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Original Article

Evaluation of dural injury in patients undergoing single-level and unilateral lumbar microdiscectomy

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Abstract

Aim: Lumbar disc herniation (LDH) is most commonly treated with microdiscectomy as the surgical approach of choice. However, several complications may arise during lumbar microdiscectomy. In this study, we aimed to evaluate dural injury as a complication observed in patients who underwent microdiscectomy for LDH.
Materials and Methods: The clinical records of patients who underwent lumbar microdiscectomy between January 2023 and January 2025 were retrospectively reviewed. Only patients operated on for single-level and unilateral LDH were included in the study. Patients with two-level disc herniation, recurrent LDH, bilateral LDH, or other spinal pathologies requiring surgery were excluded from the analysis.
Results: The study included 73 patients, consisting of 45 males and 28 females. The mean age of all patients who underwent lumbar microdiscectomy was 48.45 years, with a median age of 46 years. The mean age of male patients was 49.97 years (median 46), while the mean age of female patients was 46 years (median 45.5). Among the patients examined, dural injury was detected in a total of 7 cases, 4 of whom were male and 3 were female. The incidence of dural injury was 8.89% in male patients and 10.71% in female patients. The overall dural injury rate was 9.6% (7/73).
Conclusion: In our study, the incidence of dural injury following microdiscectomy was not found to be statistically significant and remained within an acceptable range. Further prospective, multicenter studies with larger cohorts are needed to better define risk factors and prevention strategies for incidental durotomy in lumbar microdiscectomy. The most effective way to prevent complications that may occur during lumbar microdiscectomy is meticulous attention before, during, and after the surgical procedure.

Keywords: Lumbar microdiscectomy, complication, dural injury, cerebrospinal fluid fistula, spinal

INTRODUCTION

Low back pain is a common problem in society and is one of the leading causes of workforce loss. Its lifetime prevalence reaches approximately 80%, and the annual hospital admission rate in the adult population is around 15%. Low back pain originates from intervertebral disc pathologies at a rate of approximately 39%. Among these pathologies, lumbar disc herniation (LDH) and lumbar degenerative disc disease constitute the most important conditions (1-3).

LDH, defined as degeneration and outward protrusion of the nucleus pulposus, is one of the most frequently encountered diseases of the musculoskeletal system (4).

In the treatment of LDH, medical, conservative, and surgical approaches are used. Surgical treatment is preferred in patients who do not benefit from six weeks of medical and conservative therapy and in those with absolute surgical indications. Surgical procedures include discectomy, microdiscectomy, and endoscopic microdiscectomy (5).

Lumbar discectomy is one of the most commonly performed spinal surgeries. In the treatment of LDH, conventional microdiscectomy was first introduced by Caspar and Yaşargil in 1977, and microdiscectomy remains the most frequently preferred method (6-8).

The occurrence of dural injury during spinal surgery is

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associated with surgical experience. While the incidence is 7.2% in less experienced surgeons, it decreases to 0.8% in experienced surgeons. In first-time surgeries, the rate of dural injury ranges between 1% and 3.1%, whereas in recurrent or revision surgeries, it increases to 8.1%. Dural injury is observed in 1–4% of lumbar disc surgeries, but the rate can reach 25% in posterior lumbar interbody fusion (PLIF) procedures. Nerve root injury may occur as a result of laceration, avulsion, thermal damage, or excessive traction (9-11). However, reported rates vary substantially across series depending on patient selection, procedure type, and surgeon experience.

A review of the literature shows that several risk factors exist. Many important factors influence the possible occurrence of dural injury during spinal surgical interventions. Among them, the most important are the experience of the surgeon and the surgical team, whether the procedure is a primary surgery or a recurrent/revision surgery, and the type of surgical procedure performed (12).

In this study, we aimed to evaluate dural injury as a complication that may develop during microdiscectomy performed for LDH.

MATERIALS AND METHODS

In this retrospective study, the clinical records of 73 patients (28 females, 45 males) who underwent single-level and unilateral lumbar microdiscectomy between January 2023 and January 2025 at the Department of Neurosurgery, were reviewed. This study was approved by the Yalova University Non-Interventional Clinical Research Ethics Committee (Approval no: 2025/269; 25.06.2025).

Patients were eligible for inclusion if they were aged ≥18 years, had a magnetic resonance imaging (MRI)-confirmed diagnosis of single-level and unilateral LDH, and underwent primary lumbar microdiscectomy during the specified period. Exclusion criteria were multilevel disc herniation, single-level bilateral disc herniation, recurrent disc herniation, and surgery performed for other spinal pathologies.

