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Radicular Pain Outcomes for Disc Hernia Patients Undergoing Microdiscectomy: The Role of Early Preoperative Pain Duration

Mahmut Özden[1], Gülşah Öztürk[2], Melih Bozkurt[1,3]
[1] Department of Neurosurgery, Private Memorial Hospital
[2] Department of Neurosurgery, College of Health Sciences, Gelisim University
[3] Department of Neurosurgery, Arel University, Istanbul, Turkey

Abstract
Aim: This study aims to determine whether early duration of pain before microdiscectomy in patients with lumbar disc hernia and radicular pain influences postoperative pain outcomes evaluated by the Visual Analog Scale (VAS).
Material and Methods: The study included 124 patients (68 males, 56 female), who underwent lumbar microdiscectomy. The patients' demographic features, anatomical features of disc hernia, motor paresis, and VAS values were retrospectively determined and statistically analyzed using the Number Cruncher Statistical System software.
Results: As expected, microdiscectomy significantly reduced pain intensities as assessed inthe immediate postoperative period, at the 3rd and 6th months of the postoperative period. But when patients were stratified according to the median preoperative pain duration (14 days), there was no statistically significant difference between patients with pain lasting shorter or longer than the median pain duration. Further, Spearman correlation statistics also did not reveal a significant association between preoperative duration and postoperative VAS pain scores.
Discussion: For early intervals of pain during the initial manifestation of the lumbar disc disease, patients will equally benefit from surgical treatment regardless of the pain duration. Therefore, in lumbar radicular pain, it would be appropriate to avoid being too hasty in the surgical decision in the early period and to better weigh the benefits and risks of surgery if there is no neurological deficit and unbearable pain.

Keywords
Disc Hernia, Lumbar Microdiscectomy, Radicular Pain, Visual Analog Scale

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Corresponding Author: Melih Bozkurt, Department of Neurosurgery, Memorial Hospital, 34180, Bahcelievler, Istanbul, Turkey.
E-mail: : melihbozkurt@hotmail.com P: +90 505 502 55 39
Corresponding Author ORCID ID: https://orcid.org/0000-0003-2441-0015
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Introduction

Low back pain is the most frequent cause of disability and loss of work hours, as well as the second most common cause for seeking medical help; and lumbar disc hernias are among the most frequent causes of low back and leg pain [1-3]. Disc herniation is a localized displacement of disc material from beyond the intervertebral disc space, which is <25% of the disc circumference when determined axially [4]. Lumbar disc hernia surgery has a proven efficiency, but there is no general clinical consensus on whether it should be the first-line treatment [5-7]. In patients with lumbar radicular pain, previous studies investigated whether the preoperative duration of symptoms (mainly pain) was associated with changes in physical function and pain after lumbar disc surgery [5, 7-15]. However, there is no consensus on this issue. Additionally, in previous studies, pain durations were not stratified according to the median duration of pain, which would reflect the real-life scenarios more precisely. Moreover, many studies have included disc hernia patients involving multi-level disc disease. Further, in these studies, the surgical times after the onset of pain included very delayed periods. Here, we analyzed our cohort of patients (n=124) with a single level of disc hernia, who were surgically treated at relatively earlier periods. Also, as will be detailed below, we performed detailed and relevant statistics in a carefully selected cohort to evaluate associations between the duration of early preoperative pain with surgical outcomes both with the Mann-Whitney U test and Spearman Correlation analysis. Besides determining the pain intensities with Visual Analog Scale (VAS) scores, we also included the side and level of disc hernia and the extent of paresis in our statistical analysis. Other detailed observations in our cohort regarding the associations of other concurrent diseases seemingly unrelated to disc pathology (diabetes not accompanied with diabetic neuropathy, etc) and inflammatory factors (neutrophil/platelet and lymphocyte/platelet ratios) with pain outcomes will be discussed in another study.

Material and Methods

Study Design. Patient Population, Inclusion and Exclusion Criteria

This retrospective clinical research was designed in accordance with the ethical standards of the institutional and regional responsible committee and in accordance with the Helsinki Declaration of 1975, as revised in 2000. Ethical approval was obtained from the institutional ethics committee of Memorial Bahcelievler Hospital (approval number 32; 2022-03-28). All patients signed informed consent forms for study participation. All patients who underwent surgery were previously treated with physical therapy and/or proper medications conservatively. The pain intensities were defined with VAS (Visual Analog Scale) scores. The study included patients whose radiological features of single-level lumbar disc herniation correlated with lumbar radicular pain. All patients had radicular leg pain without spinal stenosis observed on magnetic resonance imaging. The exclusion criteria were as follows: diffuse neurological deficits (cauda equina syndrome), lumbar spine pathologies of other etiologies, including infections, previous fractures, primary spinal tumors and metastases, advanced degenerative diseases of vertebral bones, spinal column malformations, and other neurologic, osteologic, and muscular diseases associated with pain.

