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Original Article *Özgün Araştırma*

COMPARISON OF CLINICAL OUTCOMES OF UNILATERAL BIPORTAL ENDOSCOPY (UBE) AND MICROSURGICAL TECHNIQUES IN THE TREATMENT OF FAR LATERAL LUMBAR DISC HERNIATION: A TWO-CENTER RETROSPECTIVE STUDY

Far Lateral Lomber Disk Hernisi Tedavisinde Unilateral Biportal Endoskopi ve Mikrocerrahi Sonuçlarının Karşılaştırılması: İki Merkezli Çalışma

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ABSTRACT

Objective: This study aimed to compare the clinical outcomes, surgical parameters, and postoperative analgesic requirements of unilateral biportal endoscopy (UBE) discectomy and microsurgical discectomy performed by experienced surgeons at two different centers for the treatment of far lateral lumbar disc herniation (FLLDH).

Material and Methods: This retrospective two-center study included 25 patients diagnosed with FLLDH who underwent surgery between August 2024 and August 2025. Thirteen patients underwent UBE at center 1, and 12 patients underwent microsurgical discectomy at center 2. Demographic characteristics, operative level, operative time, intraoperative complications, length of hospital stay, preoperative-to-postoperative hemoglobin difference, back and leg visual analog scale (VAS) scores (preoperative, postoperative day 1, postoperative week 6, and postoperative month 6), and oswestry disability index (ODI) scores (preoperative and postoperative month 6) were retrospectively analyzed.

Results: No significant differences were observed between the two groups in terms of age, body mass index (BMI), sex distribution, or operative level ($p>0.05$). The UBE group demonstrated a significantly longer operative time ($p<0.01$), a significantly lower preoperative-to-postoperative hemoglobin difference ($p<0.001$), and a significantly shorter length of hospital stay ($p<0.05$) compared with the microsurgery group. Both groups showed significant improvements in back VAS, leg VAS, and ODI scores across all follow-up time points ($p<0.001$); however, no significant intergroup differences were detected at any time point ($p>0.05$). The change in VAS and ODI scores from baseline was comparable between the two groups. No dural tears or other intraoperative complications occurred in either group.

Conclusion: Both UBE and microsurgical discectomy yield comparable and favorable clinical outcomes in the treatment of FLLDH up to six months postoperatively. UBE offers the additional advantages of reduced blood loss and shorter hospitalization. However, its longer operative time may reflect the steep learning curve inherent to the technique. The choice of surgical approach should be guided by surgeon experience and patient expectations, and further large-scale, long-term prospective studies are warranted.

Keywords: *Far lateral lumbar disc herniation, unilateral biportal endoscopy, microsurgery, minimally invasive spine surgery, clinical outcomes*

ÖZ

Amaç: Bu çalışma, iki farklı merkezde deneyimli cerrahlar tarafından uygulanan unilateral biportal endoskopi (UBE) ve mikrocerrahi diskektomi tekniklerinin far lateral lomber disk hernisi (FLLH) tedavisindeki klinik sonuçlarını, cerrahi parametrelerini ve postoperatif analjezik ihtiyaçlarını karşılaştırmayı amaçlamaktadır.

Gereç ve Yöntemler: Bu retrospektif iki merkezli çalışmaya, Ağustos 2024-Ağustos 2025 tarihleri arasında FLLH tanısı ile ameliyat edilen 25 hasta dâhil edildi. On üç hastaya merkez 1'de UBE, 12 hastaya merkez 2'de mikrocerrahi diskektomi uygulandı. Demografik özellikler, patoloji seviyesi, ameliyat süresi, intraoperatif komplikasyonlar, hastanede yatış süresi, preoperatif-postoperatif hemoglobin farkı, bel ve bacak vizüel analog skala (VAS) skorları (preoperatif, postoperatif 1. gün, postoperatif 6. hafta ve postoperatif 6. ay) ile Oswestry dizabilite indeksi (ODİ) skorları (preoperatif ve postoperatif 6. ay) retrospektif olarak incelendi.

