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Title: Open Discectomy vs. Microdiscectomy: Results from 519 Patients Operated for Lumbar Disc Herniation

Authors: Cagatay Calikoglu, Murteza Cakir

Institution: Department of Neurosurgery, Atatürk University School of Medicine, Erzurum, Turkey

Correspondence to: Cagatay Calikoglu, dr.cagatay33@gmail.com

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Abstract

Objective: The aim of this study was to evaluate the outcomes of patients with lumbar disk hernia operated between 2012 and 2017 and to compare the differences between open discectomy (OD) and microdiscectomy (MD).

Materials and Methods: Files of 519 patients who presented at our neurosurgical department with lumbar disk herniation were retrospectively reviewed and recorded. Preoperatively, all patients routinely underwent spinal lumbar magnetic resonance imaging (MRI) and anteroposterior as well as lateral lumbar vertebrae X-rays. During the early postoperative period, there was no need for imaging. Surgical interventions were performed using the two currently accepted OD and MD methods.

Results: We reviewed 519 patients with lumbar disk herniation who were operated in our clinic between 2012 and 2017. The mean age of 276 patients who underwent OD was 44.85±9.92 y, and that of the remaining 243 patients who underwent MD was 47.69±12.87 y. There was no difference

in the demographic distributions of patients; levels of lumbar disk herniations; postoperative clinical outcomes; and long-term reoperation rates due to root injury, wound infection, dural tear, or the recurrence of lumbar disk herniation ($p>0.05$). The duration of operation was significantly shorter for OD (37.82±7.15 vs. 49.07±6.88 min; $t=-18.184$, $p<0.001$).

Conclusion: The long-term results of patients who underwent OD and MD for lumbar disk herniation were similar. We believe that both methods can be safely used under appropriate conditions and surgical experience and that surgical experience has an impact on their outcomes.

Key words: Lumbar disk herniation; microdiscectomy; open discectomy

Introduction

The incidence of lumbar disc herniation (LDH) has varied between studies [1–3]. The incidence of back pain in a population has been reported to be roughly around 60% and that of sciatica has been reported to be 1% [1]. In 1934, Mixter and Barr [3] described disk disease causing neural compression for the first time, and in 1970, with the introduction of microscopy, microdiscectomy (MD) operations were started [4]. Currently, MD constitutes the standard treatment method for LDH. The MD method produces less tissue damage than conventional open discectomy (OD) and, thus, leads to less epidural fibrosis, postoperative back pain, radicular pain, and segmental instability [4–7]. Recently, with improvements in endoscopy, a more minimally invasive microendoscopic discectomy (MED) method has begun to be used. Although microsurgery and sequestrectomy have been suggested to be advantageous in early-stage comparisons in selected cases, several other studies have not found significant differences in the long-term follow-ups [8, 9].

Microscopy offers a better visual field and illumination and a better recognition of neural tissue and disk material. The advantage of OD is that there is more accumulated experience with it, no additional endoscope or microscope is needed, and the duration of the learning curve and of the operation is shorter [6–8].

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The aim of this study was to evaluate the demographic features and outcomes of our patients operated between 2012 and 2017 and to compare the differences between the OD and MD methods.

Materials and Methods

Files of patients operated at our neurosurgery clinic due to LDH were retrospectively reviewed and recorded. This study was approved by the local ethics committee. Patients in whom simple discectomy was conducted with or without microscope were included, whereas those in whom simple discectomy was conducted using some type of instrumentation were excluded.

Preoperatively, all patients routinely underwent spinal lumbar MRI and anteroposterior as well as lateral lumbar vertebrae X-rays. During the early postoperative period, there was no need for imaging. Surgical treatment was applied to patients whose complains did not resolve or even increased despite medical and physical therapy for at least 4 weeks. Surgical interventions were performed using the two currently accepted OD and MD methods.

Patients were taken to the operating table, where, in the prone position, the herniation level was determined using fluoroscopy and the lamina and interlaminar spaces of the related herniation were exposed, followed by midline median skin and fascia incision and the retraction of the paravertebral tissues.

