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Comparative Outcome Analyses of Differently Surgical Approaches to Lumbar Disc Herniation

Goran Lakičević[1], Ljerka Ostojić[1], Bruno Splavski[2], Sandor Roth[3], Tonko Vlak[4], Zdrinko Brekalo[1] and Marko Ostojić[1]

[1] School Medicine, University of Mostar, Mostar, Bosnia and Herzegovina
[2] Department of Neurosurgery, University Hospital Center Osijek, Osijek, Croatia
[3] Institute of Children Orthopedics, University Hospital Center Rijeka, Rijeka, Croatia
[4] Institut of Rehabilitation, University Hospital Center Split, Split, Croatia

A B S T R A C T

Lumbar disc herniations (LDH) occur in the lower back, most often between the fourth and fifth lumbar vertebral bodies or between the fifth and the sacrum. It is evident lack of studies dealing with comparative analysis of the surgical outcomes of the spine operation techniques. In this paper we analyzed and compared outcomes of the LDH standard techniques (laminectomy and hemilaminectomy), and contemporary operation techniques (interlaminectomy, and microdiscectomy). Adult patients (18–75 years of age) surgically treated on the Neurosurgery Department of the University Clinical Hospital Mostar – Bosnia and Herzegovina between January 1998 and December 2007 were sampled as subjects. We analyzed and compared, number of the LDH surgically treated patients; age, patient's satisfaction with postoperative status, postoperative recurrence of the LDH; incidence of the postoperative complications, and duration of hospitalization. In conclusion, modern operating methods have to be considered as superior over traditional operating types mostly because of smaller violations of forms and integrity of lumbar spine.

Key words: *neurosurgery, lumbar disc herniation, retrospective analysis, microsurgery*

Introduction

Lumbar disc herniations (LDH) occur in the lower back, most often between the fourth and fifth lumbar vertebral bodies or between the fifth and the sacrum. Symptoms can affect the lower back, buttocks, thigh, and may radiate into the foot and/or toe. The sciatic nerve is the most commonly affected nerve, causing symptoms of sciatica. The femoral nerve can also be affected, causing the patient to experience a numb, tingling feeling throughout one or both legs and even feet or even a burning feeling in the hips and legs[1,2]. Surgery is indicated if a patient has a significant neurological deficit. The presence of cauda equina syndrome (in which there is incontinence, weakness and genital numbness) is considered a medical emergency requiring immediate attention and possibly surgical decompression. Surgical options include classical – conventional methods (laminectomy, hemilaminectomy), and contemporary – nonconventional methods (interlaminectomy, mikrodiscetomy, flavectomy, lumbar percutanous discectomy, automatic endoscopic discectomy and chemonucleolysis)[3–6]. Methods we have observed in this study, and which are regularly exercised in the University Clinical Hospital Mostar – Bosnia and Herzegovina, will be briefly discussed.

Laminectomy and hemilaminectomy are spine operations to remove the portion of the vertebral bone called the lamina. The traditional form of laminectomy (conventional laminectomy) excises much more than just the lamina, the entire posterior backbone is removed, along with overlying ligaments and muscles. The usual recovery period is very different depending on which type of laminectomy has been performed: days in the minimal procedure, and weeks to months with conventional open surgery.

Interlaminectomy is contemporary operation method consisting in removement of the ligaments, and partial removement of the cranial and caudal lamina of the connected vertebras. It is the most common surgical method

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in a case of prolapsed disk, extrusion, and subligamental extrusion of the intervertebral discus. Microdiscectomy or a microdecompression is a microsurgical intervention where a small portion of the bone over the nerve root and/or disc material from under the nerve root is removed to relieve neural impingement and provide more room for the nerve to heal. A microdiscectomy spine surgery is typically performed for lumbar herniated disc. Interlaminectomy and microdiscectomy are often combined[3–5,7,8].

In the recent literature we have found only limited numbers of studies dealing with comparative analysis of the spine operation techniques, mostly comparing two procedures[9–11]. Generally, the authors concluded that the decision to use different operating technique may be left to the surgeon. However, in the literature there is an evident lack of studies which compared outcomes of more than two surgical procedures for LDH[12].