Bulgular: İki grup arasında yaş, vücut kitle indeksi, cinsiyet dağılımı ve patoloji seviyesi açısından anlamlı fark saptanmadı ($p>0,05$). UBE grubunda ameliyat süresi anlamlı olarak daha uzun ($p<0,01$), preoperatif-postoperatif hemoglobin farkı anlamlı olarak daha düşük ($p<0,001$) ve hastanede yatış süresi anlamlı olarak daha kısa ($p<0,05$) bulundu. Her iki grupta da tüm takip zamanlarında bel VAS, bacak VAS ve ODİ skorlarında anlamlı iyileşme gözlendi ($p<0,001$); ancak hiçbir zaman noktasında gruplar arası anlamlı fark saptanmadı ($p>0,05$). VAS ve ODİ skorlarındaki bazale göre değişim iki grup arasında benzerdi. Her iki grupta da dura yırtığı veya intraoperatif komplikasyon görülmedi.

Sonuç: UBE ve mikrocerrahi diskektomi, FLLH tedavisinde postoperatif altıncı aya kadar benzer ve olumlu klinik sonuçlar sağlamaktadır. UBE, daha az kan kaybı ve daha kısa hastanede kalış süresi gibi ek avantajlar sunmaktadır. Bununla birlikte, daha uzun ameliyat süresi tekniğin dik öğrenme eğrisini yansıtıyor olabilir. Cerrahi yaklaşım seçimi cerrahın deneyimi ve hastanın beklentileri doğrultusunda belirlenmelidir; daha geniş kapsamlı, uzun dönem prospektif çalışmalara ihtiyaç bulunmaktadır.

Anahtar Kelimeler: *Far lateral lomber disk hernisi, unilateral biportal endoskopi, mikrocerrahi, minimal invaziv spinal cerrahi, klinik sonuçlar*

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INTRODUCTION

Lumbar disc herniation (LDH) is a prevalent degenerative condition that substantially impairs quality of life, and its surgical management constitutes one of the most frequently performed procedures in neurosurgery.[1-3] Far lateral lumbar disc herniation (FLLDH), characterized by disc protrusion at the exit zone of the intervertebral foramen with consequent nerve root compression, accounts for 6.5% to 12% of all lumbar herniations.[1,4] Owing to its anatomical location, FLLDH directly compresses the exiting nerve root and dorsal root ganglion, resulting in more severe radicular pain and greater functional impairment than those associated with standard posterolateral herniations.[5]

The primary objective of surgical treatment is to achieve adequate neural decompression while preserving the facet joint.[6] Although FLLDH has traditionally been managed with open surgical techniques such as microsurgery and fusion, these approaches may lead to extensive tissue damage, paraspinal muscle atrophy, and chronic postoperative low back pain.[3,7] With ongoing technological advances, minimally invasive spine surgery (MISS) techniques that aim to reduce surgical trauma have gained increasing preference in the management of spinal pathologies.[8]

While microdiscectomy remains the standard technique, unilateral biportal endoscopy (UBE), a minimally invasive technique that utilizes two portals for spinal canal access, has attracted considerable attention in recent years. UBE offers a wide field of view, smaller incisions, less postoperative back pain, shorter hospital stays, and superior tissue-sparing properties.[9] Despite the growing body of evidence on UBE for central and paracentral disc herniations, comparative data specifically evaluating UBE against microsurgical techniques in the treatment of FLLDH remain scarce. The unique anatomical constraints of the far lateral zone, including the proximity of the dorsal root ganglion and the need for a paraspinal corridor, pose distinct surgical challenges that may influence the relative advantages of each technique. The present study aimed to compare the clinical outcomes, surgical parameters, and postoperative analgesic requirements of UBE and microsurgical techniques performed by experienced surgeons at two separate centers.

MATERIALS AND METHODS

This study was approved by Tokat Gaziosmanpaşa University Clinical Research Ethics Committee (Date:17/02/2026, Decision No:26-MOBAEK-062). All procedures were performed in accordance with the ethical standards of the Declaration of Helsinki. Due to the retrospective nature of the study, the requirement for informed consent was waived by the ethics committee.

This retrospective two-center study reviewed patients diagnosed with FLLDH based on radiological investigations and clinical findings between August 2024 and August 2025. Patients who underwent UBE at center 1, and those who underwent microsurgical discectomy at center 2 were included.

