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Original Articles

RECURRENCE RATE OF LUMBAR DISC HERNIATION AFTER STANDARD DISCECTOMY AND MICRODISCECTOMY: A 5-YEAR STUDY

Mladen E. Ovcharov,
Iliya V. Valkov,
Milan N. Mladenovski,
Nikolay V. Vasilev

Department of Neurology and Neurosurgery, Medical University – Pleven, Bulgaria

Summary

Lumbar disc herniation (LDH) is the most common pathology in young people, as well as people of active age. Despite sophisticated and new minimally invasive surgical techniques and approaches, reoperations for recurrent lumbar disc herniation (rLDH) could not be avoided. LDH recurrence rates, reported in different studies, range from 5 to 25%. The purpose of this study was to estimate the recurrence rates of LDH after standard discectomy (SD) and microdiscectomy (MD), and compare them to those reported in the literature. Retrospectively, operative reports for the period 2012-2017 were reviewed on LDH surgeries performed at the Neurosurgery Clinic of Dr Georgi Stranski University Hospital in Pleven. Five hundred eighty-nine single-level lumbar discectomies were performed by one neurosurgeon. The diagnoses of recurrent disc herniation were based on the development of new symptoms and magnetic resonance/computed tomography (MRI/CT) images showing compatible lesions in the same lumbar level as the primary lumbar discectomies. The recurrence rate was determined by using chi-square tests and directional measures. SD was the most common procedure (498 patients) followed by MD (91 patients). The cumulative reoperation rate for rLDH was 7.5%. From a total number of reoperations, 26 were males (59.1%) and 18 were females (40.9%). Reoperation rates were 7.6% and 6.6% after SD and MD respectively. The recurrence rate was not significantly higher for SD. Our recurrence rate was 7.5%, which makes it comparable with the rates of 5-25% reported in the literature.

Key words: recurrent lumbar disc herniation (rLDH), standard discectomy (SD), microdiscectomy (MD), lumbar disc herniation (LDH), recurrence rate, minimally invasive techniques

Corresponding Author:
Milan N. Mladenovski
Department of Neurology and Neurosurgery,
Medical University – Pleven, Bulgaria
1, St. Kl. Ohridski Str.
Pleven, 5800
Bulgaria
e-mail: milanmladenovski@gmail.com

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Introduction

Lumbar disc herniation (LDH) is the most common pathology in young people and those of working age. The frequency of LDH is reportedly 1-2% in the whole population [1]. Surgery for lumbar disc herniation is one of the most common procedures in neurosurgery. Indications for surgical excision of a herniated disc are based on the clinical manifestation and the results of the diagnostic tests demonstrating compression of the conus medullaris and/or roots of the cauda equina, which correlate with the symptomatic level and side

of neural compression. Surgical treatment is indicated under the following circumstance: acute massive disc herniation presenting with cauda equina syndrome (drop-foot and sphincter troubles), lesser degrees of neurological deficit (motor deficit of the triceps surae muscle, weak dorsiflexion of the foot and sensory deficit of the respective dermatomes). The most frequent indication for surgical treatment is the painful syndrome (surgery in this group of patients is indicated if there is a 6-month conservative treatment fails. After the clinical diagnosis of lumbar disc prolapse has been made, it has to be confirmed by appropriate radiological investigations. It is essential that the entire lumbar canal is visualized. This is achieved by magnetic resonance images (MRI) and/or computed tomography image (CT). The surgical indications should be considered very cautiously with neurotic patients when the subjective complaints dominate over objective information. The presence of a non-organic component reduces the success of discectomy. It could be standard or open, with a skin incision bigger than 3 cm (SD), microscopic discectomy (MD) the skin incision up to 3 cm, and endoscopic discectomy (ED), in which the incision is up to 1.5cm. ED could be microendoscopic (MED) and percutaneous endoscopic (PED).

Despite sophisticated and new surgical techniques and approaches, reoperations for recurrent lumbar disc herniation (rLDH) could not be avoided in all cases [2]. Numerous factors could be associated with a higher recurrence rate of LDH [3-7]. Different studies report recurrent disc herniation rates ranging between 5 and 25% [8-10].

