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Original Article

CLINICAL OUTCOMES AFTER STANDARD DISCECTOMY AND MICRODISCECTOMY FOR LUMBAR DISC HERNIATION: A SINGLE-CENTER STUDY

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Summary

Unsatisfactory results from lumbar disc herniation (LDH) conservative treatment suggest referral of patients for neurosurgical treatment. The time required for such a decision is considered to be about 4-6 weeks. In most cases, surgery quickly relieves pain symptoms, all along with the restoration of patient functions. The optimal surgical technique for LDH is theoretically controversial. We consider two discectomy methods as quite effective in our clinic: standard open discectomy (SD) and microdiscectomy (MD). Many retrospective studies have demonstrated the superiority of one of these techniques. Most studies describe microdiscectomy as a golden standard for surgical treatment of symptomatic disc herniation. We focused on the clinical aspects and correlations in the surgical treatment of LDH, as presented in the literature.

The patients we present were divided by type of surgical procedure (SD or MD), and other parameters: sex, age, duration of symptoms, blood loss, duration of the operation, reoperation rate, Visual Analogue Scale (VAS), and Oswestry Disability Index (ODI). We used chi-square tests (ANOVA analysis) and directional measures to determine statistically significant data. Five hundred eighty-nine single-level lumbar discectomies were performed for five years (2012-2017), and all the patients presented with classical signs of the condition, i.e., vertebral and radicular syndromes. SD was performed on 498 patients, and MD – on 91 patients. Analyses of the parameters mean VAS values of lumbar and leg pain postoperatively, and within one month after surgery demonstrated statistically significant differences between standard and microdiscectomy ($p<0.05$). LDH surgical techniques have become more and more sophisticated over the last 40 years, but without substantial improvement in the functional and clinical results. Appropriate patient selection is a crucial factor for the postoperative outcome. Neurosurgeons should fully master the chosen technique for satisfactory postoperative results.

Keywords: standard discectomy (SD), microdiscectomy (MD), lumbar disc herniation (LDH), recurrence rate, minimally invasive techniques

Introduction

Unsatisfactory results from lumbar disc herniation (LDH) conservative treatment suggest referral for neurosurgical treatment. The time required for such a decision is about 4-6 weeks. In most cases, surgery quickly relieves pain symptoms, all along with the

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restoration of patient functions. The optimal surgical approach/technique for LDH is theoretically controversial. We consider two methods of discectomy as quite useful in our clinic: standard open discectomy (SD) and microdiscectomy (MD). In 1934, the American neurosurgeon W. Mixter and orthopedic spine surgeon J. Barr concluded that sciatica is caused by herniation of nucleus pulposus into the spinal canal (rupture of an intervertebral disc). The lesion has been mistaken with cartilaginous neoplasm for a long time. The treatment was very satisfactory if compression was not prolonged. The mystery of sciatica was finally solved, and open discectomy was introduced.

The subsequent modifications that we have today include applying minimal laminotomy stead of laminectomy and minimal flavectomy. These modifications improve stability and minimize scar tissue formation. More recent changes in the standard procedure include using magnifying glasses, headlights, and fluoroscopy to detect the targeted level. Microdiscectomy or microsurgical discectomy was described in studies by Yasargil and Caspar in 1977. They introduced a powerful operating microscope to standard open discectomy that led to much more minimally invasive procedures: smaller and cleaner dissections, better neurosurgeon's vision, less soft tissue damage, and postsurgical scarring, less blood loss due to surgery, and shorter hospital stay). The major disadvantage, which has been reported in many studies, is that the smaller operating field could make some disc fragments more challenging to retrieve or even completely miss. Many retrospective studies demonstrated the superiority of one of the techniques.

Most of them describe microdiscectomy as a golden standard for surgical treatment of symptomatic disc herniation. The study aims to present clinical aspects and correlations in the surgical treatment of LDH according to literature data.

Objective: To compare results from the surgical treatment of LDH using SD and MD.

Material and Methods

Retrospectively, operative reports for a period 2012-2017 were reviewed on LDH surgeries performed at the University Neurosurgery Clinic - Pleven. The follow-up time of the operated patients was at least one year. All data were recorded on regular follow-ups (1st month, 3rd month, and 1st year after surgery). The mean follow-up reoperation rate/recurrent LDH in the postoperative period was 36 months (3 years). Five hundred eighty-nine single-level lumbar discectomies were performed by the same neurosurgeon. The inclusion and exclusion criteria are mentioned below.

