Analysis of pain and disability improvement after lumbar discectomy

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Abstract

Lumbar discectomy represents the golden standard for surgical therapy of intervertebral disc hernia causing sciatic pain. The goals of surgery are to decompress the impinged nerve root and to improve disability and leg pain. Disability and pain are clinically monitored by various self-assessment questionnaires, among which core outcome measures index (COMI) back, Oswestry disability index (ODI) and visual analogue scale (VAS) for back and leg pain represent the commonest. Previous studies indicate that lumbar discectomy provides quick pain relief and disability improvement with relatively stable improvement over time. This study aims to assess pain and disability improvement on a sample from a larger hospital. A retrospective analysis of prospectively collected data was employed. We assessed all patients with lumbar discectomy in years 2018 and 2019 that returned a complete set of follow up self-assessment questionnaires 3, 6, 9 and 12 months after surgery. 59 patients were assessed in the final analysis. Average follow up COMI back, ODI, VAS for back and legs were significantly ($p<0,05$) reduced after surgery, and remained stable until the 12 months follow up. We conclude lumbar discectomy to enable quick disability, leg and back pain reduction with a stable improvement of symptoms over the first 12 months after surgery. Keywords: lumbar discectomy, surgery, disc hernia, pain

Analiza bolečine in telesne prizadetosti po ledveni diskektomiji

Povzetek

Ledvena discektomija predstavlja zlati standard operativne terapije pri simptomatskih hernijah medvretenčne ploščice. Glavna cilja operacije sta dekompresija vtisnjene živčne korenine in izboljšanje telesne prizadetosti in bolečine vzdolž noge. Telesno prizadetost in bolečino klinično ocenjujemo z različnimi samo-ocenjevalnimi vprašalniki, med katerimi so core outcome measures index (COMI) za hrbet, Oswestry indeks prizadetosti (ODI) in vizualna analogna skala (VAS) za hrbet in za noge najpogosteje uporabljani. Predhodne študije nakazujejo, da ledvena discekotmija zagotavlja hitro izboljšanje bolečine in telesne prizadetosti, izboljšanje pa ostaja stabilno v daljšem časovnem obdobju. Cilj te študije je oceniti izboljšanje bolečine in telesne prizadetosti na vzorcu pacientov iz večje bolnišnice. Napravili smo retrospektivno analizo prospektivno zbranih podatkov. Vključili smo vse paciente z ledveno disketomijo, ki so bili operirani v letih 2018 in 2019 in so izpolnili in vrnili samo-ocenjevalne vprašalnike 3, 6, 9 in 12 mesecev po operaciji. V končno analizo smo vključili 59 pacientov. Povprečni COMI za hrbet, ODI, VAS za hrbet in za noge so se statistično značilo izboljšali ($p<0,05$) ob prvem merjenju po operaciji in so ostali stabilni do 12 mesečnega sledenja. Zaključujemo, da ledvena discektomija omogoča hitro izboljšanje telesne prizadetosti in bolečine v križu in v nogi ter hkrati zagotavlja stabilno izboljšanje simptomov v prvih 12 mesecih po operaciji. Ključne besede: ledvena discektomija, operacija, hernija diska, bolečina

1. INTRODUCTION

Intervertebral disc herniation causing sciatic pain is a common clinical problem causing back and leg pain and consequently physical disability. While lumbar disc herniation occurs in approximately 20% of the asymptomatic population (Boos et al., 2000), symptomatic lumbar disc herniation occurs in 1-3% of the general population, more common between the ages 30 and 59 (Jordon et al., 2009, Deyo et al., 1987).

A study by Kim et al. (2008) showed that incidence of lumbar disc herniation within the working population increases with age, differs upon sex (incidence was higher in women) and is possibly occupationally related to individuals with a higher lumbar burden (Kim et al., 2008).

Lumbar discectomy represents the most common surgical procedure employed to treat intervertebral lumbar disc herniation causing sciatic pain (Weinstein et al., 2006; Deyo et al., 2001). The main goals of surgery are to decompress the impinged nerve, remove the bulged disc tissue and therefore instantly reduce the leg pain. Following surgery, most patients should improve in terms of the bodily pain, disability and function (Gibson et al., 2007).

