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EARLY OUTCOMES OF SURGICAL TREATMENT WITH MICRODISCECTOMY IN PATIENTS WITH LUMBAR DISC HERNIATION

RANI REZULTATI HIRURŠKOG LEČENJA MIKRODISKEKTOMIJOM BOLESNIKA SA LUMBALNOM DISKUS HERNIJOM

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Summary

Introduction. The treatment of patients with lumbar disc herniation can be conservative or surgical, depending on the patient's characteristics, the disease, and treatment possibilities. This study aims to compare the intensity of pain, the presence of Lasègue's sign, and the degree of neurological deficits in patients with lumbar disc herniation before and after the operation. Additionally, the degree of intervertebral disc degeneration, evaluated by magnetic resonance imaging findings on the outcome will be determined. **Material and Methods.** A retrospective study involved 50 patients aged 18 to 45 who underwent microdiscectomy procedure. Parameters including pain intensity on the visual-analog scale, Lasègue's nerve stretching test, sensory deficits, motor deficits, and the degree of intervertebral disc degeneration according to the Pfirrmann grading system were assessed preoperatively and in the early postoperative period. **Results.** Intervertebral disc herniation most commonly occurred at the L4-5 and L5-S1 levels in our patients. Pain intensity significantly decreased from a preoperative score of 7.6 to 2.4 postoperatively. There was also a significant decrease in the number of patients with positive Lasègue's sign. According to the Pfirrmann grading system, 38% of patients had mild degenerative changes in the intervertebral disc, while 62% had severe degenerative changes. **Conclusion.** Microdiscectomy is the gold standard in surgical treatment of lumbar disc herniation. In the early postoperative period, patients experience a significant reduction in pain intensity with subsequent improvement of sensory and motor deficits. Surgical treatment of lumbar disc herniation, when indicated appropriately, carries a high success rate.

Key words: Intervertebral Disc Displacement; Treatment Outcome; Microdissection; Pain; Lumbar Vertebrae; Postoperative Period

Sažetak

Uvod. Tretman bolesnika sa lumbalnom diskus hernijom može biti konzervativni, primenom medikamena i fizikalno-terapijskih procedura ili hirurški u zavisnosti od karakteristika bolesnika, bolesti i mogućnosti lečenja. Cilj rada je poređenje intenziteta bola, pozitivnosti Lazarevićevog znaka, te stepena ispada senzibiliteta i motorike kod bolesnika sa lumbalnom diskus hernijom pre i nakon hirurškog lečenja. Utvrđivanje značaja stepena degeneracije intervertebralnog diska, vrednovanog na nalazu magnetne rezonancije, za ishod. **Material and metode.** Sprovedena je retrospektivna studija u kojoj je učestvovalo 50 bolesnika starosti od 18 do 45 godina, operisanih zbog lumbalne diskus hernije metodom mikrodiskektomije. Preoperativno i u ranom postoperativnom periodu, prilikom otpusta bolesnika praćeni su parametri: intenzitet bola po vizuelno-analognj skali, test istezanja nerva po Lazareviću, ispad senzibiliteta, ispad motorike i stepen degeneracije intervertebralnog diska po Firmanu. **Rezultati.** Hernijacija intervertebralnog diska se kod naših bolesnika najčešće javljala na L4-5 i L5-S1 nivoima. Postoperativno je intenzitet bola statistički značajno smanjen na vrednost 2,4 u odnosu na preoperativno 7,6. Postoperativno je zabeležen takođe i značajno manji broj bolesnika koji su imali pozitivan test istezanja nerva 14 u odnosu na preoperativno 41. Blage degenerativne promene intervertebralnog diska (po Firmanu) imalo je 38% bolesnika, a izražene degenerativne promene imalo je 62% bolesnika. **Zaključak.** Mikrodiskektomija je zlatni standard u hirurškom lečenju lumbalne diskus hernije. Kod ovih pacijenata u ranom postoperativnom periodu registruje se značajno smanjenje intenziteta bola, uz naknadno poboljšanje i senzibiliteta i motornog deficta. Operativno lečenje lumbalne diskus hernije kod adekvatno postavljenih indikacija ima visok stepen uspešnosti.