Inclusion criteria:

single-level lumbar disc herniation;
monoradicular symptoms;
conservative treatment failure or intolerable sciatica;
rapidly progressive neurological deficits (motor and sensory deficits, cauda equina syndrome).

Exclusion criteria:

previous lumbar back surgery;
CT or MRI signs of spinal instability or other spinal abnormalities;
excessive obesity;
history of psychiatric, addiction and mental disorders.

A diagnosis of LDH was based on the development of vertebral/radicular symptoms and magnetic resonance/computed tomography (MRI/CT) images showing compatible lesion. All radiological images were previewed via RadiAnt DICOM viewer, allowing selection of operative technique and preoperative planning. The studied patients were divided by type of surgical procedure (SD or MD) and other parameters: sex, age, duration of symptoms, blood loss, operative procedure duration, reoperation rate, VAS, and ODI. We used chi-square tests (ANOVA analysis) and directional measures to determine statistically significant data. The surgical method selection was based on age, comorbidities, the surgeon's choice, and comfort.

Procedures were performed under general anesthesia. The patients ware put in a prone position with flexed hip and knee joints. Magnification up to 4x of Carl Zeiss microscope was used during microdiscectomy. Both procedure levels were targeted by C-arm SIMAD fluoroscopy. Each technique was performed using standardized protocols as described above, with careful minimal tissue dissections (SD-skin incision up to 5cm with minimal laminotomy and minimal medial facetectomy, MD-skin incision up to 3cm with microlaminotomy and no facetectomy).

Sequestertomy or annulotomy with subtotal (limited) discectomy was performed. Herniated nucleus pulposus evaluation followed the Carragee disc herniation classification system. We followed the rules mentioned in Table 1 [1,2].

Results

Five hundred eighty-nine single-level lumbar

Table 1. Carragee four-part system classification of herniated nucleus pulposus

Disc herniation Type	Presence of fragments	Annular integrity	Surgical treatment
Type 1: Fragment-Fissure	Yes	Slit-like/small annular defect	Removal of fragments through a slit-like annular defect
Type II: Fragment-Defect	Yes	Large/massive annular defect	Removal of fragments through a massive annular defect
Type III: Fragment-Contained	Yes	No defect	An oblique incision in annulus performed to remove subanular fragments
Type IV No Fragment-Contained	No	No defect	Extensive annulotomy/ removal of a protruding disc

Table 2. Perioperative parameters in correlation with SD and MD

Perioperative parameters	SD Count (%)	MD Count (%)
Age group:		
1-18y	55 (11.0%)	9 (9.9%)
19-60y	360 (72.3%)	67 (73.6%)
>60y	83 (16.7%)	15 (16.5%)
Sex:		
M	277 (55.6%)	43 (47.3%)
F	221 (44.4%)	48 (52.7%)
Preoperative duration of symptoms:		
<6 months	405 (81.3%)	71 (78%)
6-12 months	44 (8.8%)	9 (9.9%)
> 12 months	49 (9.8%)	11 (12.1%)
Intraoperative blood loss:		
Up to 50 ml	77 (15.5%)	31 (34.1%)
50-100 ml	323 (64.8%)	54 (59.3%)
100-200ml	96 (19.3%)	6 (6.6%)
200-300ml	2 (0.4%)	0 (0%)
Surgical procedure duration:		
30 min	10 (2.0%)	0 (0.0%)
45 min	174 (34.9%)	5 (5.5%)
60 min	263 (52.8%)	20 (22.0%)
75 min	46 (9.2%)	33 (36.3%)
90 min	5 (1.0%)	31 (34.1%)
120 min	0 (0.0%)	2 (2.2%)
Reoperations (follow up – 36 months)	38 (7.6%)	6 (6.6%)

discectomies were performed from 2012 to 2017. Males were 54% of operated patients. Classic clinical presentation - vertebral and radicular syndrome, was seen in all the cases. SD was the most common procedure (498 patients), followed by MD (91 patients). Both standard open discectomy and microscopic discectomy were made, predominantly in the 19-60 age group. Our analysis demonstrated that 476 of the patients had experienced symptoms lasting less than six months. Only 60 cases were operated on for symptoms lasting more than 12 months. Fifty lumbar disc herniations initiated by MD switched to SD for various reasons. The minimum hospital stay was four days, in agreement with the national clinical protocols.