The collected demographic and clinical data included age, sex, MRI findings (single-level and unilateral disc herniation), side of surgery, surgical level, and the presence or absence of intraoperative dural injury (Table 1). All surgical procedures were performed using a standard lumbar microdiscectomy technique under an operating microscope. The surgeries were carried out by neurosurgeons working in the same department. Although the surgical technique was standardized, minor technical variations could occur depending on surgeon preference and intraoperative findings. Because of the retrospective design and limited sample size, surgeon-specific experience and learning-curve effects were not analyzed as independent variables.

Statistical Analysis

All statistical analyses were performed using SPSS version 28.0 for Windows (IBM Corp., Armonk, NY, USA). Continuous variables were presented as mean ± standard deviation or median (range) and compared using the Mann–Whitney U test. Categorical variables were analyzed using the chi-square test or Fisher's exact test, as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The study was conducted on 73 patients, including 45 males and 28 females. The mean age of all patients who underwent lumbar microdiscectomy was 48.45 years, and the median age was 46 years. The mean age of male patients was 49.97 years (median 46), while the mean age of female patients was 46 years (median 45.5). Dural injury was detected in a total of 7 patients, 4 of whom were male and 3 were female. The incidence of dural injury was 8.89% among male patients and 10.71% among female patients. Regarding the surgical side, 60.3% of the patients were operated on the left side and 39.7% on the right side. In terms of surgical level, 42.5% of cases were operated at L5–S1, 49.3% at L4–5, 5.5% at L3–4, and 2.7% at L2–3. Dural injury occurred in 10.34% of patients who underwent surgery on the right side and 9.09% of those operated on the left side. According to surgical level, dural injury was present in 13.89% of patients operated at L4–L5 and 6.45% of those operated at L5–S1 (Table 1, Figure 1).

Table 1. Comparison of the patient group and control group in terms of sociodemographic data

Variables	Mean ± SD / n (%)	Median
Age (years)	48.45 ± 12.81	46.0 (n=73)
Female	46.0 ± 13.54	45.5 (n=28)
Male	49.97 ± 12.25	46.0 (n=45)
Dural injury		
No	66 (90.4%)	–
Yes	7 (9.6%)	–
By gender		
Female	3 (10.71%)	–
Male	4 (8.89%)	–
By surgical side		
Right	3 (10.34%)	–
Left	4 (9.09%)	–
Surgical level		
L2–3	2 (2.7%)	–
L3–4	4 (5.5%)	–
L4–5	36 (49.3%)	5 (13.89%) with injury
L5–S1	31 (42.5%)	2 (6.45%) with injury