Ključne reči: diskus hernija; ishod lečenja; mikrodiskektomija; bol; lumbalni pršljenovi; postoperativni period

Introduction

Intervertebral discs are subject to metabolic, structural, and functional changes due to factors such as genetics, age, diet, and spinal load [1]. The basic pathophysiological mechanism is a disc nutrition disorder caused by atherosclerotic changes in

the blood vessels or calcification of the cartilaginous plate, leading to the lack of glucose and oxygen and reduction of the pH value, resulting thus in the degradation of the disc structural molecules and its dehydration, fragmentation and herniation [2].

Lumbar disc herniation is a local displacement of the disc contents outside the intervertebral space. It

Abbreviations

VAS	– visual analog scale
MMT	– manual muscle test
MRI	– magnetic resonance imaging
T1W	– T1 Weighted
T2W	– T2 Weighted
IVD	– intervertebral disc

most often occurs at the lumbosacral junction and the segment above (L5-S1 and L4-L5) [3, 4]. There are anterior and posterior disc herniations. Factors such as diabetes, heavy physical exertion, axial loading, and twisting of the spine contribute to the occurrence of herniation [5]. The clinical presentation depends on the segment where it occurs and may include pain, motor deficits, and sensory disturbances.

The treatment method for lumbar disc herniation depends on the patient characteristics, the disease, and the institution where the patient is treated. The choice of treatment is influenced by the patient's general condition, age, and comorbidities. The degree of the intervertebral disc herniation, presence of neurological deficit, as well as the intensity and trend of the development of complaints also influence the choice of treatment method. The last factor is the institution where the patient is treated, whether it is a primary, secondary, or tertiary institution, staff, and equipment with the necessary medical instruments to perform various procedures. When all the mentioned factors are taken into account, the treatment method is tailored individually for each patient.

Surgical treatment of lumbar disc herniation includes different surgical methods: macroscopic discectomy, microdiscectomy, and endoscopic discectomy. Different techniques in all three methods of bone-connective structure are performed depending on the extent of the lesion. Microdiscectomy is performed with the use of an operating microscope and involves removing a prolapsed or protruding disc through a small skin incision, and after dissecting the paravertebral muscles with the removal of the ligamentum flavum. Today, this method represents the gold standard in the surgical treatment of lumbar disc herniation in most neurosurgical institutions worldwide, in addition to endoscopic procedures that have somewhat more narrow indications [6]. Recovery after surgery usually lasts 3-4 days, after which the patient is discharged for further treatment at home.

Material and Methods

The study was conducted retrospectively at the Neurosurgery Clinic of the University Clinical Centre of Vojvodina for the period between October 2019 and October 2020. This study includes patients who were operated for lumbar disc herniation at one or two levels with the microdiscectomy method, which provided the total of 50 patients that were operated on. The patient age ranged from 18 to 45.

Data including gender, age, type of surgery, patient history, and physical examination at admission and after discharge from the hospital were taken from the medical history.

Evaluation of pain (lumbar or radicular) was carried out on a visual-analog scale (VAS) preoperatively and on the third day after surgery (the day of discharge). The VAS is used in clinical practice as a standardized method for assessing pain intensity. The scale ranges from 0 to 10, where 0 means no pain, and 10 is unbearable pain [7].

All patients underwent a preoperative and postoperative straight leg raise test (Lasègue), and a positive stretch test was in the range from 30 to 70 degrees [8].

Neurological status was noted:

1. Sensory deficit (hypesthesia, hyperesthesia, anesthesia) according to distribution of dermatomes. Presence or absence of sensitivity to touch was registered preoperatively and it was compared to the postoperative status. Based on the results, the patients were divided into three groups:

- status identical to the preoperative one,
- status improved after surgery,
- status worsened after surgery.

2. Muscle strength of the foot plantar and dorsiflexor muscles were tested in all patients using the manual muscle test (MMT). Muscle strength scored from 0 to 5, where grades 0, 1, and 2 were considered as plegia, and 3 and 4 weakness [9].