From this stage in OD, using a curette, the ligamentum flavum was retracted and dropped from the insertion point to the lamina, the spinal cord and nerve roots were seen after partial laminectomy and removal of the ligamentum flavum, and the nerve root was made completely visible after opening the foramen. After gentle medial retraction using a nerve hook, the disc material was removed, posterior longitudinal ligament was opened, and degenerative disc contents were removed. After checking the epidural space, the layers were appropriately closed.

In MD operations, the microscope was brought close to the field, the ligamentum flavum was removed using a curette, a minimal laminectomy was conducted, and the ligamentum flavum was opened by cutting from the lateral side and then minimally removed from the medial facet. The spinal cord was not seen because it was covered with ligamentum flavum, but the lateral nerve root was easily seen, the foramen was opened by foraminectomy, the root was retracted to the medial

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side using a nerve hook, and the disc contents were removed. The posterior longitudinal ligament was opened and degenerated disks in the space were removed. After checking the epidural space, the layers were appropriately closed. During the operation, epidural fat tissues remaining under the flavum were not damaged.

During the postoperative period, the continuation of patients' pain, sensory symptoms, and motor losses were monitored.

Statistical analysis

Statistical analyses were performed with SPSS version 24. Numerical variables were presented as mean±standard deviation (SD), and categorical variables were expressed as n(%). Bivariate comparisons were performed using the Student's t-test and the chi-squared tests where applicable. A logistic regression analysis was performed to check for factors independently affecting reoperation risk. $p<0.05$ was considered significant.

Results

We reviewed 519 patients with LDH who were operated in our clinic between 2011 and 2017. The mean age of 276 patients who underwent OD was 44.85±9.92 y (range, 27–67 y), whereas that of the remaining 243 patients who underwent MD was 47.69±12.87 y (range, 18–80 y). Patients who undergoing MD were significantly older (t=−2.786; p=0.006).

The L4–5 and L5–S1 spaces were the most common disk herniation spaces affected in patients in both groups. In OD, the L5–S1 space was affected in 136 (49.3%) patients and the L5–S1 space was affected in 96 (34.8%). In MD, the L4–5 segment was affected in 123 (50.6%) patients and the L5–S1 space was affected in 80 (32.9%). In contrast, a total of 48 patients had two-level lumbar disk herniations. Again, the two most frequently affected segments were the L4–5 and L5–S1 (Table 1).

When sciatica complaints were evaluated, right and left sciatica were seen in 122 (44.2%) and 150 (54.3%) patients, respectively, in the OD group and in 103 (42.4%) and 140 (57.6%) patients, respectively, in the MD group. There was no significant difference between the two groups (chi-square=3.867; p=0.145).

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According to the MRI scans, median/paramedian disk herniation was present in 268 (97.1%) patients in the OD group and in 211 (86.8%) patients in the MD group. A total of 40 patients had far lateral disk herniation (Table 1).

A total of 19 (6.9%) patients with OD and 23 (9.5%) with MD were re-operated because of recurrent disk herniation. This difference between the two methods was not statistically significant (chi-square=1.157; p=0.282).

Only one patient had a root injury, and paresis occurred in the ankle during the postoperative period. Dural injury occurred in four (1.4%) patients in the OD group and in eight (3.3%) patients in the MD group.

In the postoperative period, eight (2.9%) patients in the OD group and eight (3.3%) in the MD group had wound infections. However, no significant difference was found between the two groups in terms of all complications (chi-square=2.031; p=0.362).

The mean duration of OD operations was 37.83±7.15 min and that of MD operations was 49.07±6.88 min, the difference being statistically significant (t=−18.184; p<0.001; Table 2).