SD: Standard deviation, L: Lumbar, S: Sacral

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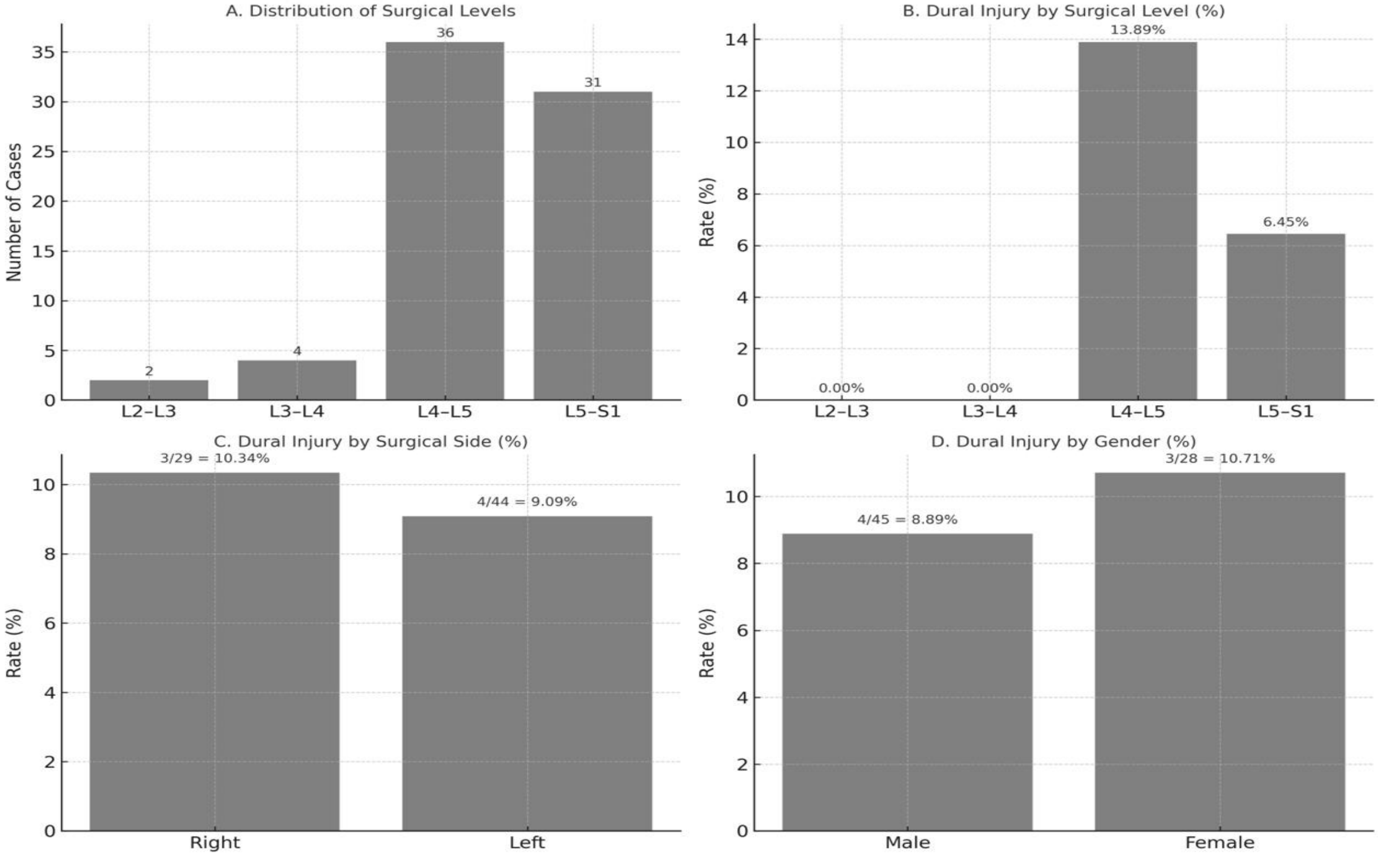

Figure 1. (A) Distribution of surgical levels in patients undergoing single-level, unilateral lumbar microdiscectomy (n=73). (B) Dural injury rate according to surgical level. (C) Dural injury rate by surgical side. (D) Dural injury rate by gender. Values above bars indicate the number of patients with dural injury relative to the total and corresponding percentages

In our study, the rates of dural injury were not found to be statistically significant. The Fisher's exact test statistic was 1, with a result not significant at $p<0.05$. The chi-square test statistic was 0.0663, with a p-value of 0.796744, which was not significant at $p<0.05$. The chi-square test with Yates' correction yielded a test statistic of 0.0229 and a p-value of 0.879835, also not significant at $p<0.05$ (Table 2).

Values in parentheses indicate expected counts. Fisher's exact test=1.0; Chi-square=0.0663, p=0.797; Chi-square with Yates' correction=0.0229, p=0.880. None of the results were statistically significant ($p>0.05$).

Table 2. Distribution of dural injury according to gender

Gender	No dural injury (n)	Dural injury present (n)	Marginal row totals (n)
Male	41 (40.68) (0)	4 (4.32) (0.02)	45
Female	25 (25.32) (0)	3 (2.68) (0.04)	28
Marginal column totals	66	7	73 (Grand total)

DISCUSSION

Low back pain and radicular pain represent a significant burden both medically and socioeconomically, with approximately 80% of adults experiencing low back pain at least once during their lifetime. This condition, which significantly impairs quality of life, is a major cause of physical disability in both younger and older individuals. While low back pain tends to resolve spontaneously within three months, it is considered chronic if it persists beyond this period. One of the most common causes of low back pain results from disc degeneration affecting surrounding neural structures (13,14).

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Herniated discs in the lumbar spine typically present with sudden-onset back and leg pain in a myotomal or dermatomal distribution. Symptoms may include radicular pain, paresthesias, and, in severe cases, weakness or foot drop. Patients are typically treated conservatively for 6–8 weeks with a combination of steroids, nonsteroidal anti-inflammatory drugs, physical therapy, epidural steroid injections, and rest. If symptoms fail to improve, surgical intervention, most commonly microdiscectomy, is recommended for patients refractory to at least six weeks of nonoperative management (15).

In the treatment of LDH, conservative approaches are generally the first choice; however, surgical intervention is indicated when symptoms persist despite conservative management, when progressive motor deficit develops, or when cauda equina syndrome due to nerve root compression occurs. In such cases, the most frequently performed surgical procedure is conventional microdiscectomy (16-18).

