

Early Recurrence of Lumbar Disc Herniation: A Retrospective Analysis of the Role of Discectomy Volume and Other Influencing Factors

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Article History

Received 07 Sep 2023

Accepted 13 Oct 2023

Published Online 20 Oct 2023

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Abstract: The aim of this study is to conduct a detailed examination of cases of "early recurrence" encountered following lumbar disc herniation surgery and to compare the data obtained with findings in the existing literature. This retrospective study analyzed the data of 856 patients who underwent surgery for recurrent lumbar hernia at our hospital between 2012 and 2022. We expanded the definition of "early relapse" in the literature to set inclusion and exclusion criteria, resulting in a cohort of 43 patients who met these criteria being included in the study. We assessed the severity of symptoms based on patients' Visual Analog Scale (VAS) scores at baseline and during subsequent periods. Patients requiring reoperation within the first 12 months were divided into two main groups: those undergoing reoperation within the first 6 months and those undergoing reoperation between 6-12 months. However, we found no statistically significant difference between the two groups regarding age, gender, comorbidities, and other determinants. Notably, patients undergoing surgery within the first 3 months were observed to be of advanced age. Comparing the data from our analysis of patients with "early recurrent lumbar disc herniation" to findings in the literature, we noted that similar variables were not significant in our series. An interesting observation was that both full endoscopic and microscopic methods yielded similar early recurrence rates. This finding is particularly noteworthy because full endoscopic discectomy often involves sequestrectomy, and the volume of the disc removed is typically minimal. Hence, our study suggests that the volume of the disc removed during surgery may not be as influential in the development of early recurrence as previously thought. These findings provide an important foundation for future research. ©2023 NTMS.

Keywords: Lumbar Discectomy; Recurrence; Early Recurrence; Microscopic Discectomy.

1. Introduction

Low back pain is one of the most commonly encountered pain symptoms in the general population. Lumbar Disc Herniation (LDH) frequently causes both low back and leg pain. In cases of symptomatic lumbar disc herniations where radicular pain is unresponsive to

medical treatment and there is radiological evidence consistent with LDH pathology, surgical intervention is indicated¹⁻³. Progressive neurological deficits, cauda equina syndrome, and severe radicular pain are cited as indications for emergency LDH intervention in the

Cite this article as: Karaoğlu Gündoğdu D, Gezer B, Köktenir E and Karabağlı H. Early Recurrence of Lumbar Disc Herniation: A Retrospective Analysis of the Role of Discectomy Volume and Other Influencing Factors. New Trend Med Sci. 2023; 4(Supplemental Issue):205-212. Doi:10.56766/ntms.1356688

literature^{2,3}.

The primary objective of LDH surgery is to alleviate pressure on neural tissues and prevent the progression of neurological symptoms, with the alleviation of pain symptoms considered a secondary benefit. A "recurrence" is evaluated as the return of neural compression at the same level and side as previously treated, accompanied by a corresponding return of pain symptoms post-surgery^{4,5}. In the past, "recurrence" was used to describe the resumption of pain following a six-month pain-free period post-LDH surgery^{6,7}. However, recent studies- facilitated by more frequent and easily accessible MRI imaging and improved patient access to healthcare centers-have questioned the necessity of a six-month well-being period for defining recurrence. Some now categorize a lumbar disc herniation at the same level and side requiring new surgery within 12 months post-initial operation as "early recurrence"⁹⁻¹¹. Publications emphasizing the concept of "early recurrence" predominantly share results of Full Endoscopic Lumbar Discectomy (FELD) methods for lumbar discectomy¹²⁻¹⁴.

Our study aims to examine our recurrence rates within the first 12 months, a period considered early according to the literature. We plan to evaluate "early recurrence" patients based on occurrences within the first six months and those between six and twelve months, aligning with the approaches found in existing research. Furthermore, we introduce the concept of "very early recurrence," not yet present in the existing literature, to assess the characteristics of patients experiencing recurrence during the first one to three months post-operation.

2. Material and Methods

Our study entailed a retrospective analysis of patient records and imaging studies archived in our hospital. We assessed the clinical information and imaging results of 856 patients who underwent surgery for recurrent lumbar disc herniation between 2011 and 2022 in our clinic. Among these, we scrutinized those who underwent reoperation within 12 months following their initial surgery. We analyzed the characteristics of 43 patients who met the inclusion criteria for the study. Written informed consent was secured from patients (or their legal guardians) for the sharing of diagnostic images and the publication of their medical data.

Inclusion Criteria for the Study:

*Both the initial and subsequent surgeries were performed at our hospital.

*The initial surgery targeted single-level and unilateral lumbar disc herniation (LDH).

