J Turk Spinal Surg 2024;35(1):19-23
DOI: 10.4274/jtss.galenos.2024.63634

DECOMPRESSION WITH INSTRUMENTATION IN THE TREATMENT OF UPPER-LEVEL DISC HERNIATIONS

Zeki Boğa, Semih Kıvanç Olguner, Yurdal Gezercan

Adana City Training and Research Hospital, Department of Neurosurgery, Adana, Turkey

ABSTRACT

Objective: The aim of this study was to compare the results of microdiskectomy + fusion and microdiskectomy + dynamic instrumentation, which are 2 different methods used for treating upper-level lumbar disk herniations, and to share the data obtained with our colleagues.

Materials and Methods: In this study, 51 patients who underwent surgery for upper-level disk herniation between 2019 and 2021 were retrospectively analyzed. The study group was divided into two groups. Patients who underwent microdiscectomy with fusion and those who underwent microdiscectomy with dynamic instrumentation were examined. In both groups, demographic data, such as age and gender, as well as quality of life scores, such as preoperative visual pain scoring and Oswestry disability index, etc. were examined and compared with the postoperative values at the end of 1 year. Complications were noted.

Results: There was no significant difference between both groups in terms of gender and age distribution (p=0.676, p=0.992). After 1 year of follow-up, both groups showed significant improvement in both the back-leg visual pain score and Oswestry disability values. When back-leg visual pain and Oswestry disability score change between the groups were analyzed, there was no significant difference in terms of pain, whereas Oswestry disability change was better in the fusion group (p=0.76, p=0.354, p=0.037 respectively). Complications were observed in 7 (13.7%) patients, and superficial wound infection was the most common complication in five (71.4%) patients. Dural tears and hematomas were detected in one patient each. None of the patients required revision surgery.

Conclusion: Both techniques can be used for treating upper-level disk herniations. After one year of follow-up, we believe that there is no significant difference between the two groups, although the fusion group appears to be superior in terms of ODI recovery.

Keywords: Dynamic instrumentation, posterior fusion, upper-level disk herniation

INTRODUCTION

Lumbar disc herniation is one of the most common pathologies encountered by spine surgeons. Medical and conservative treatments are applied in treatment strategies primarily. Different surgical treatment strategies ranging from minimally invasive surgery to instrumented fusion surgery are applied in cases that do not respond to conservative treatment. Many variable parameters play a role in the surgical method to be chosen. In addition to the patients' age, the level and location of the pathology in the lumbar region are decisive at this point. As a matter of fact, the treatment of upper lumbar disc herniations and lower lumbar disc herniations may be different[1-4]. When we review the literature, it can be easily evaluated as lower lumbar disc herniation for L4-5 and L5-S1 levels and upper lumbar disc herniation for L1-2 and L2-3 levels[4]. However, there is no definite consensus for the L3-4 level[4]. Considering the placement of the facet joints and the apex of the lumbar region, some sources describe this level as a gray zone and state that its anatomical features are more similar to the upper lumbar region[4]. In our practice, we consider the L3-4 region as the upper level and apply our surgical strategy in this context. Decompression with microdiscectomy, endoscopic surgery, hybrid instrumentation applications, and fusion surgery are the applied methods for upper-level lumbar disc herniations[4-11]. In this study, we aimed to compare the clinical results of 2 different methods, microdiscectomy + unilateral posterior instrumentation + fusion (MDPF) and microdiscectomy + unilateral dynamic instrumentation (MDD), and to share the information we obtained with our colleagues.

MATERIALS AND METHODS

This study had been carried out in accordance with principles of the Declaration of Helsinki, informed patient consent was granted from all patients and approved by the Ethics Committee of Adana City Training and Research Hospital (136/2846).

In this study, patients operated between 2019 and 2021 for upper-level disc herniation were retrospectively analyzed. Inclusion criteria for the study: Adult patients who were operated for the first time for single-level upper disc herniation and underwent instrumentation. The surgical decision was made according to magnetic resonance imaging. Surgery was