Magnetic resonance imaging (MRI) findings of the lumbosacral spine were analyzed. The MRI examination was performed according to the standard protocol for examining the lumbosacral spine. The examination included the spinal column segment from the 10th thoracic (T10) to the 2nd sacral (S2) vertebra. T1-weighted and T2-weighted sagittal images and axial T2-weighted images were made. Based on this examination, the degree of degeneration of the operated intervertebral disc was assessed according to Pfirrmann [10]. In the display of the results, the degree of the intervertebral disc degeneration was grouped into:

- Milder degree (grade I, II, III according to Pfirrmann) of degenerative changes
- Pronounced degree (grade IV, V according to Pfirrmann) of degenerative changes

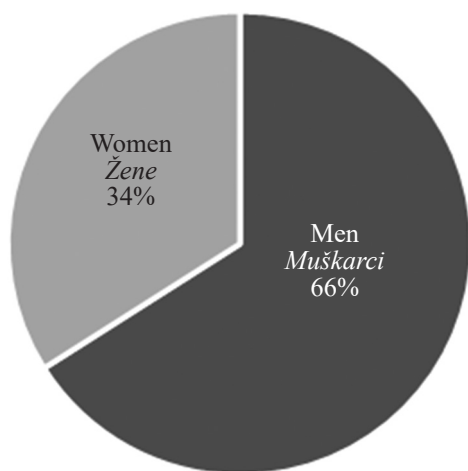
Criteria for the Pfirrmann grading system:

- Grade I: Intervertebral disc structure is homogeneous, with hyperintense signal of the nucleus pulposus, and preserved height of the intervertebral space.
- Grade II: Intervertebral disc structure is inhomogeneous, with horizontal gray bands, and hyperintense signal, clear difference between the nucleus pulposus and the annulus fibrosus, with preserved height of the intervertebral space preserved.
- Grade III: Intervertebral disc structure is inhomogeneous, with intermediate gray signal intensity. The difference between the nucleus and annulus is unclear, with the height of the intervertebral space normal or slightly reduced.
- Grade IV: Intervertebral disc structure is inhomogeneous, with hypointense dark gray signal intensity. The difference between the nucleus and annulus is lost, with the height of the intervertebral space slightly to moderately reduced.

– Grade V: Intervertebral disc structure is inhomogeneous, with black signal intensity. The distinction between the nucleus and the annulus is lost, with collapsed intervertebral space.

Results

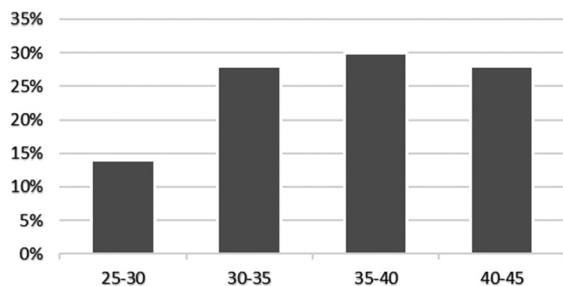
The research included 50 patients, of which 33 men (66%) and 17 women (34%) (**Graph 1**). According to age structure, there were 7 patients aged 25 to 30, 14 patients aged 31 to 35, 15 patients aged 36 to 40, and 14 patients aged 41 to 45. The youngest patient was 25 years old, and the oldest 45 years old. The average age of the patients was 36.7 (**Graph 2**).



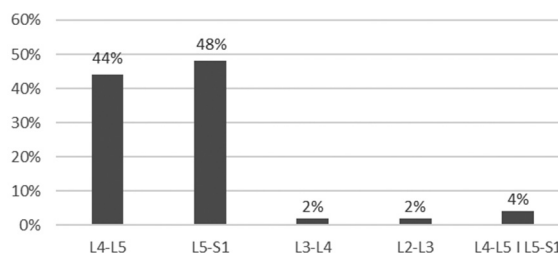
Graph 1. Distribution of patients by gender
Grafikon 1. Distribucija bolesnika po polu

Disc herniation was operated on one level and on two levels in 98% and 2% of patients respectively. Microdiscectomy at the L5-S1 and L4-5 level was performed on 24 patients (48%) and 22 patients (44%) respectively. In the remaining 4 patients (8%), microdiscectomy was performed at L3-4 (2%), L2-3 (2%) and combined at L4-5 and L5-S1 levels (4%) (**Graph 3**).

