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Research

Comparison of Unilateral Biportal Endoscopic Discectomy and Microdiscectomy for Lumbar Disc Herniation: A Single-Center 1-Year Experience

Lomber Disk Hernisi Cerrahisinde Unilateral Biportal Endoskopik Diskektomi ile Mikrodiskektominin Karşılaştırılması: Tek Merkezli 1 Yıllık Deneyim

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ABSTRACT

Objective: The aim of this study was to compare the clinical, functional, and safety outcomes of unilateral biportal endoscopic (UBE) discectomy and lumbar microdiscectomy (LMD) in the surgical treatment of lumbar disc herniation.

Methods: This single-center, retrospective study included a total of 87 patients who underwent surgery for lumbar disc herniation. Patients were divided into two groups according to the surgical technique: LMD (n=40) and UBE (n=47). Clinical outcomes were assessed using preoperative and postoperative visual analogue scale (VAS) scores for back and leg pain, the Oswestry Disability Index (ODI), and the modified MacNab criteria at postoperative 3 months. Operative time and intraoperative and postoperative complications were also recorded.

Results: There were no significant differences between the groups in terms of preoperative VAS-back, VAS-leg, or ODI scores. The UBE group demonstrated significantly lower VAS-back scores in the early and mid-term postoperative periods compared with the LMD group ($p<0.001$). No significant differences were observed between the groups in postoperative 8 hours VAS-leg scores, ODI scores, or MacNab outcomes. Operative time was significantly longer in the UBE group ($p<0.001$). A limited number of complications, including recurrent disc herniation, dural tears, and epidural hematoma, were observed in the UBE group, while no permanent neurological deficits occurred in either group.

Conclusion: UBE is a safe and effective surgical alternative that provides advantages in early pain control while achieving functional outcomes and patient satisfaction comparable to those of microdiscectomy. The choice of surgical technique should be individualized based on patient characteristics and surgeon experience.

Keywords: Lumbar disc herniation, unilateral biportal endoscopy, microdiscectomy

ÖZ

Amaç: Bu çalışmanın amacı, lomber disk hernisi cerrahisinde unilateral biportal endoskopik (UBE) diskektomi ile lomber mikrodiskektominin (LMD) klinik, fonksiyonel ve güvenlik sonuçlarını karşılaştırmaktır.

Gereç ve Yöntem: Tek merkezli ve retrospektif olarak tasarlanan bu çalışmaya, lomber disk hernisi nedeniyle opere edilen toplam 87 hasta dahil edildi. Hastalar cerrahi tekniğe göre LMD (n=40) ve UBE (n=47) olmak üzere iki gruba ayrıldı. Klinik değerlendirmede preoperatif ve postoperatif görsel analog skala (VAS) (bel ve bacak), Oswestry Dizabilite İndeksi (ODI) ve postoperatif 3. ayda MacNab kriterleri kullanıldı. Ameliyat süresi ve intraoperatif/postoperatif komplikasyonlar kaydedildi.

Bulgular: Preoperatif VAS-bel, VAS-bacak ve ODI skorları açısından gruplar arasında anlamlı fark saptanmadı. UBE grubunda postoperatif erken ve orta dönemde VAS-bel skorları LMD grubuna göre anlamlı olarak daha düşük bulundu ($p<0,001$). Postoperatif 8. saat VAS-bacak skorları,

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ÖZ

ODI skorları ve MacNab kriterleri açısından gruplar arasında anlamlı fark izlenmedi. Ameliyat süresi UBE grubunda daha uzundu (p<0,001). UBE grubunda sınırlı sayıda nüks, dural hasar ve epidural hematom gözlendi; kalıcı nörolojik defisit her iki grupta da izlenmedi.

Sonuç: UBE, erken ağrı kontrolü açısından avantaj sağlayan, fonksiyonel sonuçlar ve hasta memnuniyeti bakımından mikrodiskektomi ile karşılaştırılabilir, güvenli bir cerrahi alternatiftir. Cerrahi teknik seçimi hasta özellikleri ve cerrah deneyimine göre bireyselleştirilmelidir.

Anahtar Kelimeler: Bel fıtığı, tek taraflı biportal endoskopi, mikrodiskektomi

INTRODUCTION

Lumbar disc herniation (LDH) is a common clinical condition characterized by low back and leg pain, numbness, and muscle weakness, all resulting from compression of the spinal nerve roots by herniated disc material. Its prevalence in the general population ranges from 15% to 45%, and approximately 75% of individuals experience at least one episode of low back pain during their lifetime (1-3). While conservative treatment is recommended for mild and non-progressive symptoms, surgical intervention becomes necessary in cases of pain refractory to medical treatment or in the presence of progressive motor and sensory deficits.