Address for Correspondence: Semih Kıvanç Olguner, Adana City Training and Research Hospital, Department of Neurosurgery, Adana, Turkey
Phone: +90 532 100 62 12 **E-mail:** kivanc3olguner@hotmail.com **Received:** 30.08.2023 **Accepted:** 11.01.2024
ORCID ID: orcid.org/0000-0002-5314-4636

recommended for patients who did not respond to conservative treatment lasting longer than 6 months or who had a loss of motor strength. Patients were randomly selected according to which procedure to perform. Patients who were under 18 years of age, who underwent recurrent lumbar disc surgery or who underwent only decompression were excluded from the study. Patients who underwent MDPF and MDD were divided into 2 groups. All operations were performed by the same senior spine surgeon. The sequence of surgical procedures performed was similar in both groups. In the MDPF group, a microdiscectomy was performed after pedicle screws were placed, and a titanium rod was used (Figure 1). Posterolateral grafting was performed with autografts obtained from the area. In the MDD group, the same surgical algorithm was followed and polyetheretherketone (PEEK) rods were used instead of titanium rods (Figure 2). Posterolateral grafting was not performed in the MDD group. In both groups, demographic data such as age, and gender, as well as quality of life scores such as preoperative visual pain scoring, Oswestry disability index were examined and compared with the postoperative values at the end of 1 year. Complications were noted. All the assessors and patients were blinded to the procedure at follow-up.

Statistical Analysis

Statistical Package for the Social Sciences (SPSS) 25.0 package program was used for statistical analysis of the data. Categorical measurements were presented as numbers and percentages, and continuous measurements were summarized as mean and standard deviation [median (mean) or minimum-maximum, as appropriate]. Chi-square and Fisher's exact tests were used for comparisons of categorical expressions. Kolmogorov-Smirnov test was used to determine whether the parameters in the study showed normal distribution. For parameters that did not show normal distribution, Mann-Whitney U tests were used. The statistical significance level was taken as 0.05 in all tests.

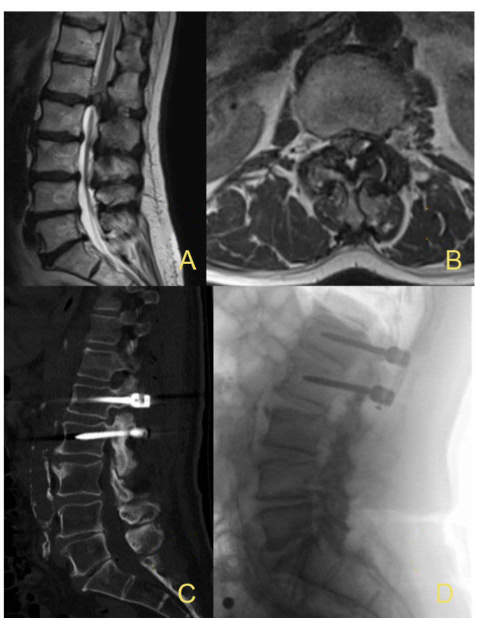

Figure 1. Images of a patient with L2-3 right posteromedial disc herniation, **A)** preoperative sagittal MRI, **B)** preoperative axial section of MRI, **C)** posterior fusion and titanium rod instrumentation is observed in postoperative coronal CT, **D)** axial section of pedicle inserted screw on CT
MRI: Magnetic resonance imaging, CT: Computed tomography

RESULTS

Twenty-six in the MDPF group and 25 in the MDD group, a total of 51 patients were included in the study. The mean age of the patients was 48.9±9.7 years, and 26 (51%) of them were female and 25 (49%) of them were male. The level distribution was L1-2 in 12 (23.5%), L2-3 in 14 (27.5%), and L3-4 in 25 (49%) patients, respectively. There was no significant difference between both groups in terms of gender and age distribution (p=0.676, p=0.992) (Table 1).

After 1-year follow-up, significant improvement was observed in both back-leg VAS and ODI values in both groups. When the back-leg VAS and ODI changes between the groups were analyzed, there was no significant difference in terms of VAS, while ODI change was better in the MDPF group (p=0.76, p=0.354, p=0.037 respectively). Complications were observed in 7 (13.7%) patients and superficial wound infection was the most common complication in 5 patients (71.4%). Dural tear and haematoma were detected in one patient each. None of the patients required revision surgery. Patients with superficial wound infection were treated with appropriate antibiotherapy.

