Original Article
Neurosurgery

Medical Journal of Islamic World Academy of Sciences
doi: 10.5505/ias.2023.90187 2023;30(1): 12-16

Endoscopic microdiscectomy and open discectomy for lumbar disk herniation: experience of 898 patients

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ABSTRACT

Low back pain is one of the most common problems in society. Although it has many causes, degenerative back pathologies may be a key contributor. Low back pain may be a common symptom in patients with lumbar disk herniation, affecting the quality of life of most patients. Lower back and leg pain that do not respond to medical treatment and continue for a long time, accompanied by weakness in the legs, are surgical causes in herniated disk pathologies.

Microendoscopic microdiscectomy and open surgery are the two different surgical treatment methods. The surgical approach is determined by the surgeon's experience, current technical capacity, and patient-related factors. The most preferred surgical method for many years has been the open surgery method. However, microendoscopic microdiscectomy is also becoming widespread due to recent research and the increasing experience of surgeons.

This study compared the aforementioned surgical methods and found that they yielded similar results. The complication rates of microendoscopic discectomy may decrease with increasing surgical experience when widely used. The advantages of microendoscopic discectomy are as follows: a short operation time, a clear view of the operating field using a 30° telescope, shorter length of stay, earlier mobilization and return to work, and lower infection rates.

Keywords: Microendoscopic discectomy, minimally invasive surgery, open surgery

INTRODUCTION

An estimated 60%–80% of people suffer from back pain at least once in their lifetime (1,2). Lumbar disk herniation is a surgical pathology and one of the reasons for discogenic back pain. Surgical intervention should be considered for patients unresponsive to conventional therapies for 6 weeks or who have experienced progressive neurological deficits. Currently, surgical treatment modalities are generalized as open discectomy (OD) and minimally invasive surgeries. Minimally invasive surgeries include microdiscectomy, microendoscopic discectomy (MED), and percutaneous endoscopic discectomy.

Following the introduction of microscopes into the neurosurgical field, Yaşargil and Caspar were among the first to perform and publish research on minimally invasive surgeries (7,12). MED was first described by Foley and Smith as a minimally invasive endoscopic method for nerve decompression (5). In 1997, the METRx system was developed. Foley et al. modified the tubular retractor incorporated into the METRx system and made it available for microscopic and endoscopic use in 2003. Three most used tubular retraction systems are the METRx tubular system, the Destandau endoscopic system, and the Easy Go spinal endoscopic system.

Until recently, OD was the method of choice for patients with surgical indications. Despite neurologic and functional improvement after OD, damage to paraspinal muscles, connective tissue, and ligamentum flavum causes complications during the postoperative period and the recovery time is prolonged. MED has gained popularity as an alternative, and is considered as a less invasive treatment modality. This minimally invasive method decreases paraspinal muscle damage, and its clinical outcomes are comparable with other surgical methods. Some surgeons are reluctant to use this operative technique due to the long learning process and difficulty in adjusting to two-dimensional image through monitor. Intraoperative radiation exposure and expensive systems are other disadvantages of MED.

This study compared the results of OD and MED techniques performed by two surgeons at two different centers. A total of 898 patients who underwent only endoscopic microdiscectomy in one center and only open surgery in another center were compared retrospectively.

MATERIALS AND METHODS

All patients were treated by two surgeons, either with MED or OD, between 2017 and 2022. Pediatric patients and patients with severe comorbidities, such as cancer, psychiatric disturbances, bleeding disorders, and previous lumbar hernia surgery, were excluded.

Statistical analyses were conducted using SPSS version 25.0 (IBM). The normality of data was evaluated before comparative analyses. The Shapiro–Wilk test was used to test the normality, and the rest of the tests were conducted accordingly. The frequency and mean (with standard deviation) were used to describe categorical and continuous data. The Mann–Whitney U test was used to compare variables not normally distributed. For normally distributed continuous variables, the independent-samples *t* test was used. Categorical data were compared using the chi-square tests.