Clinical Assessment

Demographic factors (i.e., age, gender), preoperative pain duration, disc hernia side and levels were determined and recorded for each patient. The extent of paresis (loss of muscle strength/motor deficit) was determined with a semiquantitative scale between 0 to 5 (no paresis to complete paresis) as evaluated by physical examination. Pain intensity as determined by VAS values was recorded preoperatively, immediately after surgery, and 3 and 6 months postoperatively.

Surgical Procedure

The senior author of this study (Melih Bozkurt) performed all surgical procedures at a single institution (Memorial Bahcelievler Hospital, Istanbul, Turkey). Single-level simple lumbar microdiscectomy was performed on all patients. Microdiscectomy was performed after partial hemilaminectomy plus flavectomy and root decompression with foraminotomy under surgical microscopy.

Statistical Analysis

The statistical program NCSS (Number Cruncher Statistical System, 2007, Utah, USA) was employed for statistical analysis. Descriptive statistical methods (i.e., median, mean, standard deviation, frequency, percentage, minimum, maximum) were used to evaluate the study data. Student's t-test and the Mann-Whitney U test were performed for comparisons between two groups of normally and non-normally distributed quantitative variables, respectively. One-way analysis of variance and the Kruskal-Wallis test were utilized for comparisons between groups of more than two normally and non-normally distributed quantitative variables, respectively. Pearson Chi-Square test and Fisher Freeman Halton test were utilized to compare qualitative data. The Friedman test was used to compare more than two repeated measurements of quantitative variables without normal distribution. Spearman correlation analysis was used to evaluate the relationships between quantitative variables. Statistical significance was set at $p < 0.05$.

Ethical Approval

Ethics Committee approval for the study was obtained.

Results

Patients' demographics and clinico-pathological features are summarized in Table-1. The total number of patients was 124 (68 male, 56 female). The mean duration of preoperative pain was 14 days or less in 63 patients (50.8%) and more than 14 days in the remaining 61 patients (49.2%) participating in the study. 41.9% (n=52) of the cases were on the right side and 58.1% (n=72) were on the left side. The affected levels were as follows: 1.6% (n=2) L1-2, 2.4% (n=3) L2-3, 7.3% (n=9) L3-4, 54% (n=67) L4-5, and 34.7% (n=43) L5-S1, respectively. While 39 (31.5%) had no paresis (loss of muscle strength), 7 patients (5.6%) had level 4 paresis. The mean preoperative VAS score of the patients was 9.10 ± 0.69. These values dropped to 1.53± 1.07, 1.35 ± 1.12, and 1.24 ± 1.16 in the immediate postoperative period, 3rd and 6th month of the postoperative period, respectively. Patient pain reductions at all times were statistically significant ($p<0.001$), indicating the expected

efficacy of surgery.

The characteristics of disc hernia patients stratified according to preoperative pain duration are summarized in Table 2. Gender, age and herniation side did not exert differences according to preoperative pain duration. Statistically significant differences were found between the preoperative, immediate postoperative, postoperative 3rd-month and postoperative 6th-month VAS scores of patients with preoperative pain duration of both ≤14 and ≥15 days (P=0.001; P < 0.01 for both intervals, respectively). Postoperative VAS measurements did not differ between those with preoperative pain duration <15 and ≥15 days analyzed with the Mann-Whitney U test. Spearman's correlation analyses between preoperative pain duration and the preoperative, immediate postoperative, 3rd-month postoperative, and 6th- month postoperative VAS scores were also not statistically significant (r = −0.112, P=0.26; r = −0.09, P=0.49; r = −0.041, P=0.653; r = 0.01, P=0.733; respectively) (data not shown in table). Table-3 summarizes the changes in VAS scores and their correlation with patient demographics and clinicopathological features. Preoperative, immediate postoperative, 3rd postoperative, and 6th postoperative month VAS measurements of the cases did not differ according to gender and level of disc hernia (P>0.05). Age, side of disc hernia, and extent of paresis had some associations with preoperative and postoperative pain, which all will be discussed in detail in another study.

Table 1. General characteristics of patients.