The purpose of this study is to estimate the recurrence rate of rLDH after SD and MD in respect to literature data.

Material and Methods

Retrospectively operative reports for a period 2012-2017 were reviewed on LDH surgeries performed at the Neurosurgery Clinic of Dr Georgi Stranski University Hospital in Pleven. Five hundred eighty-nine single level lumbar discectomies were performed by one specific neurosurgeon. A diagnosis of recurrent disc herniation was based on the development of new symptoms and magnetic resonance/computed tomography (MRI/CT) images showing compatible lesions in the same lumbar level as the one on the primary lumbar discectomy. All images were previewed with a RadiAnt DICOM viewer, allowing efficient use of resources in viewing medical images. The recurrence rate was determined by using chi-square tests and directional measures. The reoperated patients were divided by sex, location of the first operation, month/years at recurrence, and type of surgical procedure (SD or MD). Once the decision had been made for surgical treatment, the surgeon had to select the operative method.

Standard discectomy

This operation was usually performed under general anesthesia. The patient was put in a prone position with flexed hip and knee joints. The skin incision was made along the midline over the three spinous processes, its mid-point being at the level of the affected disc. The thoracolumbar fascia was exposed and was detached from the spinous processes and the supraspinal ligament. The two laminae and the interspace were exposed together with the articular processes. In this dissection, the sacrum had be carefully identified, as it oriented the surgeon concerning the correct localization of the disc level. A possible problem was a "mismatch" with the level of pathology. The solution to this problem was verification of the level pre- and intraoperative with the C-arm Simad. The bleeding was stopped by electrocoagulation and tamponade for a few minutes. A self-retaining retractor was put in place (Figure 1). The flavum ligament was removed with a Kerrison's instrument. It was usually necessary to remove the inferior edge of the higher lying lamina. This was done with a Kerrisons instrument or with a small electric drill. If bleeding occured, it was stopped with bone wax. The next step was to retract the epidural fatty tissue. The nerve root, situated in the dural sleeve, seemed in most cases considerably stretched. That is why it had to be carefully separated from the underlying disc prolapse and medially displaced with a root retractor so the prolapse could be revealed. A root that was not stretched could be easily retracted.

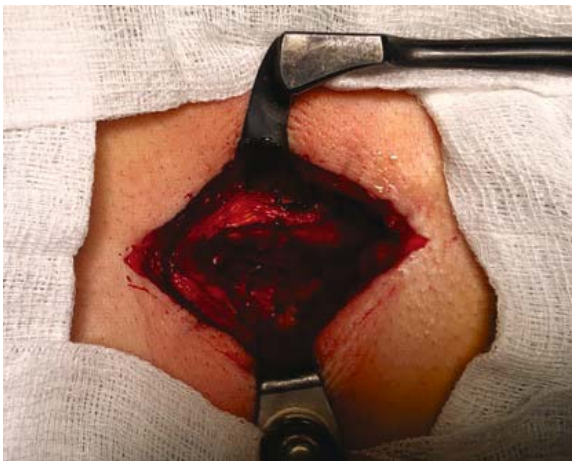

Figure 1. Standard open discectomy. The lumbar disc herniation is excised.
*The dural sac and the nerve root lie freely in place.

Microscopic discectomy

We used a Carl Zeiss microscope, magnification up to 4X (Figure 2). The incision on the midline was 3 cm. Muscle aponeurosis was incised 1 cm from the midline. Muscle multifidus was separated from the spinous processes to the joint laterally, then the speculum was inserted and opened. The microscope was focused on the operative field.

In each case, we performed annulotomy and subtotal (limited) discectomy in addition to excision of disc fragments except when a sequestertomy was made. Herniated nucleus pulposus was evaluated according to the Carragee disc herniation classification system. (Table 4) Our surgical treatment followed the rules mentioned above.