Intraoperative blood loss was between 50-200 ml for SD, while in MD, it was between 50-100 ml for most of the cases (the mean blood loss in SD was 116.6 ml, while in MD, it was 75 ml). The duration of SD was between 45-60 minutes and of MD – between 75 and 90 minutes (the mean duration of SD – 52.5 min., while MD duration was 82.5 min. The reoperation rates were 7.6% and 6.6% after SD and MD, respectively, for 36 months mean follow-up. (χ^2=5.183, df=4, p=0.269). (Table. 2)

Most of the patients had an excellent and good functional outcome, assessed by the MacNAAB classification scale. A fair result was registered in only one operated via SD technique. The Oswestry disability index in the 493 operated patients followed up for one year after the operation showed data for minimal dysfunction /from 0-20%/. (Table. 3) These were patients who could handle most of the daily activities. In our study, VAS analyses showed statistically and clinically significant data. The information is presented in Table 4 and Table 5.

Analysis of the parameters - mean VAS values of lumbar pain postoperatively within one month after surgery showed a statistically significant difference between standard and microdiscectomy.

The statistical difference ($p<0.05$) for lumbar pain in the postoperative period up to one month between a standard discectomy and microscopic discectomy is probably due to the operative

Table 3. Functional outcome parameters in SD and MD

Functional outcome parameters	SD Count (%)		MD Count (%)	
MacNAAB				
Excellent	265 (53.2%)		75 (82.4%)	
Good	232 (46.6%)		16 (17.6%)	
Fair	1 (0.2%)		0 (0.0%)	
Poor	/		/	
VAS	**Lumbar pain**	**Leg pain**	**Lumbar pain**	**Leg pain**
Preoperative				
6	2 (0.4%)	153 (30.7%)	0 (0.0%)	35 (38.5%)
7	166 (33.3%)	99 (19.9%)	35 (38.5%)	17 (18.7%)
8	135 (27.1%)	141 (28.3%)	27 (29.7%)	23 (25.3%)
9	135 (27.1%)	80 (16.1%)	25 (27.5%)	15 (16.5%)
10	60 (12.0%)	25 (5.0%)	4 (4.4%)	1 (1.1%)
Postoperative				
1	61 (12.2%)	63 (12.7%)	14 (15.4%)	14 (15.4%)
2	266 (53.4%)	270 (54.2%)	66 (72.5%)	67 (73.6%)
3	171 (34.3%)	165 (33.1%)	11 (12.1%)	10 (11.0%)
1st month				
1	245 (49.2%)	286 (57.4%)	68 (74.7%)	71 (78.0%)
2	253 (50.8%)	212 (42.6%)	23 (25.3%)	20 (22.0%)
3	/		/	
1st year				
0	395 (96.4%)	400 (97.6%)	78 (94.0%)	81 (97.6%)
1	15 (3.6%)	10 (2.4%)	5 (6.0)	2 (2.4%)
ODI 1st year				
0-20%	410 (83.2%)		83 (16.8%)	

Table 4. ANOVA analysis of lumbar pain

ANOVA analysis (lumbar pain)	SD (N=498)	MD (N=91)	P
Postoperative	1.22±0.64	0.97±0.52	P<0.05
One month after the operation	0.51± 0.50	0.25±0.43	P<0.05

Table 5. ANOVA analysis of leg pain

ANOVA analysis (leg pain)	SD (N=498)	MD (N=91)	P
Postoperative	1.20±0.64	0.96±0,51	P<0.05
One month after the operation	0.43±0,49	0.22±0.41	P<0.05

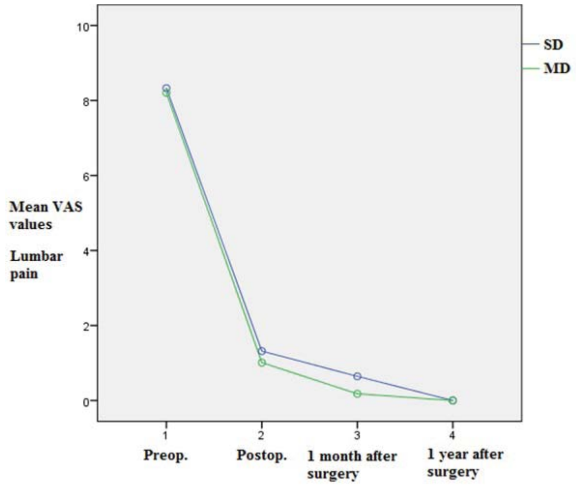

Figure 1. Graphical expression of the mean VAS dynamics of lumbar pain in SD and MD (Kaplan–Meier analysis)