Consequently, the objective of this study was to retrospectively investigate the surgical outcomes of different surgical procedures for LDH. More precisely, we compared LDH surgical methods regularly performed in the University Clinical Hospital Mostar: laminectomy, hemilaminectomy, interlaminectomy, and microdiscectomy.

Materials and Methods

We have observed adult patients (18–75 years of age) surgically treated on the Neurosurgery Department of the University Clinical Hospital Mostar – Bosnia and Herzegovina between January 1998 and December 2007. The main criterion for the inclusion was adult age of the patient, and clearly evidenced LDH, needed for surgical intervention. LDH was diagnosed by standard diagnostic procedure, including neurosurgical examination, computed tomography and magnetic resonance of the lumbo-sacral spine. In this study we involved only those patients with the accurate medical documentation and adequate number of the control medical examinations. All data were retrospectively collected using the medical documentation of the University Clinical Hospital Mostar.

Following variables were analyzed: number of the LDH surgically treated patients; age, classification of the patients according to type of the radiological diagnostic, type of the surgical intervention, and operation time. Patient's satisfaction with postoperative status was evidenced as: no pain – no problems; irregular problems and pains, and regular pains and problems[13,14].

Following final examination and control next variables were obtained: recurrence of the LDH; incidence of the postoperative complications; duration of hospitalization.

The efficacy of the operation method and patients' satisfaction with the postoperative status was evidenced according to the postoperative examination (initial examination immediately following hospitalization; control examination after physical rehabilitation program; final control examination one-year after the end of the hospitalization).

Initially, counts (N) and proportions (%) were calculated. Differences between operation's outcomes were calculated by χ^2-test (LDH recurrence, postoperative complications), Mann-Whitney test (Operation time), Kruskal-Wallis test (Duration of Hospitalization; Duration of recovery period) and/or Fisher Exact test (Patients satisfaction with the postoperative status and reoccurrence of pains). Coefficients were considered significant at level of the significance 95% ($p<0.05$).

Results

From Figure 1 it is evident that the most of the 557 surgically treated patients were within the age of 45 and 60 (34%). Of all LDH surgeries performed during the observed period (1998–2007) in the University Clinical Hospital Mostar, almost half was done using the interlaminectomy technique (Table 1). By means of Mann Whitney test we have found significant differences between operation times of different DH surgical procedures. Briefly, conventional techniques (laminectomy and hemilaminectomy) take significantly longer operation time (median values 72 and 64 minutes respectively) than interlaminectomy and microdiscectomy (53 and 51 minutes respectively). Figure 2 presents types of the postoperative complications, which we have found in less than 1% of the surgically treated patients. It mostly related to the spondilodicitis (17 cases), while empyema and liquorea were evidenced in 10 and nine cases respectively.

In the University Clinical Hospital Mostar, microdiscectomy technique is introduced in 2003. During the next four years it is most common LDH operation tech-

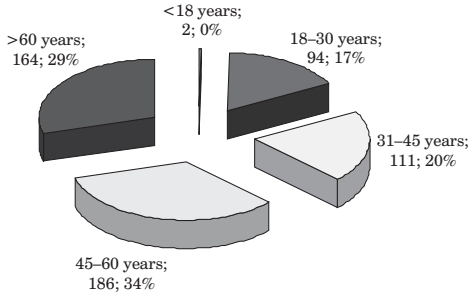

Fig. 1. Age of the LDH surgically treated patients (N; %).

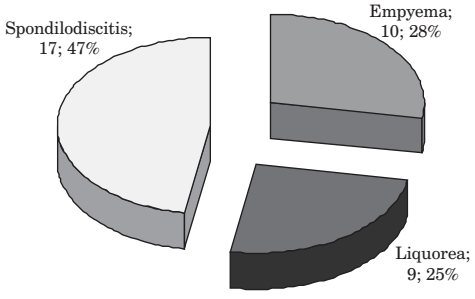

Fig. 2. Postoperative complications in the sampled subjects surgically treated for the lumbar disc herniation.