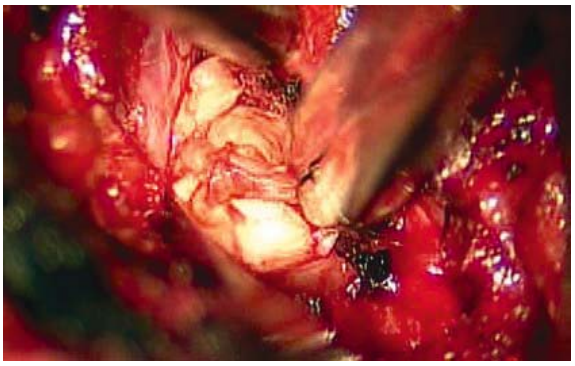

Figure 2. Microdiscectomy, using a Carl Zeiss microscope, magnification up to 4X.
*Huge disc herniation in the operating field.

Results

SD was the most common procedure (498 patients), followed by MD (91 patients). The cumulative reoperation rate for rLDH was 7.5%. The patients, primarily operated in our clinic were 26 (4.4%), and 18 (3.1%) of the patients had been treated in other neurosurgical centers in Bulgaria. (Table.1). As shown in Table 2, of the total number of reoperated patients, 26 were males (59.1%) and 18 were females (40.9%) (χ^2=1.812, df=4, p=0.770). The reoperation rates were 7.6% and 6.6% after SD and MD, respectively (χ^2=5.183, df=4, p=0.269). (Table 3). Eight reoperations were registered in the first month, and fourteen reoperations - up to 3 year-period after the initial operation (Figure 3). The recurrence rate was not significantly higher for standard discectomy. Our recurrence rate was 7.5%, which makes it comparable with rates of 5-25% reported in the literature [8-10].

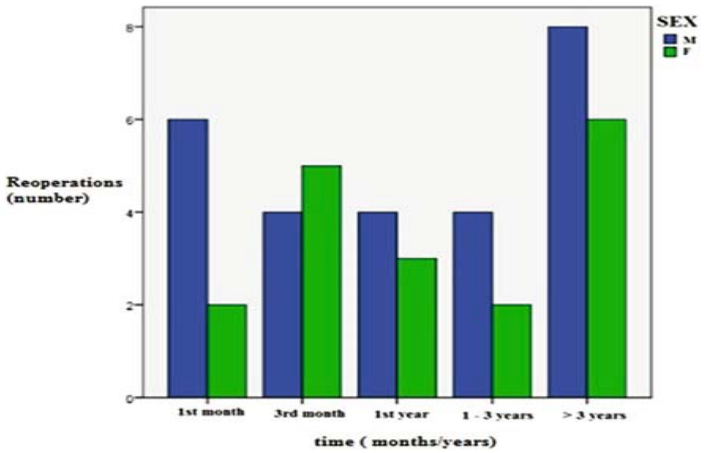

Figure 3. Graphical presentation of re-operated patients according to sex and month/years at recurrence.
*In the first 30 days, we operated only 8 patients (early recurrence). That is 18.2% of the total percentage of reoperations

Table 1. Primarily operated patients in our department

	Operated patient	Reoprations for r LDH	Primarily operated in our clinic	Primarily operated in other neurosurgical centers in Bulgaria
Number	580	44	26	18
Percentage	100%	7.5%	4.4%	3.1%

*Showing 44 reoperations (7.5%) for rLDH, nearly half of them (26) operated primarily in our clinic

Table 2. Reoperations for rLDH in correlations with sex and month/years at recurrence

Reoperations Men		**Sex** Female		**Total**
1st month	Number	6	2	8
	%/ reoperations	75.0%	25.0%	100.0%
	% / sex	23.1%	11.1%	18.2%
3rd month	Number	4	5	9
	% /reoperations	44.4%	55.6%	100.0%
	% / sex	15.4%	27.8%	20.5%
1st year	Number	4	3	7
	% /reoperations	57.1%	42.9%	100.0%
	% / sex	15.4%	16.7%	15.9%
1-3 years	Number	4	2	6
	% /reoperations	66.7%	33.3%	100.0%
	% / sex	15.4%	11.1%	13.6%
>3 years	Number	8	6	14
	% /reoperations	57.1%	42.9%	100.0%
	% / sex	30.8%	33.3%	31.8%
Total	Number	26	18	44
	% /reoperations	59.1%	40.9%	100.0%
	% / sex	100.0%	100.0%	100.0%

*26 are males (59.1%) and 18 are females (40.9%) operated for rLDH . Recurrence rate is graded 1. Up to one year – 54.6% and 2. 1-3 years – 13.6%. 3. More than 3 years – 31.8%

Table 3. Correlation between reoperations for rLDH and type of surgical procedure.