Patient Demographics & Clinico-Pathological Features		n (%)
Sex	Male	68 (54,8)
	Female	56 (45,2)
Age	Mean±Std	46,62±12,71
	Median (Min-Max)	45 (19-78)
Preop Pain Duration	Mean+Std	28,09±42,89
	Median (Min-Max)	14,5 (1-365)
	≤14	63 (50,8)
	≥15	61 (49,2)
Side	Right	52 (41,9)
	Left	72 (58,1)
Level	L1-2	2 (1,6)
	L2-3	3 (2,4)
	L3-4	9 (7,3)
	L4-5	67 (54,0)
	L5-S1	43 (34,7)
Extent of Paresis	0	39 (31,5)
	1	41 (33,1)
	2	27 (21,8)
	3	10 (8,1)
	4	7 (5,6)
Extent of Pain, Mean±Std (min-max)		
Preop VAS		9,10±0,69 (8-10)
Immediate Post-Op VAS		1,53±1,07 (0-5)
VAS – Postop 3rd month		1,35±1,12 (0-6)
VAS – Postop 6th month		1,24±1,16 (0-4)

VAS: Visual Analog Scale

Table 2. Patient Features Classified According to the Preoperative Pain Duration.

Patients Features	Duration ≤14 days (n=63)	Duration ≥ 15 days (n=61)	p-value
Age			
Mean±Std	45,61±11,59	47,67±13,79	[a]0,371
Median (Min-Max)	44 (19-73)	47 (24-78)	
Gender; n(%)			
Male	38 (60,3)	30 (49,2)	[b]0,279
Female	25 (39,7)	31 (50,8)	
Hernia Side; n(%)			
Right	25 (39,7)	27 (44,3)	[b]0,605
Left	38 (60,3)	34 (55,7)	
Extent of Paresis; n(%)			
0	25 (39,7)	14 (23,0)	[d]0,011**
1	13 (20,6)	28 (45,9)	
2	13 (20,6)	14 (23,0)	
3	6 (9,5)	6 (6,6)	
4	6 (9,5)	1 (1,6)	
Extent of Pain – Visual Analog Scale (VAS)			
Preop VAS			
Mean±Sd	9,14±0,74	9,07±0,65	[e]0,494
Median (Min-Max)	9 (8-10)	9 (8-10)	
Immediate Post-Op VAS			
Mean±Sd	1,57±1,04	1,49±1,10	[e]0,519
Median (Min-Max)	2 (0-4)	1 (0-5)	
VAS – Postop 3rd month			
Mean±Sd	1,40±1,02	1,31±1,22	[e]0,378
Median (Min-Max)	1 (0-4)	1 (0-6)	
VAS – Postop 6th month			
Mean±Sd	1,20±1,11	1,27±1,22	[e]0,850
Median (Min-Max)	1 (0-4)	1 (0-4)	
p	g0,001**	g0,001**	

[a]Student's t-test, [b]Pearson's Chi-Square Test, [d]Fisher-Freeman-Halton Test, [e]Mann Whitney-U Test, [g]Friedman Test & post hoc

Discussion

Lumbar disc hernia surgery is a treatment modality with well-established efficacy, especially in single-level sequestered discs [14, 15]. However, there is no consensus regarding its use as a first-line treatment approach compared to other major treatment options [5, 6, 13, 16, 17]. The presence of a significant motor deficit may be a valid reason for choosing surgery as the first-line treatment option [10, 11]. The contribution of preoperative symptom duration to postoperative well-being is accepted as a clinically relevant variable but there is no consensus on the length of this period [5, 17, 18, 19]. Further, recommendations for surgical timing among several earlier studies differ, ranging from 6 weeks to 12 months [5, 7, 8, 12, 13, 15, 17-19]. In our study, we aimed to analyze patients with a relatively early duration of preoperative pain and hence, we determined the median value of the preoperative pain duration of our patients as a touchstone to compare postoperative pain outcomes.

Akagi et al. retrospectively analyzed 46 lumbar disc herniation patients treated with microendoscopic discectomy [5]. They divided patients into 2 groups (23 patients each) according to their preoperative symptom duration. They selected 3 months

Table 3. Characteristics of Pain as Assessed with Visual Analog Scale.