In one clinic, the Easy Go system was used. Regardless of the type of the system used, patient positioning, preparation of the OR, and positioning of the tubular retractor system are all similar. The Easy Go system comprised a 30° Hopkins 2 telescope, a high-resolution camera, tubular dilators, and a retractor. Spinal anesthesia was mostly used, and general anesthesia was also used in a minority of cases. As in classical open microdiscectomy position, the patient was placed in a prone position over a radiolucent operation table. Fat pads were put under the chest and iliac crests to release the pressure on the abdomen. A surgeon was required to stay at the side of the herniation; after adequate skin cleaning and draping, lateral fluoroscopic imaging was done using a 22-gauge spinal needle. The needle was inserted aiming the center of the targeted disk. After placing the needle, a 1.5-cm paramedian (1 cm lateral to the midline) incision was made. Before inserting retractors, another 1.5-cm incision was also made on the fascia. The smallest dilatators were inserted without passing through the muscle. Its proximal end needed to be in touch with the spinous process and aimed at the inferior end of the lamina. Subsequent dilatators with higher radii were introduced into the same incision until the aimed size was reached (14, 18, or 22 mm). A cannula was inserted through the last dilatators, and the position of this cannula was checked using a fluoroscope. If the distal end of the cannula was positioned at the inferior edge of the lamina, the foramen and the nerve rootlet were reached easily. When the placement was sufficient, the cannula was fixed to the operation table using the flexible arm. Unexperienced surgeons may use larger cannula sizes for better visualization. Connective tissue superficial to ligamentum flavum and lamina was cauterized and coagulated.

A laminectomy of 0.5 cm size was done while preserving the facet joint using a high-speed drill inferior keyhole. The ligamentum flavum was preserved to prevent epidural fibrosis postoperatively. After exposing the ligamentum flavum, flavectomy was done using a special flavum scissor. In this study, the foramen and superior parts of the inferior lamina of the patients were felt and separated using a 2-mm Kerrison rongeur. We moved cranially through a corridor medial to facet joint without dissecting the ligamentum flavum to reach the epidural space. After reaching the epidural space, the nerve root was fixated according to the position of the disk herniation and its relationship with the nerve root.

After this step, the epidural space and the foramen were checked using a hook as in the classical microdiscectomy. The intervertebral disk was emptied using special disk forceps.

The patients were mobilized after 4–6 h and discharged after 12–24 h.

After 7–10 days of bed rest at home, they could resume their active working life.

RESULTS

A total of 898 patients were enrolled in 2 different centers. Of these patients, 509 (56.7%) were treated with OD, and 389 with MED (43.3%). When sex distributions were compared, the female-to-male ratio was 1:0.8 ($P = 0.048$) in OD and MED. The mean age was 51.6 years in the OD group and 42.8 years in the MED group, and the difference was statistically significant ($P < 0.001$). Most operated levels were L4–L5 (52.5%) and L5–S1 (32.8%) in the OD group; L4–L5 (51.2%) and L5–S1 (47.6%) were also the most operated levels in the MED group. The difference in the frequency of levels between the two groups was statistically significant ($P = 0.041$). The summary of clinical and demographic data is presented in Table 1.

Table 1 Demographic and clinical data of operated patients

	Open discectomy	Microendoscopic discectomy	Significance (*P* value)
Sex (*n*, %)			
Female	255 (50.1%)	169 (43.4%)	**0.048***
Male	254 (49.9%)	220 (56.6%)	
Age (mean ± SD)	51.6 ± 13.3	42.8 ± 11.6	**<0.001***
Level (*n*, %)			
L1–L2	5 (1%)	0 (0%)	
L2–L3	28 (5.5%)	2 (0.5%)	**0.041***
L3–L4	42 (8.3%)	3 (0.8%)	
L4–L5	267 (52.5%)	199 (51.2%)	
L5–S1	167 (32.8%)	185 (47.6%)	
Recurrence (present, %)	72 (14.2%)	11 (2.8%)	**<0.001***
Pre-Op VAS (mean ± SD)	7.3 ± 0.5	7.4 ± 0.7	**<0.001***
Post-Op VAS (mean ± SD)	1.2 ± 0.5	1.1 ± 0.4	**0.001**
Change in VAS (mean ± SD)	6.0 ± 0.7	6.3 ± 0.8	**<0.001***
Blood loss (mean ± SD)	47.1 ± 8.3	9.6 ± 5.8	**<0.001***
Length of stay (mean ± SD)	25.8 ± 7.0	17.3 ± 8.5	**<0.001***
Follow-up time (Mean ± SD)	6.6 ± 3.4	8.4 ± 2.8	**<0.001***

Evaluation of the pre- and postoperative 1-day vizuel analog scale (VAS) scores revealed that the difference in VAS scores was 6 versus 6.3 in the OD and MED groups, respectively ($P = 0.001$). Intraoperative blood loss and length of stay were significantly lower in the MED group ($P < 0.001$).

Although the follow-up period was relatively longer in the MED group (6.6 vs 8.4), the recurrence rates were significantly higher in the OD group (14.2% in the OD group vs 2.8% in the MED group).

DISCUSSION

Surgical management is indicated in patients with chronic low back pain unresponsive to medical treatments or those with progressive neurological deficits. The surgical approach is determined based on surgeon's experience, available technical capacity, and patient-related factors. MED has been developed as an alternative treatment modality. The incidence of damage to the paraspinal muscle, spinal root, and connective tissue, including ligamentum flavum damage, is lower in MED, making it the foremost advantage of this surgery.

