Comparative Outcome Analyses of Differently Surgical Approaches to Lumbar Disc Herniation

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ABSTRACT

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 legs¹⁻². 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, mikrodiscectomy, flavectomy, lumbar percutaneous 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 removal of the ligaments, and partial removement of the cranial and caudal lamina of the connected vertebrae. It is the most common surgical method
in a case of prolapsed disk, extrusion, and subligamental
excision 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 re-
moved to relieve neural impingement and provide more
room for the nerve to heal. A microdiscectomy spine sur-
gery is typically performed for lumbar herniated disc.
Interlaminectomy and microdiscectomy are often com-
bined.6–5,7,8

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 evi-
dent lack of studies which compared outcomes of more
than two surgical procedures for LDH12

Consequently, the objective of this study was to retro-
spectively investigate the surgical outcomes of different
surgical procedures for LDH. More precisely, we com-
pared LDH surgical methods regularly performed in the
University Clinical Hospital Mostar: laminectomy, he-
amilaminectomy, 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
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, comput-
ed tomography and magnetic resonance of the lumbo-sa-
cral 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 docu-
mentation 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. Pa-
tient’s satisfaction with postoperative status was evi-
denced 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 ex-
amination immediately following hospitalization; control
examination after physical rehabilitation program; final
control examination one-year after the end of the hospi-
talization).

Initially, counts (N) and proportions (%) were calcu-
lated. Differences between operation’s outcomes were
calculated by χ²-test (LDH recurrence, postoperative com-
plications), Mann-Whitney test (Operation time), Kruuskal-
-Wallis test (Duration of Hospitalization; Duration of re-
covery period) and/or Fisher Exact test (Patients satis-
faction 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 ob-
served period (1998–2007) in the University Clinical Hospital Mostar, almost half was done using the inter-
laminectomy technique (Table 1). By means of Mann
Whitney test we have found significant differences be-
tween operation times of different DH surgical proce-
dures. Briefly, conventional techniques (laminctomy 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 re-
lated to the spondilodiscitis (17 cases), while empyema
and liquorea were evidenced in 10 and nine cases respec-
tively.

In the University Clinical Hospital Mostar, micro-
discectomy 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 sur-
gically treated for the lumbar disc herniation.
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 time16–18. The operation time for the LDH surgery is generally standardized. Accordingly, the average time for the laminectomy, hemilaminectomy,
interlaminectomy and microdiscectomy is approximated on 70, 65, 55 and 50 minutes respectively\textsuperscript{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, dorso-medial extrusions and recurrent hernias\textsuperscript{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\textsuperscript{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\textsuperscript{27}. On the other hand, other authors\textsuperscript{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 than the other standard procedures. However, when comparing our results with the previously published data\textsuperscript{29–31}, 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, dorso-medial extrusions and recurrent hernias\textsuperscript{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\textsuperscript{7,8,13,14,25,26}.

<table>
<thead>
<tr>
<th>Surgery technique</th>
<th>Initial examination after hospitalization</th>
<th>Following physical rehabilitation</th>
<th>End of Intervention – one year after hospitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>S (%)</td>
<td>US (%)</td>
</tr>
<tr>
<td>Laminectomy</td>
<td>88 (63.3)</td>
<td>28 (20.1)</td>
<td>23 (16.5)</td>
</tr>
<tr>
<td>Hemilaminectomy</td>
<td>72 (57.1)</td>
<td>12 (18.6)</td>
<td>6 (14.3)</td>
</tr>
<tr>
<td>Interlaminectomy</td>
<td>217 (78.9)</td>
<td>39 (14.2)</td>
<td>19 (6.9)</td>
</tr>
<tr>
<td>Microdiscectomy</td>
<td>60 (78.9)</td>
<td>5 (15.8)</td>
<td>4 (5.3)</td>
</tr>
<tr>
<td>Interlaminectomy &amp; Microdiscectomy</td>
<td>18 (72.0)</td>
<td>6 (24.0)</td>
<td>1 (4.0)</td>
</tr>
<tr>
<td>Fisher Exact Test (p)</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Surgery technique</th>
<th>LDH recurrence (%)</th>
<th>Postoperative complications (%)</th>
<th>Duration of hospitalization (days)</th>
<th>Recovery period (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>MED IQR</td>
<td>MED IQR</td>
<td></td>
</tr>
<tr>
<td>Laminectomy</td>
<td>14 (28%)</td>
<td>7 15</td>
<td>60 20</td>
<td></td>
</tr>
<tr>
<td>Hemilaminectomy</td>
<td>6 (12%)</td>
<td>7 0</td>
<td>60 3</td>
<td></td>
</tr>
<tr>
<td>Interlaminectomy</td>
<td>24 (48%)</td>
<td>4 2</td>
<td>40 10</td>
<td></td>
</tr>
<tr>
<td>Microdiscectomy</td>
<td>6 (12%)</td>
<td>3 0</td>
<td>30 0</td>
<td></td>
</tr>
<tr>
<td>Interlaminectomy &amp; Microdiscectomy</td>
<td>2.8</td>
<td>3 1</td>
<td>30 5</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>50</td>
<td>0.001</td>
<td>0.001</td>
<td></td>
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</table>

\(\chi^2 (p)\) 0.001

Kruskal-Wallis (p) 0.001

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

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. 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. However, it should be explained by the fact that in complete sample we observed herein, microdiscectomy was done in 15% of all surgeries. Consequently, although showing evident differences in recurrence rate, the significance of the χ²-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%. 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. 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. The average hospitalization time following the LDH surgery is medically standardized and regularly used and reported. 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 (laminctomy – 8 days; interlaminectomy – 5 days; microdiscectomy – 3 days).

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.

REFERENCES

Hernijacija diska kralježnice (HDK) pojavljuje se u donjem dijelu leđa, najčešće između petog i šestog lumbar nog kralježka ili između petog kralježka 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 pacijenti 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.