Open lumbar microdiscectomy (LMD) has long been considered the gold standard for the surgical treatment of LDH. With the introduction of high-resolution endoscopic systems, endoscopic techniques have gained increasing attention in recent years due to their advantages, including improved surgical visualization, reduced soft tissue damage, faster postoperative recovery, decreased intraoperative blood loss, shorter hospital stay, and a lower risk of infection (4-8).

Among endoscopic techniques, both uniportal and biportal approaches are currently used. Uniportal endoscopic surgery requires surgical instruments specifically designed for this technique. In contrast, the unilateral biportal endoscopic (UBE) technique has been developed by adapting conventional arthroscopic systems for spine surgery and has gained popularity in recent years. The UBE technique allows effective removal of herniated disc material via a posterior approach while aiming to preserve bony and muscular structures. Despite the growing use of endoscopic systems, studies comparing the clinical outcomes of UBE and microscopic discectomy—particularly in terms of pain control, quality of life, patient satisfaction, recurrence rates, and early and late complications—remain limited. Therefore, the present study aims to compare the clinical outcomes of UBE and LMD for the surgical treatment of LDH.

METHODS

Study Design

This study is a retrospective analysis of 87 patients with LDH who underwent surgery using two techniques—open LMD and UBE discectomy—at a single center in 2024. Data were obtained from the patients' medical records and intraoperative videos. Ethical approval for the study was obtained from the Institutional Human Research Ethics Committee of İstinye University (approval no: 2025-366, date: 13.01.2026).

Patient Selection

Patients were included in the study if they presented with low back pain or radicular pain associated with LDH, failed to respond to at least two weeks of conservative treatment, had symptoms that persisted for at least two weeks, had magnetic resonance imaging findings consistent with clinical symptoms, and had a minimum follow-up of one year. Prior to surgery, all patients underwent comprehensive neurological and radiological evaluations. Patients with previous lumbar surgery, extraforaminal disc herniation, recurrent disc herniation, multilevel disc herniation, severe scoliosis or spinal deformity, advanced osteoporosis, inflammatory rheumatologic diseases, traumatic disc herniation, or insufficient clinical or radiological follow-up data were excluded from the study.

Outcome Measures and Clinical Assessment

To evaluate surgical outcomes in a patient-centered and multidimensional manner, the visual analogue scale (VAS) was used to assess pain intensity, the Oswestry Disability Index (ODI) was used to evaluate functional status, and the MacNab criteria were used to determine overall clinical success and patient satisfaction. Low back and leg pain intensities were assessed preoperatively and postoperatively using the VAS (back and leg; range 0-10), while functional status was evaluated preoperatively and postoperatively using the ODI (range 0-100%). Back and leg pain were measured using the VAS 8 hours after surgery. Mid-term clinical outcomes were analyzed at

3 months postoperatively using VAS-back scores and the MacNab criteria (excellent, good, fair, and poor). Operative time was defined as the interval from the initial skin incision to the placement of the final skin suture. The operated lumbar level and the surgical side were recorded. In addition, intraoperative and postoperative complications were systematically evaluated.

Surgical Technique

Unilateral Biportal Endoscopic Discectomy

Visualization was achieved using a 4.0 mm-diameter, 0° HOPKINS® II arthroscope (Karl Storz, Tuttlingen, Germany) inserted through the endoscopic viewing portal. Bony decompression was performed using a 3 mm high-speed burr. Soft tissue ablation and hemostasis were achieved under continuous irrigation using a bipolar Coblation® radiofrequency probe (Smith & Nephew). During other stages of the procedure, standard surgical instruments from conventional open spine surgery—Kerrison rongeurs, dissectors, hooks, and pituitary forceps—were used for bone and soft tissue manipulation.

The patient was placed in the prone position under general anesthesia. After the surgical level was confirmed using C-arm fluoroscopy, skin incisions were planned. The cranial portal was created medial to the mid-inferior aspect of the cranial vertebral pedicle at the target level, while the caudal portal was created medial to the midline of the caudal vertebral pedicle. Triangulation of the working portal and the endoscope was achieved by targeting the spinolaminar junction. In right-sided disc herniations, the working portal could be positioned slightly more inferiorly. In cases of superiorly or inferiorly migrated disc herniations, portal placement was partially modified in the direction of the pathology.