Inclusion criteria for both groups were as follows: age between 18 and 75 years; single-level lumbar disc herniation with symptoms and clinical findings concordant with radiological evidence; persistence of symptoms despite a minimum of six months of conservative treatment; and a BMI between 18.5 and 30 kg/m^2.

Exclusion criteria included: Grade 2 or higher spondylolisthesis; prior lumbar surgery at the same level; vertebral or disc space-related infectious processes; preoperative scoliosis parameters exceeding the following thresholds on standing radiographs (sagittal vertical axis (SVA) >4 cm, coronal imbalance defined as a C7 plumb line-to-central sacral vertical line (CSVL) distance >2 cm, lumbar Cobb angle >25°, or thoracic (T4-T12) Cobb angle >50°); BMI <18.5 or >30 kg/m^2; preoperative opioid use; and known allergy to nonsteroidal anti-inflammatory drugs (NSAIDs) or opioids.

Based on these criteria, 25 patients (13 patients in UBE discectomy group, 12 in the microsurgical discectomy group) were enrolled. The following parameters were retrospectively evaluated: demographic characteristics (age, sex, body mass index (BMI)), pathological level, operative time, presence of intraoperative complications, length of hospital stay, preoperative-to-postoperative hemoglobin difference, back and leg visual analogue scale (VAS) scores, and ODI (Oswestry disability index) scores.

Surgical Technique

All UBE procedures were performed by a single right-hand dominant surgeon under general anesthesia in the prone position. After fluoroscopic localization of the target intervertebral level, two paramedian skin incisions of approximately 1 cm each were made 2-3 cm lateral to the midline, centered over the upper and lower pedicles of the index segment. The paraspinal muscle corridor was developed through the intermuscular plane between the multifidus and longissimus muscles using serial dilators, reaching the working zone over the isthmus and lateral facet complex. Portal configuration was determined according to the side of the pathology and the surgeon's hand dominance: for left-sided pathology operated by a right-hand dominant surgeon, the cranial portal served as the viewing portal for a 30° arthroscope while the caudal portal was used as the working channel; for right-sided pathology, this configuration was reversed (caudal portal for viewing, cranial portal for working) to allow ergonomic

KÜ Tıp Fak Derg 2026;28(2):299-306
Doi: 10.24938/kutfd.1920193

instrument handling with the dominant hand. The opposite configuration may be preferred by left-hand dominant surgeons. Continuous saline irrigation was maintained at a low, controlled pressure throughout the procedure to ensure a clear surgical field while avoiding excessive epidural pressure. After identification of the superior articular process (SAP) as the key bony landmark of the far lateral zone, partial resection of the cranial portion of the SAP and the lateral aspect of the pars interarticularis was performed with an endoscopic drill and Kerrison rongeurs to expose the foraminal contents. The ligamentum flavum was resected under endoscopic visualization to expose the exiting nerve root and dorsal root ganglion within the foramen. The herniated disc fragment, identified ventral and caudal to the exiting nerve root, was removed with endoscopic pituitary forceps with preservation of the medial two-thirds of the facet joint. Adequate decompression of the exiting nerve root was confirmed by free mobilization of the root under direct endoscopic view.

All microsurgical procedures were performed by a single right-hand dominant neurosurgeon under general anesthesia in the prone position using a standard operating microscope. After fluoroscopic localization of the target intervertebral level, a midline or paramedian skin incision was made and the paraspinal muscles were retracted with self-retaining retractors to expose the lamina of the index vertebra. Under microscopic magnification, a partial hemilaminectomy with medial facetectomy was performed using a high-speed burr and Kerrison rongeurs, with preservation of at least half of the facet joint to minimize the risk of iatrogenic instability. The ligamentum flavum was resected to expose the dural sac and the traversing nerve root, and the exiting nerve root was then identified and followed laterally into the neural foramen. The herniated disc fragment, located ventral to the exiting nerve root, was excised with microsurgical pituitary forceps. Adequate neural decompression was confirmed by free mobilization of the exiting nerve root under microscopic magnification.

