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Effects of Surgical Timing on the Prognosis of Far Lateral Disk Herniation

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ABSTRACT

AIM: To evaluate the effects of surgical timing on the prognosis in far lateral disk herniations.

MATERIAL and METHODS: We retrospectively evaluated 171 patients diagnosed with far lateral disk herniation who underwent surgery between 2015 and 2021. Patients were divided into three groups: Those operated within the first 3 weeks, within 3-6 weeks, and after 6 weeks. Patients with progressive neurologic deficits and severe pain refractory to the analgesic treatment underwent surgery.

RESULTS: The mean age was 57±3 (28–85) years. The patients consisted of 96 females and 75 males. Sixty-eight patients underwent surgery at the L4–L5, 45 at the L3–L4, 37 at the L5–S1, and 21 at L2–3 levels. All patients had low back and radicular leg pain. Lasegue test was positive in 67% of patients. Femoral nerve stretch test was positive in 68%. Motor deficits, patellar reflex loss, and sensory deficits were present in 76%, 80%, and 91% respectively. When the postoperative recovery rates of patients who underwent surgery in all three time periods were compared according to visual analog scale, Oswestry disability index, and MacNab criteria, notably, statistically significant improvements in recovery were observed among patients who underwent surgery in the preoperative short time period when compared to those in the other time periods.

CONCLUSION: We believe that early surgery is important to prevent the progression of pain from acute to chronic neuropathic pain to promptly eliminate factors that activate the process and to provide faster and clearer symptom treatment.

KEYWORDS: Back pain, Disk herniation, Early surgery, Far lateral disk herniation, Lumbar spine, Neuropatic pain, Prognosis

ABBREVIATIONS: ODI: Oswestry disability index, **VAS:** Visual analog scale

INTRODUCTION

Lumbar disk herniations may be intracanalicular, extracanalicular, or both. Extracanalicular location accounts for 6%–12% of all lumbar disk herniations. Anatomically, far lateral disk herniation is located lateral to the upper and lower pedicles (8). It was first described by Lindblum in 1944 in cadaveric studies. The spinal nerve ganglion is located at the neural foramen or distal to the foramen (18). Therefore, far lateral disk herniations directly compress the spinal nerve root and ganglion emerging from the upper level (15).

Far lateral disk herniations most commonly occur at the L4–L5 level, followed by the L3–L4, L5–S1, and L2–L3 (10) and have clinical features different from that of medial disk herniation. These patients may present more severe clinical symptoms than those with medial disk herniation, such as severe radicular pain and motor and sensory neurologic deficits. The herniated disk fragment compresses the nerve root in a narrow neural foramen, directly compressing the dorsal radicular ganglion, a pain-sensitive structure (1).

pain can be categorized into two main types: acute and chronic. Acute pain is a symptom that occurs after trauma, surgery, or

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tissue damage. It can be controlled with analgesic drugs and disappears at the end of the healing process, whereas chronic pain is a process or disease generally present for a long time, independent of the healing process. It is accompanied by effective, cognitive, and motivational disorders, resulting in functional decline and quality of life deterioration that require multimodal treatment (29,32). The mechanisms underlying the chronicity process should be identified for effective chronic pain treatment (4,30,31). Chronic pain usually has a neuropathic component, and its underlying mechanisms are increased transmission of pain signals associated with peripheral and central sensitization in sensory neurons with altered structure and function (16,26).

In this study, we retrospectively evaluated the results of patients with far lateral disk herniation who underwent surgery between the onset of complaints and the time of surgery to compare the advantages and disadvantages of these results against each other, contributing to the determination of the ideal time for surgery.

MATERIAL and METHODS

Totally, 171 patients who underwent surgery for far lateral disk herniation via the intertransverse extraforaminal microsurgery approach were retrospectively evaluated between 2015 and 2021. Microdiscectomy techniques have been performed using the midline approach for the L4–L5 and higher levels and the paramedian transmuscular approach for the L5–S1 level. Patients without adequate documentation or with at least a 6-month follow-up, with disk herniation at other levels, and those with type 1 diabetes mellitus were excluded from the study. Patients with severe motor deficits, progressive neurologic deficits, and severe pain refractory to analgesic treatment underwent surgery.

The demographic data, disk herniation levels, examination findings, preoperative and postoperative visual analog scale (VAS) scores, and Oswestry disability index (ODI) were recorded to evaluate the preoperative and postoperative physical capacity (9) as well as postoperative long-term MacNab satisfaction rates (19).

The operated patients diagnosed with far lateral disk herniation were divided into three main groups: operated within the first 3 weeks, between 3–6 weeks, and after 6 weeks, comprising 12, 67, and 92 patients, respectively. Gabapentin/pregabalin treatment was administered to patients with postoperative neuropathic pain.