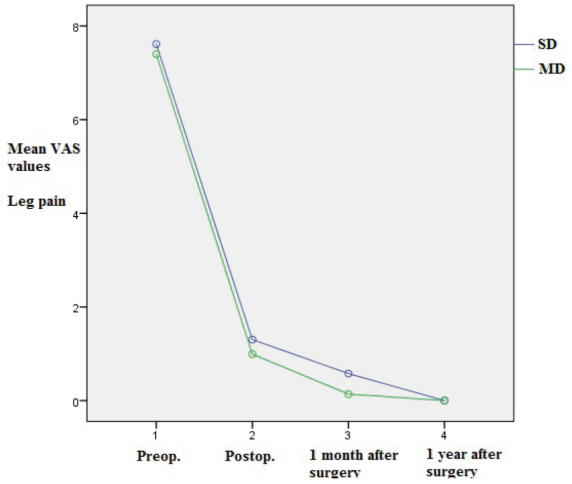

Figure. 2. Graphical expression of the mean VAS dynamics of leg pain in SD and MD (Kaplan–Meier analysis). Note: The graphical presentation for mean VAS dynamics of leg pain in SD and MD is identical

wound extent and the tissue healing process. Standardized values for the 1st month to the 1st year are shown in Fig. 1.

Same as above, analysis of mean VAS values of leg pain postoperatively and within one month after surgery demonstrate a statistically significant difference between standard and microdiscectomy.

The statistical difference ($p<0.05$) for leg pain in the postoperative period up to 1 month between an open discectomy and microscopic discectomy was probably due to the extent of iatrogenic nerve root irritation. Below are the standardized values for the 1st month to the 1st year. (Fig. 2.)

Discussion

Patients without benefit from conservative treatment should be planned for surgical intervention: standard open discectomy, microdiscectomy, or other minimally invasive procedures. Such consideration should be based on the respective clinical and radiological findings. More analyses are necessary for an optimal treatment decision [3]. Although microdiscectomy is accepted nowadays as the method of choice for the LDH surgery, some neurosurgeons are used to performing SD. Opinions as to which surgical technique for LDH surgery is the best are controversial [4]. We consider simple standard open discectomy as quite effective.

Many authors have reported better MD outcomes concerning different parameters such as shorter hospital stay, bleeding, faster functional recovery, and return to work [5,6]. Other studies have claimed no difference between the two techniques regarding the same parameters [7,8]. There were no significant differences between the SD and MD groups in terms of postoperative pain scores and outcomes [4]. In our study, postoperative pain scores showed a significant difference up to the 1st month after surgery.

Operative time is lengthened by the use of a microscope. In the SD group, the surgical intervention lasted less than one hour [4,8]. We agree with the findings of some studies reporting a shorter operation time when using the SD technique.

The best clinical and functional outcome after LDH surgery correlates with the absence of a herniation [9,10]. Our recurrence rate was 7.5% (7.6 and 6.6% after SD and MD respectively), and this rate is within the range of 5 to 25% that is reported in the literature [3].

Microdiscectomy and minimally invasive surgical (MIS) techniques have gained prevalence for initial operations. As far as rLDH is concerned, there are controversial reports on clinical success and complication rates. Recurrent LDH has been more often seen in removing hidden fragments, which is possible when SD is performed.

Despite the different numbers of cases in the two groups, the MD group (91 patients) is large enough to allow for conclusions. Our study demonstrates that SD and MD's functional results are not different, unlike the results reported earlier [8, 15].

The most apparent advantage of MD is the benefit for the residents and younger doctors to gain an insight into the neuroanatomy and relevant pathology. SD could not provide this. Minimally invasive techniques have a psychological effect on patients to consider MD superior to SD [4].

Conclusions

LDH surgical techniques have become more and more sophisticated over the last 40 years, but without significant improvement in functional and clinical results. Appropriate patient selection is a crucial factor for the postoperative outcome. Neurosurgeons should fully master the chosen technique for satisfactory postoperative results. According to our study and the results of a one-year follow-up, there was no statistically significant difference between SD and MD groups in functional outcome (mean VAS lumbar and leg pain) one month after surgery.

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