The endoscope and surgical instruments were introduced through the two portals into the interlaminar window, which was maintained in a continuously irrigated fluid environment. After initiating irrigation, the operating table was placed in the reverse Trendelenburg position to reduce epidural pressure, prevent intracranial pressure elevation, and minimize the risk of retinal hemorrhage. Soft tissues overlying the lamina were dissected using a radiofrequency ablation probe, exposing the medial surface of the facet joint.

Subsequently, hemilaminectomy was performed using the 3 mm high-speed burr. Bone resection was terminated upon visualization of the characteristic medial "V-shaped" configuration of the ligamentum flavum and was followed by flavectomy. After removal of the ligamentum flavum, the dura mater and the corresponding nerve root were identified. Following safe mobilization of the nerve root, the disc space was explored, and the herniated disc material was removed, completing the discectomy.

Microdiscectomy

In patients undergoing LMD, the procedure was performed through a midline skin incision approximately 2-3 cm long, on the side corresponding to the disc herniation. The paraspinal muscles were dissected subperiosteally to expose the lamina and interlaminar space. The operation was carried out under microscopic magnification. After a partial hemilaminectomy and removal of the ligamentum flavum, the neural structures were exposed. Following safe mobilization of the nerve root, the herniated disc material was excised to achieve adequate decompression.

Statistical Analysis

Statistical analyses were performed using IBM SPSS version 29.0 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean±standard deviation, and categorical variables as counts and percentages. Comparisons were conducted between the LMD and UBE groups. Normality was assessed using visual methods and normality tests. As most variables were not normally distributed, non-parametric tests were primarily used. Postoperative 8-hours VAS-back and VAS-leg scores, postoperative 3-months VAS-back scores, preoperative and postoperative ODI scores, and changes in ODI scores were compared using the Mann-Whitney U test. Categorical variables, including 3-months postoperative MacNab outcomes, were analyzed using the chi-square test or Fisher's exact test when applicable. All analyses were two-tailed, and $p<0.05$ was considered statistically significant.

RESULTS

Between January and December 2024, 87 patients underwent lumbar discectomy at our center. The mean age of the patients was 46.75±10.70 years, and the female-to-male ratio was 41/46. Discectomy was performed on the right side in 39 patients (44.8%) and on the left side in 48 patients (55.1%). Regarding the operated levels, 1 patient (1.1%) underwent surgery at L2-3, 5 patients (5.7%) at L3-4, 41 patients (47.1%) at L4-5, and 40 patients (45.9%) at L5-S1. Of the total cohort, 40 patients (45.9%) were included in the LMD group, while 47 patients (54.0%) were included in the UBE group (Table 1).

In terms of surgical outcomes, the mean operative time was significantly longer in the UBE group compared with the LMD group (87.4±34.2 minutes vs. 61.6±16.6 minutes;

p<0.001) (Table 2). At 8 hours postoperatively, the VAS-leg score was 2.38±0.89 in the UBE group and 2.60±1.19 in the LMD group, with no statistically significant difference between the groups (p=0.305). In contrast, the postoperative 8-hours VAS-back score was significantly lower in the UBE group compared with the LMD group (3.65±1.32 vs. 4.77±0.94; p<0.001). Similarly, at mid-term follow-up, the postoperative 3-months VAS-back scores were significantly lower in the UBE group than in the LMD group (p<0.001).

Functional outcomes were evaluated using the ODI. Both groups showed a marked and statistically significant improvement in ODI scores postoperatively compared with preoperative values (p<0.001 for both groups). However, no statistically significant differences were found between the LMD and UBE groups in postoperative ODI scores or in the magnitude of ODI change (p=0.686). Clinical success and patient satisfaction were assessed at 3-months postoperatively using the MacNab criteria. No statistically significant difference was observed between the two groups in the distribution of MacNab outcomes (p=0.277); both groups showed a high proportion of excellent and good outcomes.

No postoperative infections, permanent neurological deficits, wound-related complications, or persistent radicular pain were observed. In the UBE group, one patient developed recurrent disc herniation that required reoperation; the reoperation was successfully performed using the UBE technique. One patient developed an epidural hematoma, confirmed by imaging, after the onset of radicular pain at the 4th postoperative hour and underwent emergent evacuation using the UBE technique. Two dural tears, identified intraoperatively, occurred in the UBE group; none required postoperative intervention. No irrigation-related retinal complications were observed in the UBE group.