Statistical Analysis

Statistical analysis was performed with IBM SPSS Statistics 21.0 (SPSS Inc, Chicago, IL, USA) software using the Shapiro–Wilk test. The conformity of the data to normal distribution was analyzed by Shapiro–Wilk test, histogram, and Q–Q graphs were evaluated. Data were expressed as means and standard deviations. One-sample comparisons were made between groups. Way analysis of variance test (alternative test: Kruskal–Wallis) was used. Paired sample T-test was used to compare between preoperative and postoperative data. The relationship between categorical variables was evaluated using Pearson'schi-squared (χ 2) test (and Fisher's exact test). A p-value of <0.05 was considered statistically significant.

This study was approved by the institutional ethics committee of Erciyes University (2023/278).

RESULTS

A total of 171 patients were included in this study, comprising 96 (56.1%) females and 75 (43.9%) males. The mean or median age of patients was 57±3 (28–85) years. Among the patients, 7% (12/171) were operated on within the first 3 weeks, 39.2% (67/171) within 3–6 weeks, and 53.8% (92/171) after 6 weeks. A total of 68, 45, 37, and 21 patients were operated at the L4–L5, L3–L4, L5–S1, and L2–L3 levels, respectively (Table I). All patients had low back and radicular leg pain. Lasegue test and femoral nerve stretch tests were positive for 67% and 68%, respectively. Motor deficit, patellar reflex loss, and sensory deficit occurred in 76%, 80%, and 91% of patients, respectively.

A statistically significant difference in the pre and postoperative VAS variables was observed in all groups (<3 weeks, 3–6 weeks, and >6 weeks) (p<0.001). The mean postoperative VAS scores of patients who underwent surgery in <3 weeks (1.08±0.29), 3–6 weeks (1.22±0.42), and >6 weeks (1.23±0.41) were statistically significantly lower than the preoperative VAS scores for <3 weeks (9.25±0.62), 3–6 weeks (9.07±0.72), and >6 weeks (9.13±0.06) (p<0.001, p<0.001, p<0.001, and p<0.001, respectively) (Table II).

A statistically significant difference in pre and postoperative ODI variables was observed between the groups (p<0.001 and p<0.001, respectively). The mean preoperative ODI score (78.1±4.9) of patients with a symptom duration of ≥6 weeks was statistically significantly lower than those with symptom duration of 6 weeks but statistically significantly higher than those at <3 weeks (12.2±1.3) and 3–6 weeks (14.5±1.9) (p <0.001 and p<0.001, respectively). The mean postoperative ODI score (20.7±3.4) of patients who underwent surgery after 3–6 weeks was statistically significantly higher (p=0.006) than those who underwent surgery <3 weeks (12.2±1.3). The mean postoperative ODI scores who underwent surgery on <3 weeks (12.2±1.3), 3–6 weeks (14.5±1.9), and >6 weeks (20.7±3.4) were significantly lower than the preoperative ODI scores for <3 weeks (83.0±2.3), 3–6 weeks (82.4±2.7), and >6 weeks (78.1±4.9) (p<0.001, p<0.001, p<0.001, and p<0.001, respectively) (Table III).

When postoperative MacNab criteria were evaluated based on preoperative symptom duration (<3 weeks, 3–6 weeks, and >6 weeks), significant differences were observed between preoperative symptom durations in favor of shorter time in obtaining the best results (Table IV). When the postoperative recovery rates of patients operated in all three time periods were compared according to VAS, ODI, and MacNab criteria, statistically significant recovery rates were found in the short preoperative time period compared to other time periods (p<0.05) (19).

Table I: Distribution of Disc Herniations

Disc levels	N	Operation time		
		<3 weeks	3-6 weeks	>6 weeks
L2-3	21	-	9	12
L3-4	45	4	13	28
L4-5	68	5	26	37
L5-S1	37	3	19	15
Total	171	12	67	92

Table II: Comparison of Preoperative-Postoperative VAS Results

Symptom time to Surgery	Preoperative VAS	Postoperative VAS	p-value
<3 weeks (n=12)	9.25 ± 0.62 A,a	1.08 ± 0.29B,a	**<0.001**
3-6 weeks (n=67)	9.07 ± 0.72A,a	1.22 ± 0.42B,a	**<0.001**
>6 weeks (n=92)	9.13 ± 0.06A,a	1.23 ± 0.41B,a	**<0.001**
p-value	0.656	0.513	

Data are expressed as means± standard deviations. The same lowercase letters in the same column indicate similarity between groups and different lowercase letters indicate between-group differences. Different capital letters in the same row indicate between-group differences. ***VAS:*** *Visual analog scale.*