While all surgical procedures follow the same goals, different techniques were developed in order to release the impinged nerve root. Broad classification differentiates three major surgical technique types: open lumbar discectomy, microdiscectomy, and tubular or endoscopic discectomy (Gibson et al., 2007). Currently open discectomy and microdiscectomy are most common, alternative techniques comprise only a small percent of procedures (Stromqvist et al., 2013). Based on these techniques, other modified procedures were developed and described. Meta-analyses comparing different techniques did not confirm any evidence of superiority of one over the others (Gibson et al., 2007; Jacobs et al., 2012; Gotfryd et al., 2009).

Clinical pain and disability assessment are performed with the use of self-assessment questionnaires. Most commonly employed in the field of spine surgery is the Oswestry disability index (ODI) which poses ten sets of questions concerning the general function and disability of the patient. Disability is calculated on a 0 to 100% scale, where a result of 0-20% represents minimal disability, 20-40% moderate disability, 40-60% severe disability, 60-80% crippled status, and 80-100% bed bound or exaggerating symptoms [Fairbank et al., 2000]. Back and leg pain are measured with the visual analogue scale (VAS) which represents individual's subjective pain assessment on a scale from 0 to 10 [Grant et al., 1999]. A valuable instrument to assess multidimensional surgical outcomes in spine surgery is also the Core outcome measures index (COMI), which implement questions on back and leg pain, general life function and disability. COMI is scored as a 0-10 index, where minimal clinically important score difference for improvement was calculated at 2,2 (Mannion et al, 2009).

The objective of this manuscript is to measure the clinical improvement of a group of patients who reported the self-assessment data after lumbar discectomy within the first year after surgery. We hypothesize quick improvement of symptoms and stable clinical outcome within the first 12 months of follow up.

2. METHODS

Study design and participants

This was a retrospective analysis of prospectively collected data in a single center spine surgery database.

We reviewed our center's spine surgery database for all patients who had a lumbar discectomy in 2018 and 2019. We included patients with (1) isolated single level lumbar discectomy, (2) self-assessment outcome questionnaires submitted every three months for the follow up period of 12 month. Exclusion criteria were as follows: (1) lumbar discectomy accompanied with another procedure (spinal decompression, spinal fusion), (2) unresponsiveness to self-assessment follow up, and (3) follow up period less than 12 months. All participants consented to data gathering and processing at the time of surgery.

Participants' evaluation
We evaluated the patients in our self-assessment database for eligibility for enrolment into the study based on the inclusion and exclusion criteria. We noted their age at surgery, sex, and previous spinal surgeries. Self-assessment was performed every three months for the first 12 months after surgery. It was monitored with COMI back questionnaire, ODI and VAS for back pain and VAS for leg pain.

Interventions
Surgeries were performed at the Department of Orthopedic surgery in a University hospital. We employed a classical minimally invasive open discectomy using Caspar's retractors [Jacobs et al., 2012] as the surgical method of choice. A radiographic mark was performed for the level of surgery, followed by a midline incision above the conjoining spinous processes, dissection of the subcutaneous fatty tissue and fascial incision on the ipsilateral side of the herniated disc. Paravertebral muscles were then dissected form the spinous processes and laminae and ligamentum flavum was bluntly separated to reach the spinal canal. Partial resection of ligamentum flavum was performed along with laminotomy of the upper vertebra in order to visualize and expose the passing nerve, the intervertebral disc, and the sequestration. Following the removal of sequester partial discectomy was done until sturdy tissue of the disc was encountered. All patients underwent the same standardized postoperative care and physical therapy protocol, and were discharged on the second postoperative day.

Outcomes
The primary outcome measures of the study were functional outcome self-assessment data (COMI back, ODI, VAS for back and leg pain) in the preoperative and four postoperative periods.

Sample size
This study aimed to recruit as many patients as possible from the two-year period between the beginnings of 2018 until the end of 2019. As data was prospectively collected, based on the personal choice of the patients to return the self-assessment questionnaires, only 12% of analyzed patients fitted the inclusion and exclusion criteria.