DISCUSSION

In recent years, minimally invasive spine surgery techniques have become increasingly widespread, as endoscopic approaches offer notable advantages over traditional surgical methods, including faster postoperative recovery, reduced blood loss, a reduced risk of infection, shorter hospital stays, and reduced postoperative pain. The main finding of the present study is that unilateral biportal endoscopic surgery provides significant advantages in early- and mid-term pain control compared with microdiscectomy, while also achieving comparable clinical outcomes in terms of functional recovery and patient satisfaction. In particular, the significantly lower back pain scores observed in the UBE group during the early and mid-term postoperative periods support that minimally invasive approaches have a tissue-preserving effect on paraspinal soft tissues. Conversely, similar levels of functional improvement assessed by the ODI and comparable clinical success rates per the MacNab criteria indicate that UBE is a clinically equivalent alternative to microdiscectomy. These findings suggest that the choice of surgical technique in LDH should be guided not only by radiological decompression success but also by

Table 1. Demographic and clinical characteristics of the patients

	Total (n=87)	UBE (n=47)	LMD (n=40)
Age	46.75±10.70 (28-86)	48.23±11.41 (28-86)	45.02±9.67 (30-78)
Gender			
Female	41 (47.1%)	23 (26.4%)	18 (20.6%)
Male	46 (52.8%)	24 (27.5%)	22 (25.2%)
Side			
Right	39 (44.8%)	20 (22.9%)	19 (21.8%)
Left	48 (55.1%)	27 (31.0%)	21 (24.1%)
Level			
L2-3	1 (1.1%)	0	1 (1.1%)
L3-4	5 (5.7%)	5 (5.7%)	0
L4-5	41 (47.1%)	25 (28.7%)	16 (18.3%)
L5-S1	40 (45.9%)	17 (19.5%)	23 (26.4%)
Recurrence	1 (1.1%)	1 (1.1%)	0
Complication			
Dural injury	2 (2.2%)	2 (2.2%)	0
Epidural hematoma	1 (1.1%)	1 (1.1%)	0

UBE: Unilateral biportal endoscopy, LMD: Lumbar microdiscectomy

patient-centered outcomes, such as early pain relief and preservation of soft tissue integrity.

Although conventional microdiscectomy is an effective technique for symptomatic disc herniation, muscle and ligamentous injuries inherent to the procedure may lead to postoperative low back pain and muscle atrophy (9-11). Consequently, recovery and pain control may be prolonged, and some patients may require additional treatments. The incidence of postoperative low back pain after microdiscectomy has been reported to range between 30% and 70%, and approximately 8-10% of these patients may ultimately require fusion surgery for pain control (9,12-14). In contrast, the UBE technique, which avoids paravertebral muscle dissection and is performed under continuous saline irrigation, results in less tissue damage, a reduced inflammatory response, and decreased postoperative adhesion formation, thereby contributing to lower rates of postoperative low back pain (15). In the present study, the finding that patients in the UBE group experienced significantly less low back pain at the 8-hours postoperative and 3-months follow-up evaluations, compared with the LMD group, represents one of the notable advantages of the UBE technique.

The longer operative time observed in the UBE group than in the microdiscectomy group may be attributed to the inherent characteristics of endoscopic techniques and the associated learning curve. UBE requires two portals, continuous irrigation, and endoscope-specific hand-eye coordination, which may result in longer operative times during the initial phase of adoption. However, the literature indicates that operative times for UBE decrease significantly with increasing surgeon experience and eventually become comparable to those of microdiscectomy (2,16-18). This suggests that operative time should be regarded not as the sole indicator of technical efficiency, but rather as a dynamic parameter reflecting the surgeon's level of experience and progression along the learning curve. Despite longer operative time in the present study, lower postoperative VAS-back scores in the UBE group compared with the LMD group, together with the absence of significant differences in VAS-leg scores, support the effectiveness of UBE when used in appropriately selected patients and performed by experienced surgical teams. In terms of patient satisfaction, the lack of significant differences between the LMD and UBE groups in ODI and MacNab outcomes suggests that UBE's tissue-preserving nature, its contribution to early pain relief, and its support of functional recovery play a decisive role in clinical outcomes, despite its longer operative duration.