Table III: Comparison of Preoperative-Postoperative ODI Results

Symptom time to Surgery	Preoperative ODI	Postoperative ODI	p-value
<3 weeks (n=12)	83.00 ± 2.30 A,a	12.17 ± 1.27 B,a	**<0.001**
3-6 weeks (n=67)	82.44 ± 2.66 A,a	14.52 ± 1.78 B,b	**<0.001**
>6 weeks (n=92)	78.13 ± 4.86 A,b	20.71 ± 3.43 B,c	**<0.001**
p-value	**<0.001**	**<0.001**	

Data are expressed as means ± standard deviations. The same lowercase letters in the same column indicate similarity between groups, and different lowercase letters indicate between-group differences. Different capital letters in the same row indicate between-group differences. ***ODI:*** *Oswestry disability index.*

Table IV: Outcome Data Regarding to MacNab Scoring (19)

Symptom time to Surgery	Excellent	Good	Fair/Poor
<3 weeks (n=12)	83.3% (10/12)	16.7% (2/12)	0% (0/12)
3-6 weeks (n=67)	74.6% (50/67)	14.9% (10/67)	10.4% (7/67)
>6 weeks (n=92)	62.0% (57/92)	15.2% (14/92)	22.8% (21/92)
χ^2 p-value	7.090 0.131		

In the postoperative evaluation of patients, leg pain improved by 100% whereas low back pain, sensory deficit, and loss of strength improved by 91.6% in the first 3 weeks. At 3–6 weeks, leg pain improved to 92.5%, low back pain to 88%, sensory deficit to 85.1%, and loss of strength to 94%. After 6 weeks, leg pain improved by 91.3%, low back pain by 86.9%, sensory loss by 68.5%, and loss of strength by 81%. Statistically significant improvement rates were found in the short preoperative time interval compared to other time intervals (p<0.05). Gabapentin/pregabalin was not administered to patients operated within the first 3 weeks, but was administered to 11 patients operated between 3–6 weeks and 27 patients operated after 6 weeks. When the drug use rates were compared with each other, a statistically significant difference was found in favor of short duration (p<0.05) (Table V).

Table V: Preop / Postop Comparison of Symptoms

	Symptom time to Surgery			χ^2 p-value
	<3 weeks (n=12)	**3-6 weeks (n=67**	**>6 weeks (n=92)**	
Recovery rate of back pain	91.7% (11/12)	85.1% (57/67)	87.0% (80/92)	0.268 0.939
Recovery rate of leg pain	100% (12/12)	92.5% (62/67)	91.3% (84/92)	1.146 0.747
Recovery rate of sensory deficit	100% (1/1)	83.3% (10/12)	69.0% (29/42)	1.342 0.617
Recovery rate of loss of strength	90% (9/10)	82.6% (38/46)	73.4% (58/79)	2.354 0.317
Post op medication use (gabapentin/ pregabalin)	0% (0/12)	16.4% (11/67)	27.1% (25/92)	6.012 **0.041**

No surgical complications were observed. In the postoperative follow-up one of the patiens was operated on within the first month, one of the patients was operated on within the first month, 1 in the 6th month, and the other two were operated on later. We considered the one operated within the first month as inadequate decompression and the others as recurrence.

DISCUSSION

In contrast to lumbar intracanalicular disk herniations, far lateral disk herniations are observed in the advanced age group. Although lumbar disk herniations more commonly occur in patients aged 30–50 years, far lateral disk herniations are most common in the sixth decade of life (5,28). In our study, the mean age was 57 years. The female to male ratio was 96/75.

The most common findings were low back pain, radicular leg pain, numbness, burning, loss of strength, and reflexes in the dermatome of the compressed root. The femoral nerve stretch test and partially straight leg-raising test are mostly positive. In our study, all patients had low back and/or radicular leg pain. The Lasegue test was positive in 67% of patients. This positivity was 81% in L5–S1 disks.

Peripheral neuropathic pain results from peripheral nervous system lesions caused by mechanical trauma, metabolic diseases, neurotoxic chemicals, infection, or tumor invasion. It involves multiple pathophysiological changes both within the peripheral nervous system and in the central nervous system (6,31). The primary disease and its associated neural damage are the only initiators of a series of changes that lead to and maintain neuropathic pain (31). Neuropathic pain has a prevalence of as high as 5% (2). Kehlet et al. stated that chronic neuropathic pain syndrome may progress as long as a primary disease such as diabetes mellitus continues to damage the nervous system (11).