Postoperative Management

All patients in both groups received a standardized postoperative analgesia protocol consisting of intravenous paracetamol (1 g every 8 hours) and an NSAID. Rescue analgesia with intravenous tramadol (50 mg per dose) was administered when the standardized regimen was insufficient to control postoperative pain, based on patient-reported pain at routine bedside nursing assessments. The number of rescue doses administered per patient during the inpatient stay was recorded and categorized as none, single dose, or multiple doses. Patients were mobilized on the day of surgery or the first postoperative day according to their tolerance.

Outcome Measures

Pain intensity was assessed using a 10-cm visual analog scale (VAS; 0 = no pain, 10 = worst pain imaginable) separately for back and leg pain. Functional disability was evaluated using the Oswestry Disability Index, with higher scores indicating greater disability. Assessments were performed preoperatively, on postoperative day 1 (VAS only), at postoperative week 6, and at postoperative month 6.

Statistical Analysis

Descriptive statistics for continuous variables were expressed as mean ± standard deviation, median, minimum, and maximum values; categorical variables were presented as frequencies and percentages. The Shapiro-Wilk test was used to assess the normality of distributions.

For comparisons of continuous variables between the UBE and microsurgery groups, the independent samples t-test was employed for normally distributed data, and the Mann-Whitney U test was used for non-normally distributed data. Categorical variables were compared using the chi-square test or Fisher's exact test.

Friedman's analysis of variance was used to compare VAS scores across follow-up time points (preoperative, postoperative day 1, postoperative week 6, and postoperative month 6) within each group. *Post hoc* pairwise comparisons were performed using Friedman's multiple comparison test, and adjusted p-values were reported. Repeated-measures analysis of variance was used to compare preoperative and postoperative ODI scores. All analyses were conducted using IBM SPSS for Windows, version 20.0 (SPSS Inc., Chicago, IL, USA), with a significance threshold of $p<0.05$.

RESULTS

A total of 25 patients were included in this retrospective two-center study: 13 patients who underwent UBE discectomy at center 1, and 12 patients who underwent microsurgical discectomy at center 2. The demographic characteristics, operative levels, operative times, intraoperative complications, lengths of hospital stay, and preoperative-to-postoperative hemoglobin differences for both groups are summarized in Table 1.

KÜ Tıp Fak Derg 2026;28(2):299-306
Doi: 10.24938/kutfd.1920193

Table 1: Demographic characteristics of patients in unilateral biportal endoscopic discectomy (UBE) group and microsurgical discectomy group

	UBE discectomy (n=13)		**Microsurgical discectomy (n=12)**		
	Mean±SD Median (Min-Max)		**Mean±SD Median (Min-Max)**		**p**
Age (years)	49.15±7.79 49 (36-61)		49.66±8.34 49 (36-62)		0.875 [a]
BMI (kg/m^2)	24.43±0.88 24.3 (23.2-28.8)		24.17±1.08 24.4 (21.9-26.2)		0.522 [a]
Operation time (minutes)	66.92±6.62 65 (55-80)		60.42±3.34 60 (55-65)		0.005 [b]
Hemoglobin decrease (g/dl)	0.40±0.18 0.4 (0.2-0.8)		0.78±0.18 0.8 (0.4-1.1)		<0.001 [a]
	n	**%**	**n**	**%**	
Sex					
Male	9	69.2	8	66.7	1.000 [c]
Female	4	30.8	4	33.3	
Level					
L2-L3	4	30.8	4	33.3	1.000 [c]
L4-L5	8	61.5	7	58.4	
L5-S1	1	7.7	1	8.3	
Length of hospital stay (days)					
1	10	76.9	3	25.0	0.018 [c]
2	3	23.1	6	50.0	
3	0	0	3	25.0	
Tramadol requirement					
Not required	9	69.2	4	33.3	0.104 [c]
Single dose was required	4	30.8	5	41.7	
More than one dose was required	0	0	3	25.0	

UBE: Unilateral biportal endoscopy, BMI: Body-mass index (kg/m^2)
[a]:Independent samples t test, [b]: Mann Whitney U test, [c]: chi-square Test/Fisher's Exact test

No significant differences were found between the two groups with respect to age, BMI, sex distribution, or operative level (p>0.05). A significant difference was identified in operative time between the two groups (p<0.01), with the UBE group demonstrating longer operative times. The preoperative-to-postoperative hemoglobin change was significantly lower in the UBE group (p<0.001), indicating less intraoperative blood loss. A statistically significant difference was observed in length of hospital stay (p<0.05), with the UBE group requiring shorter hospitalization. No dural tears or intraoperative complications occurred in either group. The proportion of patients requiring tramadol during hospitalization did not differ significantly between the two groups (p>0.05).