Statistical analysis
We used an ANOVA test to assess the statistical significance of differences of the primary outcome measures (COMI back, ODI, VAS for back and leg pan) between different postoperative periods. We then performed a Bonferroni multiple comparisons test to calculate the statistical significance of differences between all individual outcome measures within distinctive follow up periods (preoperative, 3 months, 6 months, 9 months, and 12 months). $P < 0.05$ was considered statistically significant.

3. RESULTS

Baseline data
We assessed 620 patients for eligibility, 500 of those fulfilled surgical criteria, however only 59 returned a complete set of self-assessment questionnaires in all follow up periods. The final analysis included 38 male and 21 female patients. Average age at surgery of the included patients was 50,6 (±13,5) years. Twentyfour (41%) patients had a herniated disc at the L5S1 level, 25 (42%) patients at the L4L5 level, 6 (10%) patients at the L3L4 level, 3 (5%) patients at the L2L3 level, and 1 (2%) patient at the L1L2 level.
We included patients who have undergone lumbar discectomy however some of them had other concomitant spinal pathologies. One had concomitant asymptomatic two-level spinal stenosis, 5 patients had a recurrent disc herniation at the index level, two of these the second recurrence. Three patients had previous lumbar discectomies at other than the index level, whereas one of them had two previous surgeries at the same non-index level.
Nine patients (15%) had a motor neurological deficit prior to surgery; two patients had clinical signs corresponding to cauda equina syndrome (acute overflow incontinence and perineal sensibility loss along with motor neurological deficit). Both recovered to normal bladder and bowel functions.

One patient suffered from a concomitant aseptic necrosis of the femoral head and had a hip replacement surgery within the follow up period. Table 1 includes summary of the self-assessment measures analysis of the finally included patients.

Table 1: Analysis of the self-assessment questionnaires in different follow up periods

Outcome measure	Preoperative Mean (SD)	3 months Mean (SD)	6 months Mean (SD)	9 months Mean (SD)	12 months Mean (SD)
COMI back	8,35 (0,57)	5,12 (2,56)	4,07 (2,26)	4,04 (2,33)	4,23 (2,41)
ODI	65,14 (7,82)	34,57 (20,35)	29,23 (18,99)	32,20 (16,92)	31,86 (20,05)
VAS back	7,80 (0,78)	3,46 (2,35)	3,19 (2,32)	3,76 (2,16)	3,88 (2,44)
VAS leg	7,76 (1,13)	3,85 (2,74)	3,27 (2,41)	3,12 (2,58)	3,25 (2,50)

Follow up analysis

The ANOVA test was statistically significant ($p<0,05$) for all tested primary outcome measures (COMI back, ODI, VAS back, VAS leg) (Table 2). The Bonferroni multiple comparisons test results are presented in Table 3. The calculation shows a statistically significant difference ($p<0,05$) between the preoperative measurement and the first postoperative measurement for all four parameters. Comparison between the 3 months follow up and the following follow ups shows no statistical significance ($p>0,05$).

Table 2: ANOVA test for primary outcome measures

Outcome measure	p
COMI back	0,000
ODI	0,000
VAS back	0,000
VAS leg	0,000

The Bonferroni multiple comparisons test results are presented in Table 3. The calculation shows a statistically significant difference ($p<0,05$) between the preoperative measurement and the first postoperative measurement for all four parameters. Comparison between the 3 months follow up and the following follow ups shows no statistical significance ($p>0,05$).

Table 3: Bonferroni multiple comparisons between different follow up periods

COMI back			ODI		
,00	3,00	,000	,00	3,00	,000
	6,00	,000		6,00	,000
	9,00	,000		9,00	,000
	12,00	,000		12,00	,000
3,00	,00	,000	3,00	,00	,000
	6,00	,091		6,00	1,000
	9,00	,072		9,00	1,000
	12,00	,255		12,00	1,000
6,00	,00	,000	6,00	,00	,000
	3,00	,091		3,00	1,000
	9,00	1,000		9,00	1,000
	12,00	1,000		12,00	1,000
9,00	,00	,000	9,00	,00	,000
	3,00	,072		3,00	1,000
	6,00	1,000		6,00	1,000
	12,00	1,000		12,00	1,000
12,00	,00	,000	12,00	,00	,000
	3,00	,255		3,00	1,000
	6,00	1,000		6,00	1,000
	9,00	1,000		9,00	1,000