The duration of the stimuli that cause pain signals is the most fundamental factor in the development of chronic pain. The prevention of sensitization by early and adequate acute pain treatment is important to prevent chronic pain (18,35). The chronicity of pain involves a series of molecular and cellular processes. Primarily, prolonged neurogenic inflammation, peripheral sensitization, and central sensitization alter pain transmission and processing, ultimately altering the pain perception. If inflammation is not treated appropriately, inflammatory and alogenic mediators that persist in the environment cause sensitization, leading to permanent nociceptor changes (20). Inflammatory substances cause sensitization of nociceptors by increasing neuronal stimulation. The excitation thresholds of sensitized nociceptors are decreased; thus, they become sensitive to normal stimuli. During peripheral sensitization, pain transmission increases in the afferent nociceptive neurons; the clinical equivalent of this condition is hyperalgesia (30). Poleshuck et al. showed that the severity of postoperative acute pain increased the incidence of chronic pain (24). The transition from acute to chronic neuropathic pain increases in relation to the lesion size and timing (11). Koksal and Koc reported that early surgery in far lateral disc herniation is important for successful neuropathic pain management (12). Although pain in the far lateral disk is similar to classic disk herniation pain, it is often severe and sometimes unbearable. This striking feature is due to direct compression of the nerve root and the spinal ganglion, an extraordinarily pain-sensitive structure (21).

The surgical approach to far lateral disk herniations widely varies depending on the exact location of the disk and the experience of the surgeon. However, no studies clarified the effects of surgical timing on postoperative outcomes in these disk herniations. In our patient series, the VAS, ODI, and MacNab scores are better in the early surgical intervention. Dysesthesia lasting >4 weeks postoperatively was found in eight of patients who underwent surgery in 3–6 weeks and 24 after 6 weeks. None of the patients who underwent surgery in the first 3 weeks had dysesthesia lasting >4 weeks. Postoperative gabapentin/pregabalin was administered in eight patients who underwent surgery in the initial 3–6 weeks and 24 patients who underwent surgery after 6 weeks. Postoperative dysesthesia may occur due to prolonged neural ganglial compression before delayed surgery. In addition, dysesthesia may become more prominent and palpable with decreased severe postoperative pain.

Minimally invasive microsurgical techniques for far lateral disk herniations are not significantly superior to each other in terms of results; however, they have very good results in the surgery of these cases and provide surgeons with a good working and visual field. The disk material can be accessed with minimal bone resection without causing instability. Adequate decompression can be achieved with minimal muscle retraction and blood loss. Thus, pain can be reduced without causing additional pain (3,7). Microdiscectomy is the gold standard treatment far lateral disk herniations (14,25).

The lateral microsurgical approach through the median incision, familiar to spine surgeons, allows access to the far lateral region. Disk material can be accessed with minimal bone resection without causing instability. Muscle retraction is minimal, operative time is very short, and surgical site bleeding is minimal (7). The goal of minimally invasive spinal approaches is to reduce postoperative pain and recovery time by ensuring proper exposure of important anatomical structures, allowing adequate neural decompression (3). Recently, far lateral disk herniations can be treated with minimally invasive techniques, such as the far lateral intertransverse approach through a midline incision paramedian transmuscular approaches with tubular retractors, and percutaneous posterolateral transforaminal endoscopic surgery (22,33,34). Epstein in a follow-up study comparing different surgical procedures for far lateral disk herniations obtained better results using the lateral approach (8). Ryanng et al. reported favorable results in 57% of those operated with the medial approach, although they achieved good and excellent results in 95% of patients with the lateral approach (27).

Lee et al. reported dysesthesia development as the most important postoperative patient complaint after the minimally invasive far lateral approach for extraforaminal decompression of the L5 nerve (17). Although the cause of dysesthesia has not been proven, it may be due to manipulation of the dorsal root ganglion, thermal injury due to cautery use, or even detachment of the dorsal ramus from the dorsal ganglion (23). Lee et al. reported a 28.8% incidence of postoperative dysesthesia in their series that regressed within 1month in most patients (17). O'Hara reported that early recognition of the posterior ramus and safe dissection of the extraforaminal region reduced the risk of severe postoperative sensory dysesthesia (23). Kotil et al. reported that postoperative dysesthesia is the most important complication and that this complaint persisted postoperatively in their study, and as a result, ganglion manipulation should be avoided at all costs if possible (13).

CONCLUSION

Early surgery is believed to be more promising to provide faster and clearer treatment of symptoms that occur by promptly removing factors activating the process to prevent the progression of pain from acute to chronic neuropathic while being eliminated with compression.

Declarations

Funding: No financial support was utilized during the study.

Availability of data and materials: The datasets generated and/or analyzed during the current study are available from the corresponding author by reasonable request.

Disclosure: Authors declare no conflict of interest.

AUTHORSHIP CONTRIBUTION

Study conception and design: MM

Data collection: MM

Analysis and interpretation of results: MM, RKK

Draft manuscript preparation: MM

Critical revision of the article: MM, RKK

All authors (MM, RKK) reviewed the results and approved the final version of the manuscript.

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