The comparison of back and leg VAS scores at each follow-up time point between the two groups is presented in Table 2. Within the UBE group, a significant difference was observed across back VAS scores at the four time points (p<0.001). Back VAS scores at postoperative week 6 and month 6 were significantly lower than preoperative values, and the postoperative month 6 score was significantly lower than the postoperative day 1 score.

A similar pattern was observed in the microsurgery group (p<0.001). However, no significant intergroup differences in back VAS scores were detected at any time point (p>0.05). The trends in back VAS scores for both groups are illustrated in Figure 1.

A significant improvement in leg VAS scores was observed across all follow-up time points within both the UBE group and the microsurgery group (p<0.001 for both). Within each group, leg VAS scores at postoperative week 6 and month 6 were significantly lower than preoperative values, and the postoperative month 6 score was significantly lower than the postoperative day 1 score. No significant intergroup differences in leg VAS scores were found at any time point (p>0.05). The trends in leg VAS scores are shown in Figure 2.

Table 2: Comparisons of VAS-Back and VAS-Leg scores between Unilateral biportal endoscopic discectomy (UBE) group and microsurgical discectomy group

	UBE Discectomy (n=13) Mean±SD Median (Min-Max)	Microsurgical Discectomy (n=12) Mean±SD Median (Min-Max)	p
VAS Back			
Preoperative	6.31±0.48 6 (6-7)	6.42±0.51 6 (6-7)	0.650 [a]
Postoperative day one	3.23±0.59 3 (2-4)	3.50±0.67 3 (3-5)	0.470 [a]
Postoperative sixth week	2.15±0.55 2 (1-3)	2.17±0.38 2 (2-3)	1.000 [a]
Postoperative sixth month	1.31±0.48 1 (1-2)	1.50±0.52 1.5 (1-2)	0.437 [a]
p value (preoperative-postoperative)	<0.001 [b]	<0.001 [b]	
VAS Leg			
Preoperative	7.92±0.64 8 (7-9)	8.00±0.60 8 (7-9)	0.810 [a]
Postoperative day one	3.00±0.70 3 (2-4)	3.25±0.45 3 (3-4)	0.437 [a]
Postoperative sixth week	1.77±0.59 2 (1-3)	2.08±0.28 2 (2-3)	0.225 [a]
Postoperative sixth month	1.38±0.50 1 (1-2)	1.33±0.49 1 (1-2)	0.852 [a]
p value (preoperative-postoperative)	<0.001 [b]	<0.001 [b]	

UBE: Unilateral biportal endoscopy, VAS: Visual analogue scale
[a]: Mann Whitney U test,[b]: Friedman Variance Analysis

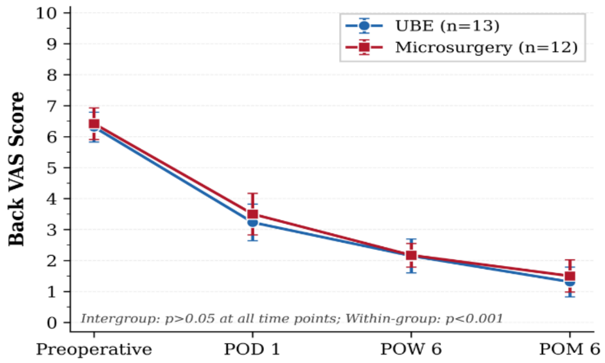

Figure 1: Comparison of back visual analog scale (VAS) scores between the unilateral biportal endoscopy (UBE) and microsurgery groups across follow-up time points.
POD, postoperative day; POW, postoperative week; POM, postoperative month, UBE: Unilateral biportal endoscopic discectomy

