjustment can separate them: the ANCOVA could account for patient-level covariates only, not for the center itself. What this study estimates is consequently the difference between two complete care pathways, a technique as performed by one surgeon within one institutional routine, rather than the difference between two techniques in isolation.

Three sources of bias deserve specific mention. First, surgeon-related factors: individual operative speed, familiarity with the exposure, and personal thresholds for extending decompression are inseparable from the assigned technique, so part of the difference in operative time and complications may reflect the surgeon rather than the method. Second, institutional practice patterns: time to first mobilization and length of stay are determined not only by surgical trauma but also by ward routines, nursing culture, analgesic administration habits, and discharge policies. These two endpoints are thus the most vulnerable in our dataset, and one of them is a primary endpoint; the 8.8-hour difference in mobilization should be read with this in mind. By contrast, hemoglobin decrease is a laboratory measurement and operative time a clock measurement, so both are less exposed to institutional culture, and VAS and ODI were collected with identical instruments at the two centers. Third, outcome assessment was unblinded and performed by the operating teams themselves, which may have favored the technique used at each center, particularly for the subjective back pain score. For interpretation, these mean that the perioperative advantages we report for UBE should be regarded as consistent with, rather than as proof of, a technique effect. For generalizability, it means that the size of these advantages may not reproduce in institutions with standardized early-mobilization protocols or different discharge criteria, where the gap between techniques would plausibly be narrower. These findings therefore require confirmation in prospective multicenter studies in which both techniques are performed within the same institutions and, ideally, by several surgeons per technique.

Beyond this central issue, several further limitations apply. First, the retrospective design precludes standardized data-collection protocols and permits selection bias, although restricting the cohort to single-level stenosis and the comparable baseline profiles attenuate this concern. Second, the focus on single-level decompression may limit generalizability to multi-level procedures, where cumulative operative time, tissue trauma, and technical complexity could affect the two techniques differently. Additionally, no radiological outcomes were measured, which would have objectively documented the adequacy and extent of decompression achieved by each method. Finally, cost-effectiveness data were not gathered; such analysis would help guide resource allocation given the greater equipment demands of endoscopy.

Conclusion

Our data indicate that, in the short term, both UBE and microscopic ULBD are safe and effective for lumbar spinal stenosis. The endoscopic approach was associated with perioperative benefits such as less blood loss, faster mobilization, shorter admission, and better early relief of axial back pain, making UBE a valuable minimally invasive option when rapid recovery is a priority. Because each technique was performed at a single center, however, these advantages should be confirmed in settings where both procedures are carried out under the same institutional protocols. Prospective randomized trials with longer follow-up are needed to further define the comparative effectiveness of the two techniques.

Ethics

Ethics Committee Approval: Institutional Ethics Committee of Tokat Gaziosmanpaşa University approval was obtained (approval no: 25-MOBAEK-370; date: 25/11/2025).

Informed Consent: Because the analysis was retrospective, the requirement for individual informed consent was waived.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: A.K., Y.Ü., Concept: A.K., Y.Ü., Design: A.K., Data Collection or Processing: D.E.K., Analysis or Interpretation: D.E.K., İ.S., Literature Search: A.D., Writing: A.K., A.D., İ.S.

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