Reoperations SOD		**Type of surgical procedure: MD**		**Total**
Number	460	85	Number	460
% / reoperation (yes/no)	84.4%	15.6%	% / reoperation (yes/no)	84.4%
% / type of surgical procedure	92.4%	93.4%	% / type of surgical procedure	92.4%
Number	38	6	Number	38
% / reoperation (yes/no)	86.4%	13.6%	% / reoperation (yes/no)	86.4%
% / type of surgical procedure	7.6%	6.6%	% / type of surgical procedure	7.6%

* It is obvious that 44 (7.5%) patients were re-operated (7.6% for SD and 6.6% for MD). The recurrence rate was not significantly higher for SD.

Discussion

Unforeseen revision spinal surgery is the most unsatisfactory and undesirable result for surgeons, patients and health-insurance organizations. Unplanned repeated spinal operations could be due to development of new symptoms, comorbidity, evolution of the basic disease, and other patient risk factors. Furthermore, revision surgery could be due to complications of the first operation different from rLDH on the same level [11-17].

Our study did not include patients with new herniations (on another level), contralateral herniations. Patients with scar or adhesive arachnoiditis, infection, hematoma and cerebrospinal fluid leakage as surgical findings were also excluded from the study.

Differentiating and diagnosing a rLDH from scar tissue formation is thought to be facilitated by gadolinium-enhanced lumbar MRI. The latter can suggest a more appropriate treatment choice and patient selection for a successful second operation [18].

Some studies have reported results from second operations worse that those from the original interventions [19-22]. In our experience, perioperative complications (residual pain, nerve root injury etc.) after second operations did not exceed the above-mentioned complications after the first interventions.

A major factor correlated with best clinical outcome from discectomy is the absence of reherniation, for which a large annulus fibrosus defect is the most prominent predictor. There are also other patients' characteristics that are related to the risk of reherniation.

Akmal et al. (2004) reported that nicotine inhibits collagen metabolism and production, thus reducing the resistance of the fibrous annulus to trauma and degenerative changes. In his study, smoking and nicotine was a credible risk factor for rLDH [3].

Age difference and BMI have not been reported as significant risk factors for rLDH in other studies. However, smoking and physical activity level in younger subjects may increase the risk for rLDH [5-7]. Many other studies suggesting other factors, such as alcohol consumption, compliance with doctors' postoperative recommendations, level of daily activities, type of occupation, return to work, education, surgeons' choice, etc. [2, 15, 16].

Kim et al. (2009) suggest other predictors for reherniation after percutaneous ED: high BMI, age, protrusion type of LDH, and positive Modic changes [15, 16]. On the other hand, Swartz et Trost (2003) do not consider smoking, herniation level, and durations of symptoms to be sufficient risk factors for rLDH [20].

Wilke et al. (2003) have presented an in-vitro model and shown that at younger age, a highly hydrated nucleus pulposus is more likely to reherniate under mechanical stress [21]. They have also pointed out reherniation is less likely to occur in patients older than 55. In our study, disc degeneration with aging also acted as a protection against reherniation.

The optimal surgical approach for rLDH is theoretically controversial. We consider simple revision discectomy quite effective for a second operation. Theoretically, the advantages of applying interbody fusion are not in agreement with practical disadvantages such as elimination of segmental motion, increased low back pain, infections, malposition of the screws etc. [22, 23].

Postoperative mechanical instability could be induced by revision surgery if a massive joint section is removed. Some studies have shown that patients receiving a re-exploration discectomy or reoperation for rLDH get lumbar fusion at a rate 3.95-38.4% after 3 months to 4 years after the initial operation [24-27].

Future studies without financial interests should determine if interbody fusion within revision discectomy is recommendable.

Modic differentiates type I from type II endplate changes after lumbar discectomy. Type I is associated with instability and inflammatory lesions, while type II changes are much more stable [28, 29]. So, stabilization and fusion procedures are considered beneficial [25]. Based on comparative reviews of MRI images, we suggest healing the inflammatory process is preferable to stabilization.