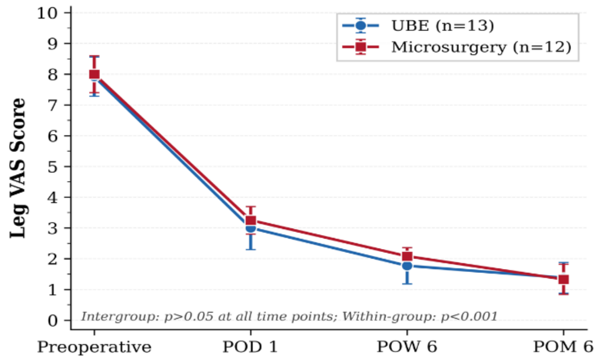

Figure 2: Comparison of leg visual analog scale (VAS) scores between the UBE and microsurgery groups across follow-up time points.
POD, postoperative day; POW, postoperative week; POM, postoperative month, UBE: Unilateral biportal endoscopic discectomy

The changes in VAS scores from baseline (Δ values) are summarized in Table 3. No significant differences were observed between the two groups in back VAS Δ1, Δ2, or Δ3, nor in leg VAS Δ1, Δ2, or Δ3 ($p>0.05$ for all).
The comparison of ODI scores between the two groups is presented in Table 4. No significant difference was found in preoperative ODI scores between the groups ($p>0.05$). A significant reduction in ODI scores from preoperative to postoperative month 6 was observed in both groups ($p<0.001$).
The magnitude of improvement in ODI scores was comparable between the UBE and microsurgery groups, as evidenced by a non-significant interaction term. The ODI score trends are depicted in Figure 3.
With respect to surgery-specific complications relevant to far lateral lumbar disc herniation, no patient in either group developed new-onset or worsening postoperative neuropathic pain or dysesthesia attributable to dorsal root ganglion or exiting nerve root injury. No clinical or radiographic signs of segmental instability were detected during the six-month follow-up. No reoperations and no recurrences at the index level were observed during the follow-up period. No wound infections, postoperative hematomas, or cerebrospinal fluid leakage were encountered in either group.
The minimal clinically important difference (MCID) thresholds were defined as a 30% improvement in ODI and a 33% improvement in VAS scores from baseline values.[10] In the UBE group, 12 of 13 patients (92.3%) achieved MCID for back VAS, 13 of 13 (100%) for leg VAS, and 13 of 13 (100%) for ODI at postoperative

month 6. In the microsurgery group, 11 of 12 patients (91.7%) achieved MCID for back VAS, 12 of 12 (100%) for leg VAS, and 12 of 12 (100%) for ODI at postoperative month 6. No significant difference in MCID achievement rates was observed between the groups.

Table 3: Comparison of changes in VAS scores between patients operated with the UBE (unilateral biportal endoscopic discectomy) technique and those who underwent microsurgery

	UBE Discectomy (n=13)	Microsurgical Discectomy (n=12)	
	Mean±SD Median (Min-Max)	Mean±SD Median (Min-Max)	p
VAS Back			
Difference between preoperative and postoperative day1 scores (Δ1)	-3.07±0.64 -3 (-4)- (-2)	-2.91±0.51 -3 (-4)- (-2)	0.574 [a]
Difference between preoperative and postoperative 6.week scores (Δ2)	-4.15±0.37 -4 (-5)- (-4)	-4.25±0.45 -4 (-5)- (-4)	0.689 [a]
Difference between preoperative and postoperative 6.month scores (Δ3)	-5.00±0.40 -5 (-6)- (-4)	-4.91±0.66 -5 (-6)- (-4)	0.769 [a]
VAS Leg			
Difference between preoperative and postoperative day 1 scores (Δ1)	-4.92±0.95 -5 (-7)- (-3)	-4.75±0.75 -5 (-6)- (-4)	0.611 [a]
Difference between preoperative and postoperative 6.week scores (Δ2)	-6.15±0.80 -6 (-7)- (-4)	-5.92±0.79 -6 (-7)- (-4)	0.437 [a]
Difference between preoperative and postoperative 6.month scores (Δ3)	-6.53±0.87 -7 (-8)- (-5)	-6.66±0.88 -7 (-8)- (-5)	0.810 [a]