TABLE 1
RADIOLOGICAL EXAMINATIONS (COMPUTED TOMOGRAPHY – CT AND MAGNETIC RESONANCE – MR) PRIOR THE LUMBAR DISC HERNIATION SURGERY INTERVENTIONS

Surgery	N (%) of the radiological examinations			Total surgeries	% of all	Operation time (min)	
	CT	MR	CT & MR			MED	IQR
Laminectomy	96 (69.1)	28 (20.1)	15 (10.8)	139	24.96	72	5
Hemilaminectomy	27 (64.3)	14 (33.3)	1 (2.4)	42	7.54	64	7
Interlaminectomy	174 (63.3)	69 (25.1)	32 (11.6)	275	49.37	53	10
Microdiscectomy	33 (43.4)	22 (28.9)	21 (27.6)	76	13.64	51	7
Interlaminectomy & Microdiscectomy	6 (24.0)	14 (56.0)	5 (20.0)	25	4.49	55	7
Mann Whitney test (p)						0.001	

Percent of total operations performed by each technique (% of all)
Median operation time for each technique (med – median, iqr – interquartile range)
Significance of the Mann Whitney test – difference in the operation time between surgical procedures

TABLE 2
RETROSPECTIVE OF THE TYPES OF OPERATIONS PERFORMED IN THE CLINICAL HOSPITAL MOSTAR FROM 1998 TO 2007

Surgery technique	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Laminectomy	18 (12.9)	16 (11.5)	16 (11.5)	14 (10.1)	15 (10.8)	13 (9.4)	12 (8.6)	14 (10.1)	11 (7.9)	10 (7.2)
Hemilaminectomy	9 (21.4)	5 (11.9)	5 (11.9)	5 (11.9)	4 (9.5)	4 (9.5)	4 (9.5)	3 (7.1)	3 (7.1)	0
Interlaminectomy	34 (12.4)	2 (0.7)	37 (13.5)	55 (20.0)	49 (17.8)	22 (8.0)	18 (6.5)	21 (7.6)	21 (7.6)	16 (5.8)
Microdiscectomy	0	0	0	0	0	7 (9.2)	12 (15.8)	17 (22.4)	17 (22.4)	23 (30.3)
Interlaminectomy & Microdiscectomy	0	0	0	0	0	0	5 (20.0)	7 (28.0)	6 (24.0)	7 (28.0)

nique. The frequency of the microdiscectomy procedure increase constantly and in 2007 it prevailed even over interlaminectomy operations. The main reason for such state should be found in the fact that surgical microscope in systematically introduced in the operation, mainly during the extirpation of the discus substance.

In the initial, control and final examination, the patients which underwent microdiscectomy surgery are mostly satisfied with their postoperative status and reported no pain recurrence (78.9%; 78.9%; 81.8% respectively). Contrary, those patients treated with hemilaminectomy most frequently reported irregular pain recurrence and problems (28.6%; 28.6%; 35.7% respectively), while those treated with laminectomy reported regular recurrence of pains mostly (16.5%; 15.8%; 13.5% respectively).

Fisher's Exact test found significant differences between the satisfactions of the patients after different LDH surgical procedures. It is evident that patients are initially most satisfied with the outcomes of the microdiscectomy. Almost 90% of the patients are satisfied with the final outcome of this procedure, and only 2.9% of the treated patients suffer regular pains on the end of the intervention (one-year after the hospitalization). Satisfaction with the hemilaminectomy outcome is on the lowest rate of all procedures, with no evident differences if it is observed initially (after hospitalization), following physical rehabilitation, and/or at the end of the intervention.

Discussion

Although most of the authorities within the field suggest that contemporary surgical techniques (e.g. interlaminectomy, microdiscectomy) have to be considered as superior in most of the outcomes than classical surgical LDH techniques, there is evident lack of empirical data which will support such observations. For example, Hoffman et al.[15] in their review stated that most studies where comparison was made were poorly designed and not rarely compared the data of the LDH surgeries done in different Clinics.