Patients with rLDH who have not benefited from non-operative treatment should be considered for appropriate surgical intervention (standard open, micro, microendoscopic, PED, and with or without fusion). Such consideration should be based on the presenting clinical and

radiological characteristics (low back pain, radiculopathy, instability, lumbar deformities, reherniation etc.). Additional clinical analyses are necessary in order to decide on the optimal treatment.

Microdiscectomy and minimally invasive techniques have gained prevalence for the initial operations. A far as rLDH is concerned, there exist varying controversial reports regarding the clinical success and complication rates [13, 17].

Osterman et al. (2003) reported that reoperated patients had a 25.1% risk of another spinal intervention over the next decade [7].

Kim et al. (2009) have presented a nationwide research of reoperation rates after surgery for LDH. In their metadata analysis, 46 % of the reoperations were performed within 0.5 years after primary surgeries [16]. According to other studies, 29-65% of all revision surgeries for rLDH were performed during the first year after the initial intervention [11-13, 17-20]. In our study, the 54.6% of the revisions were performed in the first year.

Annuloplasty with annular closure device (Barricaid®) is a modern neurosurgical technique for reducing reherniation rate after subtotal discectomy. While reducing reherniation rates, this technique may create aseptic instability as a complication. More prevalent endplate changes were seen in patients in cases with annular closure device. In our opinion, the possibility for aseptic instability may be higher than the recurrence rate of rLDH. A similar possibility was confirmed by Krutko A.V et al. of the Novosibirsk Research Institute of Orthopaedics and Traumatology [10]. They presented a risk of aseptic instability and the need for stabilization procedures.

The most effective method for preventing rLDH is still to be found. Currently, reconstruction of the annular fibrosis fissure is a promising method for preventing LDH recurrence.

Recurrent herniation has been more often found after minimally invasive discectomy (MED, PED), than after standard open disc surgeries [14, 16]. We assume that this is due to decompression and removal of the hidden fragments, applicable in open disc surgeries only. Teli et al. (2010) have found that recurrent lumbar disc herniations were significantly more common after MED, as compared to those following micro- or open discectomy [30].

The recurrence rate after limited discectomy has been reported to be higher than that after aggressive discectomy. With limited discectomy, more real recurrent disc herniations are likely to occur [31, 32]. No consensus has been achieved whether aggressive disc resection with curettage (discectomy) versus conservative removal of the offending disc fragment alone (sequestertomy) provide better outcomes. We present the concepts for both procedures (Table 5.). [33, 34].

In his study, Carragee pointed out (see Table 4) that of the four groups, the fragment-fissure reherniations (group 1) were associated with the best outcomes and lowest rate of reherniation (1%). Those with annular prolapse (group 4) were associated with poorer clinical outcomes,

Table 4. Carragee four-part system classification of herniated nucleus pulposus.

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

Table 5. Characteristics of sequestertomy and aggressive disc curettage

	Sequestertomy	Aggressive disc curettage
1	Retain disc height	Collapse of the disc height
2	Minimal joint instability	Intervertebral joint instability
3	Without spondylosis and joint hypertrophy	Accelerate spondylosis and joint hypertrophy
Concept:	Retention of normal disc and endplates do not cause secondary changes.	Remained disc has high incidence of reherniation

with 38% of patients experiencing recurrent or persistent symptoms [35, 36].

Considering the results obtained, along with the steady trend in spine surgery to develop minimally invasive techniques, important concerns have been raised regarding the justification of funding. Seeking good overall long-term functional result implies that surgeons should decide to use a specific surgical technique, keeping in mind their experience with the method they choose.

Conclusions

Numerous factors could be associated with a higher recurrence rate of lumbar disc herniation after the initial operation. When neurosurgeons explain the risk for reherniation after initial discectomy, patients should be informed for a less than 10% chance of undergoing a repeat surgery for a rLDH within 3 or more years. Higher risk of reherniation is most common in younger patients. The results from initial and revision surgery depend on a surgeon's experience, careful selection of patients, and patients' postoperative behaviour. Further studies are needed in future regarding longer follow-up (3.5 years mean follow-up in our study).

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