Intensity of Pain – VAS Scores			Preop VAS	Immediate Post-Op	Postop 3rd month	Postop 6th month	Change – Pre vs Postop	Pre vs Postop 3rd month	Pre vs Postop 6th month
Age	Age <45	Mean±Std	9,22±0,73	1,59±1,19	1,43±1,25	1,32±1,27	7,63±1,27	7,79±1,39	7,82±1,40
		Median (Min-Max)	9 (8-10)	1 (0-5)	1 (0-6)	1 (0-4)	8 (5-10)	8 (3-10)	8 (5-10)
	Age ≥ 46	Mean±Std	8,98±0,65	1,48±0,94	1,28±0,97	1,16±1,05	7,51±1,13	7,72±1,11	7,77±1,18
		Median (Min-Max)	9 (8-10)	1 (0-3)	1 (0-4)	1 (0-3)	8 (5-10)	8 (5-10)	8 (5-10)
	p Value		[e]0,051	[e]0,814	[e]0,718	[e]0,646	[e]0,557	[a]0,084	[a]0,069
Gender	Male	Mean±Std	9,10±0,67	1,62±1,07	1,34±1,15	1,20±1,12	7,49±1,17	7,79±1,30	7,83±1,25
		Median (Min-Max)	9 (8-10)	2 (0-5)	1 (0-6)	1 (0-4)	8 (5-10)	8 (3-10)	8 (5-10)
	Female	Mean±Std	9,11±0,73	1,43±1,08	1,38±1,09	1,28±1,23	7,68±1,25	7,71±1,22	7,76±1,35
		Median (Min-Max)	9 (8-10)	1 (0-5)	1 (0-4)	1 (0-4)	8 (5-10)	8 (5-10)	8 (5-10)
	p Value		[e]0,939	[e]0,245	[e]0,768	[e]0,833	[e]0,347	[a]0,881	[a]0,945
Level of Disc Hernia	L4-L5	Mean±Std	9,00±0,70	1,60±1,14	1,43±1,23	1,20±1,22	7,40±1,22	7,58±1,30	7,67±1,31
		Median (Min-Max)	9 (8-10)	1 (0-5)	1 (0-6)	1 (0-4)	7 (5-10)	8 (3-10)	8 (5-10)
	L5-S1	Mean±Std	9,16±0,69	1,51±1,01	1,19±0,93	1,13±0,99	7,65±1,15	7,98±1,12	8,03±1,14
		Median (Min-Max)	9 (8-10)	1 (0-3)	1 (0-3)	1 (0-3)	8 (6-10)	8 (6-10)	8 (5-10)
	P Value		[e]0,230	[e]0,883	[e]0,430	[e]0,974	[e]0,293	[a]0,299	[a]0,190
Side of Disc Hernia	Right	Mean±Std	8,94±0,70	1,46±0,87	1,33±1,04	1,16±1,07	7,48±1,13	7,63±1,25	7,73±1,33
		Median (Min-Max)	9 (8-10)	2 (0-3)	1 (0-4)	1 (0-3)	7,5 (5-10)	8 (5-10)	8 (5-10)
	Left	Mean±Std	9,22±0,68	1,58±1,20	1,38±1,18	1,30±1,24	7,64±1,26	7,85±1,26	7,86±1,27
		Median (Min-Max)	9 (8-10)	1 (0-5)	1 (0-6)	1 (0-4)	8 (5-10)	8 (3-10)	8 (5-10)
	p Value		[e]0,028*	[e]0,933	[e]0,952	[e]0,652	[e]0,318	[a]0,387	[a]0,526
Extent of Paresis	0	Mean±Std	9,33±0,66	1,74±1,14	1,46±1,02	1,08±1,02	7,59±1,19	7,87±1,10	8,17±1,28
		Median (Min-Max)	9 (8-10)	2 (0-5)	2 (0-4)	1 (0-4)	8 (5-10)	8 (6-10)	8 (5-10)
	1	Mean±Std	8,88±0,71	1,37±0,94	1,20±1,17	1,13±1,22	7,51±1,21	7,68±1,27	7,67±1,20
		Median (Min-Max)	9 (8-10)	1 (0-3)	1 (0-6)	1 (0-4)	8 (5-9)	8 (3-10)	8 (5-10)
	2	Mean±Std	9,26±0,59	1,44±1,25	1,19±1,11	1,35±1,15	7,81±1,21	8,11±1,19	7,87±1,29
		Median (Min-Max)	9 (8-10)	1 (0-5)	1 (0-4)	1 (0-3)	8 (5-10)	8 (6-10)	8 (6-10)
	3	Mean±Std	8,80±0,79	1,90±0,57	1,90±1,20	2,11±1,27	6,90±1,20	6,90±1,52	6,67±1,22
		Mean±Std	9 (8-10)	2 (1-3)	2 (0-4)	2 (0-4)	7 (5-9)	6,5 (5-9)	7 (5-8)
	4	Median (Min-Max)	9,00±0,58	1,14±1,07	1,57±1,27	1,14±1,21	7,86±1,21	7,43±1,51	7,86±1,35
		Median (Min-Max)	9 (8-10)	1 (0-3)	2 (0-3)	1 (0-3)	8 (6-9)	7 (6-10)	8 (6-10)
	p Value		[f]0,020*	[f]0,192	[f]0,219	[f]0,220	[f]0,376	[aa]0,100	[aa]0,032*