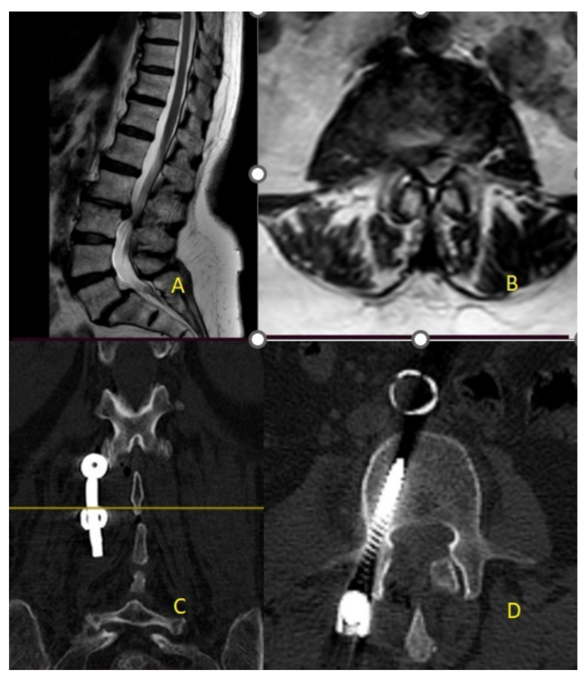

Figure 2. Images of a patient with L1-2 left posteromedial disc herniation, **A)** preoperative sagittal MRI, **B)** preoperative axial section of MRI, **C)** posterior dynamic peek rod instrumentation is observed on postoperative sagittal CT, **D)** lateral view of instrumentation on X-ray
MRI: Magnetic resonance imaging, CT: Computed tomography

Table 1. Comparison of patient data between groups

	MDPF (n=26)	MDD (n=25)	Total (n=51)	p-value
Gender [n (%)]				
Female	14 (53.8)	12 (48)	26 (51)	0.676
Male	12 (46.2)	13 (52)	25 (49)	
Level [n (%)]				
L1-2	7 (26.9)	5 (20)	12 (23.5)	0.838
L2-3	7 (26.9)	7 (28)	14 (27.5)	
L3-4	12 (46.2)	13 (52)	25 (49)	
Complication [n (%)]	4 (15.4)	3 (12)	7 (13.7)	0.725
Age (Mean ± SD)	48.8±9.0	49.2±10.5	48.9±9.7	0.992
Preop back VAS (Mean ± SD)	5.12±1.7	4.68±1.3	4.90±1.5	0.312
Postop back VAS (Mean ± SD)	2.50±1.1	2.24±1.0	2.37±1.1	0.464
Preop leg VAS (Mean ± SD)	8.04±1.1	8.44±1.0	8.24±1.1	0.186
Postop leg VAS (Mean ± SD)	2.58±1.3	2.48±1.4	2.53±1.3	0.816
Preop ODI (Mean ± SD)	62.4±10.9	53.9±13.3	58.2±12.8	0.016*
Postop ODI (Mean ± SD)	19.0±8.4	18.2±8.4	18.6±8.3	0.755
ΔBack VAS	-2.61±2.0	-2.44±1.6	-2.52±1.8	0.760
ΔLeg VAS	-5.46±1.8	-5.96±1.7	-5.70±1.8	0.354
ΔDelta ODI	-43.4±12.6	-35.8±13.5	-39.6±13.5	**0.037***

*p<0.05, a: Chi-square and Fisher's exact, b: Mann-Whitney U, Δ: Change of parameters at the end of 1 year, MDPF: Microdiscectomy + unilateral posterior instrumentation + fusion, MDD: Microdiscectomy + unilateral dynamic instrumentation, SD: Standard, VAS: Visual Analog Scale

Table 2. Distribution of complications between groups

	MDPF	MDD
Superficial wound infection	3	2
CSF fistula	1	-
Haemotoma	-	1

MDPF: Microdiscectomy + unilateral posterior instrumentation + fusion, MDD: Microdiscectomy + unilateral dynamic instrumentation, CSF: Cerebrospinal fluid fistula

There was no statistical difference in terms of complications between the groups and no implant-related complications were observed (p=0.725) (Table 2). At the end of 1-year follow-up, no recurrent disc herniation was observed in both groups.