Of the applied operative techniques, interhemilaminectomy was performed on 29 (58%) patients, and flavectomy was performed on 21 patients (42%). Interlaminectomy and laminectomy were not present as operative techniques in this group of patients.



Graph 2. Age structure of patients
Grafikon 2. Starosna struktura pacijenata



Graph 3. Operated levels
Grafikon 3. Operisani nivoi

Indications for operative treatment were as follows:

3. Pain (lumbar and/or radicular) that lasted longer than 3 months and significantly disturbed the patient's ability to live and work - 31 patients (62%)

4. Muscle weakness (mostly in plantar or dorsiflexors of the foot) in 19 patients (38%).

Given that only elective surgical interventions were performed in the examined group, polyradicular syndrome (cauda equina syndrome – paraparesis with sphincter dysfunction) was not represented.

The average pain intensity was 7.6 preoperatively, and 2.4 postoperatively (**Graph 4**). A statistically significant difference was determined in pain intensity, calculated according to VAS, when compared before and after the surgery.

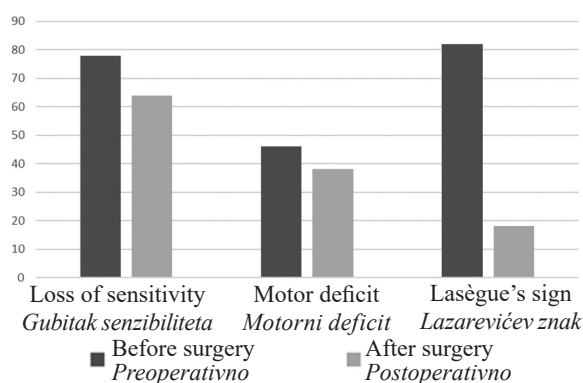


Graph 4. Mean VAS values before and after surgery
Grafikon 4. VAS srednje vrednosti pre i posle operacije

Positive straight leg raise test preoperatively was registered in 41 patients (82%), while negative test was recorded in 9 patients (18%). After lumbar microdiscectomy, the positive straight leg raise test was found in 14 patients (28%). Using the χ^2 test, it was determined that the number of patients with positive straight leg raise test ($p < 0.05$) statistically significantly decreased after the operative treatment.

Sensory loss of varying degree was registered in 39 patients (78%), while sensitivity was preserved in 11 patients (22%). 32 patients (64%) reported certain degree of sensibility disorder on discharge. No patient reported worsening of tactile sensitivity. Using the χ^2 test, it was determined that the number of patients whose sensitivity improved after the surgery was not statistically significant ($p > 0.05$) (**Graph 5**).

Muscle weakness, in the form of weakness or plegia of the plantar and dorsiflexors of the foot, was recorded in 23 patients (46%), of which 1 patient (4%) had grade 1 plagia according to MMT, and the other 22



Graph 5. The percentage of loss of sensitivity, motor deficit and Lasègue's sign before and after surgery
Grafikon 5. Procenat gubitka senzibiliteta, motornog deficita i Lazarevičevog znaka pre i posle operacije

patients had grade 3 and 4 weakness as per MMT. After the operative treatment, muscle weakness was observed in 19 patients (38%), of which 1 patient (5%) had plegia, and 18 patients had weakness.

Muscle weakness in the early postoperative period decreased in 4 patients. Using the paired t-test, no statistically significant difference in MMT scores was determined before and after operative treatment.

Classifying the degenerative changes of the intervertebral disc on MRI according to Pfirrmann, the patients were divided into two groups: Group A had 18 patients (36%) and it included grade I, II and III, and group B had 32 patients (64%), with grade IV and V.

After lumbar microdiscectomy, pain intensity in group A was reduced in 16 patients (89%), while 2 patients (11%) did not report any reduction in pain, and no patient reported any worsening of pain intensity.

In group B, 28 patients (87%) reported a decrease in pain intensity, while 4 patients (13%) reported that there had been no change in pain intensity compared to pain intensity prior to surgery.