VAS back			VAS leg		
,00	3,00	,000	,00	3,00	,000
	6,00	,000		6,00	,000
	9,00	,000		9,00	,000
	12,00	,000		12,00	,000
3,00	,00	,000	3,00	,00	,000

	6,00	1,000		6,00	1,000
	9,00	1,000		9,00	,952
	12,00	1,000		12,00	1,000
6,00	,00	,000	6,00	,00	,000
	3,00	1,000		3,00	1,000
	9,00	1,000		9,00	1,000
	12,00	,761		12,00	1,000
9,00	,00	,000	9,00	,00	,000
	3,00	1,000		3,00	,952
	6,00	1,000		6,00	1,000
	12,00	1,000		12,00	1,000
12,00	,00	,000	12,00	,00	,000
	3,00	1,000		3,00	1,000
	6,00	,761		6,00	1,000
	9,00	1,000		9,00	1,000

4. DISCUSSION

The natural path of clinical symptoms after intervertebral disc herniation includes acute or subacute onset of back and leg pain, possibly with neurologic deficit, that generally slowly resides within three months of onset (Jordon et al., 2009). Urgent surgery is indicated in case of a cauda equine syndrome or acute motor neurologic deficit affecting bodily function. Elective surgery is indicated when the sciatic pain continues for more than 3 months or cannot be appropriately medically managed (Vodičar et al., 2017). Based on systematic reviews of the literature, lumbar discectomy is perceived to be the surgical method of choice. It should enable improved function and disability with instantaneous leg pain reduction and concomitant back pain reduction with a stable and beneficial long-term result (Gibson et al., 2007; Kreiner et al., 2014).

The results of our study show statistically significant difference between the disability and pain scores before surgery and after all stages of follow up. This confirms the hypothesis that lumbar discectomy assures quick pain relief and disability improvement that remains stable over 12 months.

There are no statistically significant differences between the 3 months follow up and consecutive follow ups which indicates that clinical improvement is achieved quickly after surgery, and does not change later on.

Forty-two percent of participants had a herniation at the L4L5 level and 41% at the L5S1 level. The more cranial levels are less represented. The distribution of levels in our random sample nearly fits to the results of a study by Pietilä et al, which showed that 58% of patients had a herniation at the L5S1 and 38% of patients at the L4L5 level. The authors of this study suggest that the age of the patients correlates with the cranialization of the disc herniation [Pietilä et al., 2001]. The participants in our study were 25 years older on average in comparison to the sample in Pietilä's study, which would explain the difference in the distribution of the affected levels.

In comparison to a previous clinical study we performed on a selected population of younger patients (Vodičar et al., 2017), the outcome measures were reduced more after 3 months (ODI 20,3, VAS back 1,1, VAS leg 1,1) than in this study (ODI 34,6, VAS back 3,46, VAS leg 3,85). There are several possible explanations for this occurrence. Firstly, the participants of the previous study were carefully selected by age and longevity of the symptoms, while in general, especially older population, included in this study the pain and disability reduction potential are lesser. This explanation would be in accordance with the study by Kim et al, where a big data analysis of insurance eligibility showed correlation between increased age and worse clinical outcome (Kim et al., 2018). Secondly, 14% of participants of this studied group had a previous spine surgery at the index of other level. According to Buchmann et al, repeated lumbar discectomies had a mean postoperative ODI of 41,7 (Buchmann et al., 2016), which could explain an increase in overall average postoperative increase in disability and pain in our sample. Third, there may be a sample bias as the sample was chosen based on the random compliance of the patients. It had been previously suggested that the patients with poorer outcomes tend to return the self-assessment questionnaires more often and tend to have more discrepancy between clinical status and self-assessment tools (Lattig et al., 2009).

A relatively large proportion of patients with acute motor neurological deficit and cauda equina syndrome (19%) may suggest that patients with more severe clinical symptoms are more likely to be compliant for follow up.
There are certain limitations to this study, especially sample bias, and relatively poor compliance of the general patients' population. The biggest strength is that there is a complete set of follow up data for all patients.

5. CONCLUSION

Lumbar discectomy enables quick disability, leg and back pain reduction with a stable improvement of symptoms over the first 12 months after surgery.

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