DISCUSSION

Upper-level lumbar disc herniations are encountered more rarely than distal-level disc herniations (L4-5, L5-S1)[3]. However, it can create similar symptoms like distal level disc herniations by causing back pain and radicular findings. Urinary problems are observed more frequently due to its proximity to the conus medullaris[8]. Conservative treatments are the primary choice in patients without neurological deficit. However, surgical interventions are performed in the presence of loss of muscle strength and severe neural compression. It is worth mentioning a few important points here. In the treatment of upper-level lumbar disc herniations, the anatomical differences of the lumbar region from distal to proximal should be known. The close neighborhood of the conus medullaris and the smaller diameter of the spinal canal in the upper lumbar region necessitates the application of different surgical options[3,9]. The orientation of the facet joints varies as they move from the distal to the proximal. In the thoracic region, facet joints that are sagittally positioned at lower lumbar levels are oriented coronally[12]. At the transition from the lower lumbar region to the upper lumbar and thoracolumbar regions, the facet joints are actually in an anatomical transition zone. Therefore, in the surgical treatment of upper lumbar disc herniation, in the presence of a broad-based herniation, more than 50% of the facet joint may unintentionally be resected, which can lead to segmental instability[4,9]. In this context, we apply unilateral instrumentation in addition to microdiscectomy in our surgical strategy to prevent both instability and recurrent disc herniations. In this study, we compared the results of two different instrumentation we applied.

MDPF and MDH are technically similar methods. In fusion surgery, a titanium rod is used, and posterolateral grafting is performed for fusion, while in the hybrid method, a PEEK rod is used, and no grafting was performed. While motion-preserving surgery is aimed with PEEK rods[5,6], fusion is intended with MDPF. Both methods are known in the literature as treatment strategies that have been applied for many years[5,13-15]. In the study on lumbar disc herniations by Sezer and Acikalin[16], 20 patients who underwent unilateral dynamic instrumentation showed significant improvement in both VAS and ODI scores at the end of 1 year. In a study on lumbar disc herniations and various spinal pathologies by Karakoyun et al.[17], they reported the results of unilateral dynamic instrumentation and reported a significant decrease in VAS and ODI scores at the end of 1 year. And in the study of Bozkus et al.[18], patients who underwent decompression and unilateral facetectomy for various spinal pathologies underwent unilateral dynamic instrumentation, and significant improvement reported in ODI and VAS scores at the end of 12 months (p<0.01). In our study, in addition to the above data, significant improvement was observed in both VAS scores and ODI scores at the end of 1 year in the MDD group.

We think that applying fusion along with decompression in upper-level disc herniations may prevent the development of instability and reduce the recurrence rate[9]. As a matter of fact, in the study of Sanderson et al.[1], 11 out of 19 patients (58%) who underwent surgery at the L1-2 and L2-3 levels had previously undergone surgery in the same area. In the same study, fusion was performed on 4 patients (20%) and 4 patients (20%) required re-operation at a later time[1]. In another study, unilateral fusion surgery was performed for broad-based disc herniations, and the patients' ODI score decreased from 68.74±8.99 to 24.17±7.55 one year after the surgery[19].

In the study of Lin et al.[9], patients who underwent only decompression and those who underwent decompression+fusion were divided into 2 groups. At the end of the study, patients who underwent decompression with fusion had a significant improvement in ODI scores and higher satisfaction rates (p=0.034).

In our study, we found similar results to those mentioned above. At the end of a year, we achieved improvement in both VAS and ODI scores. When we made an evaluation between the groups, we did not find any significant statistical difference related to back and leg VAS change (p=0.750, p=0.354 respectively). When ODI scores were examined, ODI values were found to be similar at the end of 1 year in both groups (19.0±8.4 18.2±8.4). However, regarding the ODI change, we observed that the improvement was statistically better in the MDD group (p=0.037). We believe that the reason for this is that the preoperative ODI score was lower in the MDD group, thus a mathematical difference occurred. Nevertheless, studies in large groups may provide a more objective opinion.

Study Limitations

The limitation of our study is that it was a retrospective study, the follow-up period was short, and the group was small. Nevertheless, we think that the comparison of 2 different surgical techniques in a rare pathology will contribute to the literature.

CONCLUSION

As a result, both techniques can be used in the treatment of upper-level disc herniations. After one year of follow-up, we believe that although the fusion group was superior in terms of ODI recovery, there was no significant difference between the two groups.

Ethics

Ethics Committee Approval: This study had been carried out in accordance with principles of the Declaration of Helsinki, and approved by the Ethics Committee of Adana City Training and Research Hospital (136/2846).

Informed Consent: Informed patient consent was granted from all patients.

Authorship Contributions

Surgical and Medical Practices: Z.B., S.K.O., Y.G., Concept: Z.B., S.K.O., Y.G., Design: Z.B., S.K.O., Y.G., Data Collection or Processing: Z.B., S.K.O., Y.G., Analysis or Interpretation: Z.B., S.K.O., Y.G., Literature Search: Z.B., S.K.O., Y.G., Writing: Z.B., S.K.O., Y.G.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study received no financial support.

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