Student t-test revealed a statistically significant reduction in pain intensity after surgical treatment ($p < 0.05$) both in patients with mild degenerative changes of the intervertebral disc (group A) and in patients with pronounced degenerative changes (group B).

In our group of subjects, all wounds primarily surgically healed and we had no infectious complications.

Discussion

Surgical treatment of lumbar disc herniation is, in addition to being one of the most common neurosurgical interventions, also the area with the greatest number of controversies in neurosurgery. Indications for operative treatment depend primarily on the clinical image and clinical course of the disease, MRI findings, as well as the technical possibilities for performing the procedure itself [11]. In modern literature, the field of indications for this type of treatment is increasingly expanding for various medical and economic reasons.

In the series of operated patients of younger age, the gender structure is in accordance with the literature.

Men are dominantly represented, and possible reasons are greater physical strain at work, more stressful occupations, and certain congenital factors [12, 13]. On the contrary, longer duration of symptoms and female gender are associated with a worse outcome of operative treatment [6].

The average age of our group of respondents was 35, which is not in accordance with the literature, but it is in line with relevant studies that included a young population [14].

Most patients were operated at the L5-S1 and L4-5 levels, which is most likely due to the fact that 95% of lumbar flexion and extension takes place at these two levels [6]. Similar data can be found in the literature, and they range from 90 - 96% of those operated on the aforementioned two lumbar levels [7, 8]. We can also find data on a significant difference in the success of operative treatment when comparing the two levels, regardless of the surgical technique [10]. There was no such observation in the conducted research.

The conducted research once again showed that persistent radicular pain or sciatica resistant to conservative treatment can be very successfully treated surgically. This is indicated by a significant difference in the VAS value, regardless of age, type of indication, and the degree of degenerative changes of the intervertebral disc. It is important to emphasize that good results are achieved postoperatively in terms of regression of radicular pain regardless of the preoperative degree of distinction of degenerative changes of the intervertebral disc according to Pfirrmann [15].

According to the guidelines, elective operative neurosurgical treatment is indicated in patients having lumbar disc herniation with radicular pain that present for more than 4-6 weeks, regardless of the type of conservative treatment performed, and when there is a significant progression of pain intensity regardless of time [10, 11].

Studies show that complete recovery of sensitivity after the compression syndrome requires several months, while improvements are rarely observed in the early postoperative period [12].

The disappearance of the motor deficit caused by compression of the spinal nerves is rarely observed in the early postoperative period, while there is significant improvement after operative treatment and implemented rehabilitation therapy, and after several months [11].

In a more recent observational study conducted in Sweden – Swespine study, it was observed that adolescents and people of a younger age show better results after the lumbar disc herniation treatment, and they are more satisfied when returning to daily activities compared to the older population. The primary objective of this study was the self-assessment of patients before and after the surgical treatment [11].

A large number of neurosurgical studies indicate that there is reduction in symptoms after surgery in elderly patients, but the return to work and daily activities is less frequent [14].

In studies conducted in the United States of America, the results indicate that young and active

patients after surgical treatment of lumbar disc herniation can successfully return to physically demanding occupations and professional sports [13].

All studies indicate that lumbar microdiscectomy is a safe and reliable surgical method with a low rate of complications. It was also observed that the degree of complications in the younger population is lower, which is probably related to the rare comorbidity and very important previously performed spinal procedures [14, 15].

Conclusion

1. The conducted research confirms that lumbar microdiscectomy achieves good treatment results in terms of significant reduction in pain intensity postoperatively.

2. Regression of preoperative loss of tactile sensitivity after surgery is observed in a smaller number of patients, which correlates with the fact that the return of sensitivity in most patients is observed in a later period compared to the observed period.

3. The improvement of motor deficit postoperatively is not statistically significant, considering that a longer period of time is needed for the complete recovery of motor functions.

4. There is equal reduction of pain intensity after lumbar microdiscectomy both in patients with mild and the ones with pronounced degenerative changes on the disc.

5. When performed in the right indications by a competent surgical team, lumbar microdiscectomy is a safe procedure with few complications, short stay in the hospital, and good postoperative results.

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