A limited number of complications were observed in the UBE group. Among patients who underwent UBE, one case of recurrent disc herniation, two dural tears identified intraoperatively, and one postoperative epidural

Table 2. Comparison of clinical outcomes between the UBE and LMD groups

	UBE	LMD	p
Back pain			
Preoperative VAS	6.23±1.30 (3-9)	6.57±1.23 (4-9)	p=0.255†
Postoperative 8 hours VAS	3.65±1.32 (1-6)	4.77±0.94 (3-6)	**p<0.001†**
Postoperative 3rd month VAS	2.23±1.00 (0-4)	3.02±0.94 (1-5)	**p<0.001†**
Leg pain			
Preoperative VAS	7.12±1.05 (4-9)	7.57±0.84 (6-9)	p=0.053†
Postoperative 8 hours VAS	2.38±0.89 (1-5)	2.6±1.19 (0-6)	p=0.305†
ODI			
Preoperative	77.46±8.15 (61-91)	79.85±7.31 (59-90)	p=0.165†
Postoperative	13.25±6.49 (4-36)	14.82±5.94 (7-32)	p=0.169†
Preoperative and postoperative changes	64.2±10.1 (39-80)	65.0±8.6 (47-82)	p=0.686†
MacNab criteria			p=0.277*
Excellent	35 (74.4%)	24 (60%)	
Good	7 (14.8%)	6 (15%)	
Fair	3 (6.3%)	8 (20%)	
Poor	2 (4.2%)	2 (5%)	
Operative time (minutes)	87.4±34.2 (40-180)	61.6±16.6 (28-93)	**p<0.001†**

†: Determined using the Mann-Whitney U test, *: Determined using the chi-square test, UBE: Unilateral biportal endoscopy, LMD: Lumbar microdiscectomy, VAS: Visual analogue scale, ODI: Oswestry disability index

hematoma were recorded. The dural tears were recognized intraoperatively and managed appropriately, with no need for additional intervention during the postoperative period. The epidural hematoma was diagnosed early and treated without resulting in a permanent neurological deficit. In the LMD group, no major complications requiring reoperation or resulting in serious neurological impairment were observed. No permanent neurological deficits or deaths occurred in either group. That most complications in the UBE group occurred during the learning-curve phase, along with the longer operative time observed, suggests that these complications may be related to technical experience. Nevertheless, when the overall complication profile is considered, UBE appears to have an acceptable and manageable safety profile when performed with appropriate patient selection and by experienced surgical teams (19-21).

Study Limitations

One of the major strengths of this study is the comparison of two patient groups who underwent surgery at the same center for similar surgical indications, based on detailed clinical and functional parameters. The similarity in preoperative pain and functional scores between groups enhances the internal validity of comparisons of postoperative outcomes. In addition, the combined evaluation of early and mid-term pain scores, functional recovery, and patient satisfaction allowed a comprehensive assessment of patient-centered outcomes related to the surgical techniques. However, the retrospective design of the study and the time-based group formation may introduce selection bias. The inclusion of cases from the early phase of the surgeon's learning curve in the UBE group may have influenced certain parameters, such as operative time. Furthermore, the lack of long-term clinical and radiological follow-up limits the generalizability of the findings to extended periods. Therefore, larger prospective studies with long-term follow-up are warranted to better define the role of UBE in the surgical treatment of LDH.

CONCLUSION

The results of this study indicate that in the surgical treatment of LDH, the UBE approach may provide advantages in early- and mid-term control of low back pain compared with LMD, while both techniques yield similar clinical outcomes in terms of functional recovery and patient satisfaction. While UBE offers potential benefits such as soft tissue preservation and early pain relief owing to its minimally invasive nature, longer operative time and learning curve-related complications should be considered limitations. Microdiscectomy, on the other hand, remains a reliable surgical technique supported by well-established efficacy, predictable operative duration, and extensive clinical experience. In this context, the selection of the optimal surgical technique for LDH should be individualized based on patient-specific clinical characteristics, surgeon experience, and institutional resources. When used in appropriately selected patients and by operators with sufficient expertise, UBE can be considered a safe and effective alternative to microdiscectomy.

ETHICS

Ethics Committee Approval: Ethical approval for the study was obtained from the Institutional Human Research Ethics Committee of İstinye University (approval no: 2025-366, date: 13.01.2026).

Informed Consent: Because the study was designed retrospectively no written informed consent form was obtained from the patients.

FOOTNOTES

Authorship Contributions

Surgical and Medical Practices: E.Y., A.G., A.E., Concept: S.C., Design: S.C., Data Collection or Processing: E.Y., A.E., Analysis or Interpretation: A.G., A.U., Literature Search: E.Y., A.U., Writing: E.Y., A.G.

Conflict of Interest: No conflict of interest was declared by the authors.

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