UBE: Unilateral biportal endoscopic discectomy, VAS: Visual analogue scale
[a]: Mann Whitney U test

Table 4: Comparison of ODI scores between patients operated with the UBE (Unilateral Biportal Endoscopic) technique and those who underwent microsurgical technique

		Time (T)		
		Preoperative	Postoperative 6.month	
	Group (G)	Mean ± SD	Mean ± SD	
ODI	UBE discectomy	67.08±4.66	25.08±2.90	T; F=1010.37 p<0.001 G; F= 0.064 p=0.802 GxT; F=0.009 p=0.926
	Microsurgical discectomy	66.92±5.77	24.67±3.55	

ODI: Oswestry disability index, UBE: Unilateral biportal endoscopy

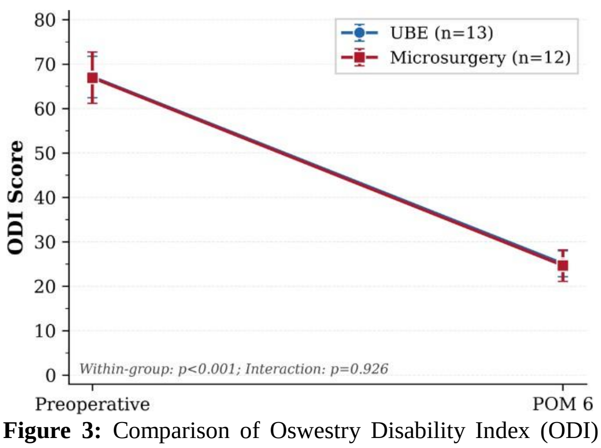

Figure 3: Comparison of Oswestry Disability Index (ODI) scores between the UBE and microsurgery groups at preoperative and postoperative month 6.
POM, postoperative month, UBE: Unilateral biportal endoscopy

DISCUSSION

Surgery for FLLDH demands meticulous attention owing to the vulnerable nature of the dorsal root ganglion.[7] The present study demonstrates that both UBE and microsurgery achieve comparably high clinical success in the treatment of FLLDH.

The lower intraoperative blood loss observed in the UBE group is consistent with the existing literature, which attributes this advantage to the tissue-sparing nature of UBE and effective hemostasis achieved through continuous saline irrigation.[8,11] Continuous saline irrigation during UBE provides a clear surgical field by flushing blood and debris while exerting a tamponade effect on small epidural venous bleeders, potentially eliminating the need for bipolar cauterization in many instances. In contrast, microsurgical exposure typically involves paraspinal muscle dissection with a wider soft-tissue corridor, which inherently contributes to greater blood loss from both the surgical approach and the operative field.

The significantly longer operative time in the UBE group aligns with the findings of Li et al., who reported prolonged operative times for UBE in FLLDH cases, although it contrasts with the results of Zhang et al., who observed shorter operative times with UBE.[4,12]

KÜ Tıp Fak Derg 2026;28(2):299-306
Doi: 10.24938/kutfd.1920193

This discrepancy may be attributable to the steep learning curve associated with the biportal technique and the technical complexity of managing two portals within a confined surgical field.[3,12] Yuan et al. reported a mean operative time of 96.4 minutes for UBE discectomy in a comparable FLLDH cohort, while Chau et al. reported 86 minutes for tubular far lateral microdiscectomy in the largest published case series (n=176).[13,14] Similarly, the length of hospital stay in our UBE group (76.9% discharged on day 1) was considerably shorter than the 6.44-day mean reported by Yuan et al. and the 1.3-day mean reported by Chau et al. for microsurgical cases, suggesting that both centers in the present study achieved efficient perioperative management.[13,14]