Recurrence rates were more common among males and younger patients (Table3). A logistic regression model was built to check for the combined effects of the studied factors on disease recurrence by including the following variables: age (numerical), sex (1=female, 2=male), and surgical method (1=OD, 2=MD). The regression analysis demonstrated that sex (p=0.009; odds ratio=2.78; 95% CI: 1.28–6.01) and age (p=0.025; odds ratio=0.96; 95% CI: 0.93–0.99) were related with reoperation rates independent of the surgical method (p=0.121) applied.

Discussion

In our study, the preoperative evaluations of patients in both groups were performed in the same manner, and no differences were observed in terms of age, symptoms, and findings. The mean duration of operation was shorter for OD. In both the OD and MD groups, the L4–5 and L5–S1 were the most frequently affected segments. We found that median and paramedian disks were more frequently encountered. There was no significant difference between the two groups with regard to

the preoperative dural tears and nerve root injuries. In addition, no statistical difference was found in the postoperative complication rates.

Thome et al. have reported, in their study that compared microdiscectomic sequestrectomy and OD, similar recurrence rates in back pain symptoms in both groups, with 10% in OD patients and 5% in MD patients at the end of 18 months during the early postoperative period. During the first 4–6 months, MD patients showed significantly better Prolo Scale and Short Form (SF)-36 subscale scores; thus, they concluded that MD was advantageous in the short-term follow-up [8].

Caspar noted, in 1977, that the broad opening used for classical MD until that day and the procedure of exploring at least two sub-segments was unnecessary and harmful and that microsurgery caused lesser tissue damage. He also mentioned the importance of the experience of surgeons and the need to treat the tissues as gently as possible [4]. In another comparative study in 1991, MD was found to be definitely advantageous in all aspects, such as lesser tissue damage, less blood loss, less bed rest, quick mobilization, and return to work [5]. Also, in our classical discectomies, we do not make large incisions to see the upper and lower levels, as criticized by Caspar, and the courtesy to neural tissues is kept at the highest level. Probably for this reason, we did not find any significant difference in the long-term results.

In our study, we identified the L4–5 and L5–S1 segments as the most frequently affected LDH segments, which is consistent with other studies [1, 9].

In the prospective randomized study by Katayama et al. [10], no difference was found between the results of classical and MD operations performed by the same surgeon and the need to use painkillers, which is consistent with our results.

Schmid et al. [9] compared MD and OD in their study and found that the duration of OD was shorter and that the length of hospital stay was significantly shorter in MD, but they found no difference in terms of pre- and postoperative complications. There was no significant difference in the pre- and postoperative complications between the two groups in our study. Similarly, we could not detect any difference between the two methods, except the advantage of the duration of operation.

In the study by Phan et al. [11], 23 large and comprehensive studies were evaluated and full endoscopic discectomy (FED), MD, and OD results were compared. Clinical outcomes were assessed

using the visual analog scale and the Oswestry index (OSI) scales, with similar results observed between FED and OD as well as between MD and OD, without any significant differences between the groups. Furthermore, when all complications (recurrence, wound infections, nerve damage, and dural injury) were evaluated both pre- and postoperatively, no difference was observed between the groups. Similarly, no difference has been observed in the clinical results of several other comparative studies. However, it has been reported that MED provides a serious advantage in terms of less paravertebral tissue traumatization, less blood loss, less bed rest, and persistent back pain [11–13].

Despite the relatively long duration of MD operation, Ryang et al. have reported mildly better blood loss, lesser tissue damage and complications, and significantly better clinical outcomes [14].

Henriksen et al. have reported, in a controlled and prospective study, that the reduction of the fascial incision and muscle dissection by a mean of 70–31 mm did not shorten the length of hospital stay and that there was no effect on the postoperative morbidity [15].

In our long-term study, 19 (6.9%) patients in the OD group and 23 (9.3%) in the MD group were re-operated because of recurrence. In a 4-year follow-up, Schmid et al. [9] have reported the same figures as 12.4% and 11.3%, respectively. In addition, Weinstein et al. have reported a recurrence rate of 10% at the end of 4 years [16]. Because patients in the MD group were significantly older, one can claim that reoperation rates change after age adjustment. However, the logistic regression analysis did not reveal such an effect.