[a]Student t-test, [aa]Oneway Anova, [e]Mann-Whitney U Test, [f]Kruskal-Wallis Test *p<0,05**p<0,01

as a threshold, since previous studies demonstrated permanent neural injury within 12 weeks of disc hernia-induced nerve compression [5, 9]. However, they did not encounter a significant effect of symptom duration on surgical outcomes as assessed with VAS pain scores. These results are compatible with our findings, including a higher number of patients. Schoenfeld and Bono reviewed 11 studies and in 9 out of 11 studies, 4 of which were prospective, longer symptom duration negatively affected postoperative recovery [13]. However, they also admitted that 5 out of 9 studies in their analysis found that surgery could be performed for 6 months or longer without affecting patient recovery [13].

Støttrup et al. conducted a prospective cohort investigation on 2144 patients who were surgically treated for lumbar disc hernia and divided the subjects into three groups based on their preoperative leg pain duration: <3 months, 3–12 months, and >12 months [15]. They revealed that patients who underwent surgery within the first 3 months of leg pain demonstrated better results 1 year postoperatively compared to others who underwent surgery at later time points [15]. The difference between our results and those of Støttrup et al. may be mainly due to our patient population with earlier duration of pain. Chen et al. retrospectively investigated the records of 521 patients who underwent full endoscopic lumbar discectomy [5]. Their median follow-up was considerably long (1685 days; range: 523-3923 days) and they found that the preoperative symptom duration longer than 1 year was associated with worse outcomes on univariate analyses. Beck et al studied the association of sciatic pain duration with the results of lumbar disc surgery in 6216 patients [8]. Patients who underwent lumbar discectomy with pain duration of less than 12 months exhibited a more prominent reduction in postoperative leg pain and were more satisfied with surgical outcomes. Sabnis and Diwan performed an analysis and review of the literature encompassing 37 years (1975-2012) and concluded that a longer duration of leg pain before surgery is associates with poorer outcomes [19]. However, they also admitted that only a broad time frame (2-12 months) could be extracted from the literature analysis due to the lack of high-quality investigations and even contrasting results of the available studies [19]. In a recent study, Mehendiretta et al analyzed 209 patients with lumbar disc hernia treated with microdiscectomy and found that preoperative symptom duration of less than 6 weeks was associated with better ODI (Oswestry Disability Index) scores

[20]. There are also recent studies, which studied preoperative symptom duration with clinical outcomes in cervical disc hernia patients treated with anterior cervical discectomy and fusion [21]. In one study analyzing 34 patients with cervical disc hernia treated with cervical discectomy, shorter symptom duration was found to associate with significantly reduced postoperative pain and neck disability index scores [21]. Despite the fact that clinicopathological features and surgical treatment techniques of cervical and lumbar disc hernias certainly have differences, these studies also contribute to the knowledge of whether preoperative pain duration contributes to the postoperative well-being in disc hernia. As mentioned, our study population has relatively earlier periods of pain duration with a median of 14 days, which may explain the differences with some of the above cited studies. Nonetheless, not only the Mann- Whitney U test comparing VAS scores among patients with preoperative pain durations shorter and longer than 14 days, Spearman's correlation analyses also did not find any statistical difference regarding the association between exact day of preoperative pain duration and postoperative pain levels. This should also be noted as 15 patients in our cohort had at least 2 months of pain duration (data not shown in tables).

Our current study has limitations. It is retrospective and the reported duration of pain is subjective since it depends on relative patient complaints. It is also possible that patients who have had surgery at a later time are inherently more tolerant to pain, causing a bias. On the other hand, there are also strengths of our study. We analyzed a homogenous patient population and selecting the median duration of preoperative pain in this cohort might have reflected more realistic results and demonstrated real-life scenarios. As said, there are previous studies evaluating the pain-associated prognostic factors in the microsurgical management of lumbar radicular pain. Nonetheless, our study selectively focuses on the role of early pain duration in a more precise manner in a highly selected patient population.

Conclusion

During early manifestation of lumbar radicular pain, postponing the time of surgery seems not to influence the pain outcomes adversely. For this reason, it can be thought that in the absence of severe neurological deficit and very intense pain, acting too hastily in directing patients with disc herniation to immediate surgery does not provide additional clinical benefit. However, additional prospective studies are needed to better determine the relationship between early preoperative pain duration and patient recovery after microdiscectomy.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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