Most recently, a single-center retrospective comparative study by Özer et al. directly compared UBE (n=10) and microscopic discectomy (n=10) for FLLDH and reported findings broadly concordant with ours: UBE was associated with significantly less postoperative blood loss (postoperative hemoglobin 12.8 vs. 12.1 g/dL, p=0.011) and shorter hospital stay (16.8 vs. 23.0 hours, p=0.012), while ODI improvements and functional recovery measured by the modified McNab criteria were comparable between groups.[15] Two findings of Özer et al. differ from ours and merit consideration. First, they reported a significantly lower early postoperative back VAS in the UBE group (2.2 vs. 4.1, p=0.005), whereas we did not detect a statistically significant intergroup difference in back VAS at any of the four time points evaluated; this discrepancy may be attributable to differences in patient selection, the timing of the postoperative VAS assessment, sample size, and the standardized postoperative analgesia protocol applied in our series. Second, they observed comparable operative times between groups, whereas in our series UBE required significantly longer operative times, which likely reflects the early phase of the UBE learning curve at our center and the technical demands of managing two portals within a narrow paraspinal corridor.

Our finding of comparable VAS and ODI scores between the two groups throughout the follow-up period is noteworthy. This result does not support the meta-analysis by Meng et al., which suggested that UBE may be superior to microsurgery in achieving lower pain scores.[8] The relatively small sample size of our study may have limited the power to detect subtle differences between the groups. Importantly, the mean VAS reductions in both groups exceeded the MCID thresholds for both back (>33%) and leg pain (>33%), and the mean ODI improvement surpassed the 30% MCID threshold, indicating that both surgical techniques provided clinically meaningful functional recovery regardless of the statistical comparability of their scores.

A notable finding pertains to postoperative pain management. Although the proportion of patients requiring tramadol was numerically lower in the UBE group (30.8%) than in the microsurgery group (66.7%), this difference did not reach statistical significance (p=0.104), likely due to the small sample size. Nevertheless, this trend is consistent with the report by Suzuki et al., who demonstrated reduced narcotic analgesic requirements following UBE compared with microsurgery.[1] Moreover, the significantly shorter length of hospital stay in the UBE group (p=0.018) confirms the positive impact of minimally invasive techniques on patients' early return to daily activities.[4,6]

While the reported incidence of dural tears in FLLDH surgery ranges from 0.9% to 13.2% in the literature, no dural injuries occurred in either group in our study, confirming the safety of both techniques.[12] Furthermore, the risk of facet joint damage and iatrogenic instability, concerns associated with microsurgery, is thought to be minimized in paraspinal approaches such as UBE, which preserve facet joint integrity.[5,16-18]

One aspect that remains unaddressed in the present study is the recurrence rate. Chau et al.[14] reported a 12% reoperation rate at the index level in their far lateral microdiscectomy series over a mean follow-up of 21 weeks.[14] Long-term follow-up data are essential to determine whether UBE and microsurgery differ in terms of recurrence rates and the need for revision surgery in FLLDH cases.

The strengths of this study include the direct comparison of UBE and microsurgery for FLLDH with follow-up extending to six months postoperatively, thereby contributing to the limited body of literature on this subject. Additionally, the homogeneous surgical approach provided by a single surgeon at each center reduces variability attributable to surgical technique, enhancing internal validity.

Several limitations warrant consideration. First, the retrospective design carries an inherent risk of selection bias, as patients were not randomized to treatment groups. Second, the small sample size (n=25) may have been underpowered to detect clinically relevant differences between the groups, particularly for secondary outcomes such as tramadol requirement. Third, the follow-up period was limited to six months, which precludes assessment of long-term outcomes including recurrence rates and the development of adjacent segment disease. Fourth, the two groups were treated at different institutions by different surgeons, introducing potential confounders related to perioperative protocols and institutional practices. Finally, outcome assessors were not blinded to the surgical technique, which may have introduced measurement bias.

Minimally invasive surgical techniques have gained increasing preference owing to their advantages of reduced blood loss, shorter hospitalization, lower postoperative pain, and decreased narcotic analgesic requirements. Given that the six-month clinical outcomes of UBE and microsurgery performed at two separate centers by different surgeons were comparable, the choice of surgical technique may be individualized based on surgeon experience and patient expectations. Future studies should incorporate prospective randomized designs with larger sample sizes, longer follow-up durations, and standardized outcome measures to provide more definitive evidence regarding the comparative effectiveness of these techniques for FLLDH.

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