The operation time is one of the crucial parameters observed in analysis of the surgical outcome. It is generally accepted that longer time of the operation increases the risk of the negative influence of the anesthesiology, the potential occurrence of the postoperative complications, while decreasing the dynamics of the rehabilitation. Therefore, nowadays in most cases surgery tend to decrease the operation time[16–18]. The operation time for the LDH surgery is generally standardized. Accordingly, the average time for the laminectomy, hemilaminectomy,

TABLE 3
COMPARISON OF THE PAIN AND PROBLEM RECURRENCE AFTER THE SURGERY, LEVEL OF THE SIGNIFICANCE FOR THE FISHER EXACT TEST (P)

Surgery techique	Initial examination after hospitalization			Following physical rehabilitation			End of Intervention – one year after hospitalization		
	N (%)			N (%)			N (%)		
	NP	IP	RP	S	IP	US	S	IP	US
Laminectomy	88 (63.3)	28 (20.1)	23 (16.5)	85 (61.2)	32 (23.0)	22 (15.8)	79 (56.8)	41 (29.5)	19 (13.7)
Hemilaminectomy	24 (57.1)	12 (28.6)	6 (14.3)	24 (57.1)	12 (28.6)	6 (14.3)	22 (52.4)	15 (35.7)	5 (11.9)
Interlaminectomy	217 (78.9)	39 (14.2)	19 (6.9)	217 (78.9)	41 (14.9)	17 (6.2)	225 (81.8)	42 (15.3)	8 (2.9)
Microdiscectomy	60 (78.9)	12 (15.8)	4 (5.3)	62 (81.6)	10 (13.2)	4 (5.3)	67 (88.2)	8 (10.5)	1 (1.3)
Interlaminectomy & Microdicectomy	18 (72.0)	6 (24.0)	1 (4.0)	18 (72.0)	4 (16.0)	3 (12.0)	21 (84.0)	2 (8.0)	2 (8.0)
Fisher Exact Test (p)		0.001			0.001			0.001	

NP – no recurrent pains; no problems; IP – irregular problems and pains; RP – recurrent pains; regular problems

TABLE 4
LUMBAR DISC HERNIA (LDH) RECURRENCE, POSTOPERATIVE COMPLICATIONS, DURATION OF THE HOSPITALIZATION AND RECOVERY PERIOD, ANALYSIS OF THE DIFFERENCES BETWEEN DIFFERENT SURGICAL TREATMENTS (χ^2 AND KRUSKAL-WALLIS TEST SIGNIFICANCE)

Surgery techique	LDH recurrence	Postoperative complications	Duration of hospitalization (days)		Recovery period (days)	
	N (% of recurrent)	(%)	MED	IQR	MED	IQR
Laminectomy	14 (28%)	36.1	7	15	60	20
Hemilaminectomy	6 (12%)	11.1	7	0	60	3
Interlaminectomy	24 (48%)	41.7	4	2	40	10
Microdiscectomy	6 (12%)	8.3	3	0	30	0
Interlaminectomy & Microdiscectomy		2.8	3	1	30	5
TOTAL	50					
χ^2 (p)	0.001	0.001				
Kruskal-Wallis (p)			0.001		0.001	

number – n, percent – %, med – median value, iqr – inter quartile range

interlaminectomy and microdiscectomy is approximated on 70, 65, 55 and 50 minutes respectively[19–21]. When comparing our data with operation time suggested previously, only minimal variations have to be evidenced.

In the last five years of this investigation, frequency of the standard surgical treatments is significantly decreased. More specifically, laminectomy and hemilaminectomy are used almost exclusively in evidently indicated patients with spinal cord stenosis, dorsomedial extrusions and recurrent hernias[18,20,22–24]. Therefore, we can expect that the number of the microsurgical LDH procedures will increase additionally in the following period, which follows the trends reported in the literature[7,8,13,14,25,26].

It is interesting that findings and opinions regarding advances of the microdiscectomy over standard procedures are not unique. For example, some authors suggested that microdiscectomy appears to give slightly better results than standard operation in the first few weeks or months after surgery, but not successively[27]. On the other hand, other authors[28] are of the opinion that after the introduction of microneurosurgery technique in neurosurgical practice the results of operations became significantly better. After the traditional intervention (e.g. laminectomy, hemilaminectomy) the outcome was good in 73% and in the other cases the results were mild or poor. After microdiscectomy good results were achieved in 92%. There was a smaller number of postoperative complications when microdiscectomy was performed: wound infection 1.9% *vs.* 5.7%, discitis 0.6% *vs.* 3%, neurological deficit 1.3% *vs.* 1.9%, urinary catheter 0.6% *vs.* 1.9%, reoperation 5% *vs.* 13%.