Although different factors determine the recurrence rate, success rates for MED in the literature has been reported to be around 90% and recurrence rates are approximately 5% (10). In our study, patients undergoing MED demonstrated a recurrence rate of 3%, which was comparable to the results of previous studies. On the other hand, recurrence rates for OD were as high as 14%.

Shorter hospital stays were reported for OD in previous studies. This was also correct for our study. The length of stay after OD was 17 h, which was 8 h shorter than that after OD. The reason behind shorter hospital stays in OD is because of decreased damage to the paraspinal muscle (9). Other factors associated with prompt recovery were minimal dissection of the nerve root, low amounts of bone removal, and shorter incisions (1,6,11). According to Nakagawa (3), intraoperative damage was lower after MED compared with OD. Although postoperative complications were not the main outcome in this study, we did not encounter any major complications in both patient groups. Pang et al. reported a mean 7.25 h of hospital stay after MED, which was longer compared

Table 2 Follow-up and operation data

	Open discectomy	Microendoscopic discectomy	Significance (*P* value)
Pre-Op VAS (mean ± SD)	7.3 ± 0.5	7.4 ± 0.7	**<0.001***
Post-Op VAS (mean ± SD)	1.2 ± 0.5	1.1 ± 0.4	**0.001**
Change in VAS (mean ± SD)	6.0 ± 0.7	6.3 ± 0.8	**<0.001***
Blood loss (mean ± SD)	47.1 ± 8.3	9.6 ± 5.8	**<0.001***
Length of stay (mean ± SD)	25.8 ± 7.0	17.3 ± 8.5	**<0.001***
Follow-up time (mean ± SD)	6.6 ± 3.4	8.4 ± 2.8	**<0.001***
Recurrence (present, %)	72 (14.2%)	11 (2.8%)	**<0.001***

with our cohort. This difference can be described by different cohort sizes and differences in clinical settings (public care and private care).

In the MED group, postoperative scar revision was required in two patients. Rest of the patients did not develop any kind of infective complication. Li et al. demonstrated lower complication levels after MED compared with OD, but this difference lacked statistical significance. In our study, although the complication rates of OD were not recorded, low complication rates after MED in patients demonstrated a clear advantage of MED. Song *et al.* also evaluated the clinical outcomes of MED operations. They described a 12.1% yearly complication rate for patients who underwent MED. In our study, the complication rate was less than 1%. This difference can be explained by poor descriptions of complications or differences in follow-up times. Stricter definitions of complications could increase the generalizability of our results.

Song *et al.* reported a 6% yearly recurrence rate. Although the yearly recurrence rate was not calculated in our study, the total recurrence frequency was 2.8% with a mean 8-month follow-up. Longer follow-up periods might increase recurrence rates in future studies.

Besides complication rates, intraoperative blood loss was recorded for every case. Blood loss after OD in patients was 47 mL, whereas it was 9.6 mL after MED ($P < 0.001$). This evidence from our study was in line with previous reports advocating lower blood loss in MED (8). In our study, the blood loss was lower compared with the result obtained by Pang et al. (35.4 vs 9.6 cc).

Pang *et al.* evaluated 48 patients who underwent MED. In these patients, the mean preoperative VAS score was 6.8, while the postoperative score at 6 months was 1.2. In this study, the mean preoperative VAS score was 7.4 for patients who underwent MED, and the mean postoperative VAS score [recorded at the last follow-up (mean = 8.4 months)] was 1.1. This showed that MED, as OD, can provide pain relief.

MED is not used only in paramedian disk herniation but can also be used in far lateral, extraforaminal, caudally or cranially migrated, and spinal stenosis cases successfully (4).

The present study is one of the largest studies comparing OD and MED performed by two different surgeons in two different centers. Most studies comparing different surgical techniques suffer from inter-surgeon differences such as techniques, experience, clinical settings, and other factors. In this study, we aimed to objectively demonstrate advantages and disadvantages of MED compared with OD. MED is a strong alternative to OD. It is less invasive, allows faster recovery, decreases blood loss, and still provides at least comparable if not superior improvement in VAS scores and recurrence rates. Therefore, we strongly argue its usage in daily neurosurgical practice.

CONCLUSIONS

The overall success rate after MED was 90%, and the recurrence rate was 5%. With increasing experience, the complication rates will decrease. Short operation time, clear view of the operative field with a 30° telescope, shorter length of stay, earlier mobilization and return to work, and lower rates of infections

are among the advantages of MED. In this study, we demonstrated that our findings were in line with the previous studies and advocate the use of MED as a noninferior alternative to treat lumbar disk herniation.

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