In our study, preoperative dural rupture was 1.4% for OD and 3.3% for MD. The mean values were similar in the literature (OD, 1.8%–2.7% and MD, 3%–5.7%) [9, 16–18]. Thus, in accordance with the literature, the complication of dural tear is less common. We believe that this is due to the increased experience in the use of microscopes.

Wound infection rates were 2.9% in the OD group and 3.3% in the MD group in our study. Schmid et al. [9] have reported wound infection rates of 2.7% and 3.3% in the OD and MD groups, respectively. Similar results were found in other studies, and no differences were observed between the two groups [17, 18].

In this study, patients who underwent OD and MD in our clinic were evaluated, and no difference was observed between patients in the two groups in terms of clinical outcomes, complications, and

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re-operations due to recurrence. However, we should particularly mention that because neurosurgeons are more accustomed to using microscopes, they have started performing surgery with as little incision as that used during OD operations, and with increasing experience over the years, they have started to move away from wide incisions that have been criticized by Caspar. For all ODs, incisions are made as small as possible and minimally invasive approaches are used. Because no significant difference was observed between both methods in our study, we believe that it is appropriate to use both methods in disk surgery.

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Table 1: Demographics of patients and comparison between OD and MD

	OD (n=276)	MD (n=243)	Chi-square/t; p
Sex			9.152; **0.002**
Male	176 (63.8%)	123 (50.6%)	
Female	100 (36.2%)	120 (49.4%)	
Mean Age, years	44.85±9.92	47.69±12.87	2.286; **0.006**
Level			21.697; **0.001**
L2–3	4 (1.4%)	-	
L3–4	8 (2.9%)	24 (9.9%)	
L4–5	136 (49.3%)	123 (50.6%)	
L5–S1	96 (34.8%)	80 (32.95%)	
L2–3/L3–4	4 (1.4%)	-	
L3–4/L4–5	4 (1.4%)	-	
L4–5/L5–S1	24 (8.7%)	16 (6.6%)	
Pain Localization			3.867; 0.145
Right	122 (44.2%)	103 (42.4%)	
Left	150 (54.3%)	140 (57.6%)	
Bilateral	4 (1.4%)	0	
Disc Localization			19.162; **<0.001**
Median/paramedian	268 (97.1%)	211 (86.8%)	
Far lateral	8 (2.9%)	32 (13.2%)	

OD: open discectomy, MD: microdiscectomy

Table 2: Comparison of complications and duration of operation between the two groups

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	OD (n=276)	MD (n=243)	Chi-Square/t; p
Reoperation rate	19 (6.9%)	23 (9.5%)	1.157; 0.282
Root injury	-	1 (0.4%)	Unavailable
Dural tear	4 (1.4%)	8 (3.3%)	2.031; 0.362
Wound infection	8 (52.9%)	8 (3.3%)	
Duration of operation, min	37.83±7.15	49.07±6.88	t=18.184; <0.001

OD: open discectomy, MD: microdiscectomy

Table 3: Association of different factors with reoperation

	Re-operated						
	No		Yes		Total		
	n	%	n	%	n	Chi-square/t	p
Age (mean±SD)	46,56±11,74		42,26±7,35			2.328	**0.020**
Sex							
Male	266	89,0	33	11,0	299	8,221	**0,004**
Female	211	95,9	9	4,1	220		
Disc Level							
Only L3/L4	31	96,9	1	3,1	32	1,666	0,435
Only L4/L5	235	90,7	24	9,3	259		
Other	211	92,5	17	7,5	228		
Pain Side							
Right	207	92,0	18	8,0	225	0,368	0,832
Left	266	91,7	24	8,3	290		
Bilateral	4	100,0	0	0,0	4		
Surgical Method							
OD	257	93,1	19	6,9	276	1,157	0,282
MD	220	90,5	23	9,5	243		
Disc Localization							

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Median/paramedian	440	91,9	39	8,1	479	0,020		0,886
Far lateral	37	92,5	3	7,5	40			

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