From the data previously presented and discussed, we can conclude that microdiscectomy is far more effective

method of all we have studied, observed even one year after hospitalization. However, overall data we have found in the final examination (>80% reported no pains) are within the range of those previously reported[15] where 65% to 85% of patients reported no pains one year after surgery.

LDH recurrence is one of the most important problems of the spinal neurosurgery. First and most important risk of the LDH recurrence is inadequately performed surgical treatment. Second risk factor is related to patients postoperative discipline, while third one relates to the, in most cases controversial – overall cleaning of the intervertebral space from the discus material during the surgical treatment. The forth one is evidenced as postoperative scar tissue as a result of the surgical treatment[29–31].

In our analysis, 50 surgically treated patients suffered recurrent LDH (9%). Most of the recurrences are observed after interlaminectomy and laminectomy (24 cases, and 14 cases respectively), which is comparable to data from the literature[31–33].

We were somewhat surprised by the fact that we have found relatively low reoccurrence of the LDH after microdiscectomy (6 cases; 12%), which is significantly lower than previous data suggests[34]. However, it should be explained by the fact that in complete sample we observed herein, microdiscectomy was done in 13% of all surgeries. Consequently, although showing evident differences in recurrence rate, the significance of the χ^2-test should be therefore observed accordingly. Recurrent LDH are one cause of the failed back surgery syndrome. The differential diagnoses include retained fragments, spinal stenosis, spinal instability, scar tissue (arachnoiditis and epidural fibrosis), and medical and psychosocial factors. Data from the literature suggest that recurrent LDH occur with a frequency of approximately 15%[35].

Duration of the hospitalization is one of the most important parameters in the neurosurgery from the medical, but also from the economical point of view[36]. However, medical attention and prospective is sometimes even more important, knowing the possible medical complications and psychological considerations which are regularly correlated to the time spent in the hospital environment[4,5,37]. The average hospitalization time following the LDH surgery is medicaly standardized and regularly used and reported[3–6]. Finally, although significantly different between surgical treatments performed, we can conclude that the hospitalization period we reported in this study do not differ from the established standards (laminectomy – 8 days; interlaminectomy – 5 days; microdiscectomy – 3 days)[3–6].

Conclusion

We have evidenced quite a lot of relatively young – economically active patients (18–45 years of age – altogether 37% of all surgically treated), which should be more precisely studied in further. The relatively high frequency of the LDH recurrence when surgery is performed by standard techniques was found. At the same time the reoccurrence was low when surgery is done by microdiscectomy. Based on the results of this research on 557 patients with surgical treated LDH it can be concluded that modern operating methods have to be considered as superior over traditional operating types mostly because of smaller violations of forms and integrity of lumbar spine.

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Lj. Ostojić

School of Medicine, University of Mostar, 88000 Mostar, Bosnia and Herzegovina
e-mail: ljerka.ostojic@sve-mo.ba

ANALIZA ISHODA KIRURŠKOG LIJEČENJA HERNIJACIJE DISKA KRALJEŽNICE

S A Ž E T A K

Hernijacija diska kralježnice (HDK) pojavljuje se u donjem dijelu leđa, najčešće između petog i šestog lumbarnog kralješka ili između petog kralješka i sakruma. Postoji jasan manjak objavljenih istraživanja vezanih uz kirurški pristup liječenju ovog stanja. U ovom radu prikazana je analiza i uspoređeni ishodi uobičajenih pristupa (laminektomija i hemilaminektomija) i novijih pristupa (interlaminektomija i mikrodisektomija). U istraživanje su uključeni pacijeni starosti 18–75 godina, koji su liječeni u Sveučilišnoj kliničkoj bolnici Mostar u razdoblju 1998.–2007. godine Uspoređen je broj operiranih pacijenata, kao i njihova dob, zadovoljstvo, ponovno pojavljivanje HDK, komplikacija i trajanje hospitalizacije. U zaključku, noviji operativni pristupi trebali bi se smatrati boljima jer uzrokuju manje ozljede i ne smanjuju integritet lumbalne kralježnice.