Although various noninvasive methods have been described as alternatives to microsurgery in the treatment of LDH, microdiscectomy remains the most effective surgical technique today due to its minimally invasive features. This approach provides advantages such as a smaller incision, minimal subperiosteal muscle dissection, adequate exposure, and reduced blood loss (5).

In our study, dural injury was observed more frequently at the L4–L5 level compared with the L5–S1 level. This difference may be explained by several anatomical and biomechanical factors. The L4–L5 segment represents the most mobile level of the lumbar spine and is the most frequently affected segment in LDH. Degenerative changes, hypertrophy of the ligamentum flavum, and adhesions between the dura mater and surrounding structures may be more pronounced at this level. These conditions can increase surgical difficulty during microdiscectomy and may consequently increase the risk of incidental dural tears. In addition, the higher number of surgeries performed at the L4–L5 level may also contribute to the increased incidence observed in this study.

Lumbar microdiscectomy is widely regarded as a safe and effective procedure; however, complications can occur. One of the most common complications is wrong-level surgery, which can be minimized with proper preoperative planning. Other intraoperative complications, such as dural injury and excessive bleeding, occur less frequently. The most severe complications, though rare, include major vascular and visceral injuries. Additional reported complications include recurrent disc herniation, new-level disc herniation, progressive motor deficits, dural tears and cerebrospinal fluid (CSF) fistulas, superficial and deep wound infections, spinal headaches, and others (18–21).

Unintended dural tears are among the most frequent complications of spinal surgery, with highly variable reported incidences. The frequency of dural injury during spinal procedures has been reported to range between 0.4% and 15.8% (7). The incidence of incidental durotomy is between 0.3% and 13%, and the risk increases up to 18% in reoperations. The risk of CSF fistula requiring surgical repair is approximately 1 in 10.000. Pseudomeningocele has been reported at a rate of 0.7–2%. When a dural opening occurs, CSF leakage may result in pseudomeningocele or CSF fistula. Nerve roots may herniate through the dural defect, leading to contusion, laceration, or cauda equina injury. CSF leakage can cause collapse of the thecal sac and result in epidural hematoma. Less commonly, arachnoiditis, chronic pain, and bladder, bowel, or sexual dysfunction may occur (22).

In our study, the incidence of dural injury following microdiscectomy was not statistically significant and was within acceptable limits. Most studies on dural injury in the literature are multicenter and include all types of spinal procedures. However, studies focusing specifically on single-center cohorts undergoing single-level, unilateral microdiscectomy are extremely limited. A strength of our study is that all cases were performed at a single institution and included only patients with single-level and unilateral lumbar microdiscectomy, thereby providing more reliable outcomes regarding dural injury. These findings are consistent with previous studies reporting that L4–L5 is the most frequently involved level in LDH surgery. All intraoperative dural injuries were identified during surgery and managed appropriately, and no postoperative cerebrospinal fluid fistula requiring reoperation was observed.

The limitations of our study include its single-center design, the limited number of patients, and the exclusion of cases operated for other spinal pathologies.

Overall, it should be emphasized that such complications may negatively affect surgical outcomes. To minimize complications during lumbar microdiscectomy, careful preoperative planning is essential, meticulous dissection should be performed intraoperatively, and close postoperative monitoring is required. In cases where complications occur, early diagnosis and prompt treatment are crucial (17,20).

Despite the relatively small sample size, our study provides focused data on dural injury specifically in patients undergoing single-level and unilateral lumbar microdiscectomy. Many previously published studies include heterogeneous spinal procedures or multicenter cohorts, which may introduce variability in surgical indications and complication profiles. By limiting our analysis to a homogeneous patient population within a single institution, we aimed to provide a clearer evaluation of dural injury rates in standard microdiscectomy practice.

CONCLUSION

In our study, the incidence of dural injury following microdiscectomy remained within acceptable limits and did not reach statistical significance. To obtain definitive and reliable results, further long-term, large-scale clinical studies together with randomized controlled trials are required. Although some complications may occur during lumbar microdiscectomy, the most effective way to prevent them is meticulous attention before, during, and after surgery. In the event of a complication, treatment should be initiated promptly in the postoperative period.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that there is no financial support.

Ethical Approval
The study protocol received approval from the Yalova University Non-Interventional Clinical Research Ethics Committee (Approval no: 2025/269, 25.06.2025).

Patient Consent
Not necessary for this manuscript.

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