*Flexion-extension radiographs and anteroposterior scoliosis radiographs were available from before the first surgery, showing no severe degenerative lumbar pathologies such as listhesis and scoliosis.

Pre-operative lumbar magnetic resonance imaging (MRI) results from the initial surgery were retrievable from our hospital's imaging system.

*Contrast-enhanced lumbar MRI results before the second surgery were accessible in our hospital's imaging system.

*Both pre-operative and post-operative Visual Analog Scale (VAS) scores for patients were documented in the system.

*Patients demonstrated "absolute improvement" in VAS scores during inpatient post-surgery visits and at outpatient check-ups on the 20th day following the surgery, compared to pre-operative scores.

Exclusion Criteria:

*Patients who underwent multiple recurrence surgeries.

*Patients requiring stabilization due to signs of instability observed during the second surgery.

*Patients failing to show post-operative improvement in Visual Analog Scale (VAS) scores.

*Patients who had early surgery due to complications such as lumbar epidural hematoma and cerebrospinal fluid (CSF) fistula were excluded from the study.

*Patients reporting a decline in Visual Analog Scale (VAS) scores after a minimum of 30 days of well-being post-operative improvement, and confirmed to have pressure consistent with lumbar disc herniation at the same level and side as the previous surgery in contrast-enhanced lumbar MRI upon recurrence of symptoms, were categorized as experiencing "Early Recurrence" and were incorporated into the study (Figure 1).

2.1. Statistical Evaluation

We conducted the statistical analysis utilizing SPSS 22.0 software. In descriptive statistics, we represented continuous variables using mean±standard deviation, and categorical variables using frequency and percentage. The Kolmogorov-Smirnov test facilitated the normality analysis. Owing to the non-normal distribution of numerical variables, we employed the Mann-Whitney U test for the analysis. We acknowledged a p-value of <0.05 as indicative of statistical significance.

3. Results

In our study, a total of 43 patients were included. The average age of the participants was 49.93±10.87, ranging from 28 to 76 years. Out of these, 23 patients (53.5%) were female, and an equal number reported no comorbidities. Furthermore, 11 patients (25.5%) had hypertension (HT), and 9 (20.9%) had diabetes mellitus (DM). Other comorbidities included both HT and DM in three patients (6.9%), coronary artery disease (CAD) in two (4.6%), and chronic obstructive pulmonary disease (COPD) in one (2.3%). Due to the low frequency of the latter conditions, the statistical evaluation of comorbidities focused on HT and DM.

The average body mass index (BMI) was 30.44±3.78, with a span of 21-40. When assessing the recurrent LDH levels, 28 patients (65.1%) had it at the L4-L5 level, 12 patients (27.9%) at the L5-S1 level, and 3 patients (7.1%) at the L3-L4 level. Over half, 22 patients (51.2%), had the herniation on the right side.

Recurrence was assessed based on VAS (Visual Analog Scale) scores. Any patient not showing an improvement in VAS scores during the initial 20-day follow-up was not deemed to have "recurrence." The patients' average preoperative VAS score was 8.5 (range: 6-10), which dropped to 2 (range: 1-3) 24 hours post-operation, and further decreased to 1.25 (range: 0-2) during outpatient follow-up. When symptoms resumed, the evaluated VAS score was 6.61 (range: 5-8).

Patients exhibiting symptoms of recurrence as evidenced by contrast-enhanced lumbar MRI findings underwent another surgery. These individuals were then classified as having early recurrence within the first 12 months according to the recurrence surgery date. Subsequently, we divided these 43 patients into two groups: those undergoing a second surgery between the 1st and 6th month postoperatively (41.8%, group 1) and those having it between the 6th and 12th month (58.1%, group 2). We assessed patient variables accordingly (Table 1).

During the assessment, it was noted that 4 patients (9.3%) had undergone surgery within the initial three

months. We labeled this category as "very early recurrence" and separately evaluated these individuals from others experiencing recurrence between months 3 and 12 (Table 2).

Regarding the initial surgery, 18 patients (41.8%) had the operation within the first 6 months, while 25 patients (58.1%) underwent surgery between the 6th and 12th month. Specifically, 4 individuals (22.2%) from the first group had surgery within the first 3 months. We observed that the mean disc volume removed during the initial surgery was 19.51 ± 5.54 cc (range: 10-35) in the first group and 19.07 ± 5.14 cc (range: 10-30) in the second group.

Comparative analysis of the variables between the two groups revealed no significant correlation with age, gender, comorbidities such as HT and DM deemed significant in recurrent disc literature, herniation localization, or the volume of the removed disc (Table 1).

In analyzing patients undergoing reoperation due to recurrence within the first three months as a distinct group, we found that only their higher average age bore statistical significance (Table 2)

Table 1: Analysis of Demographic Characteristics of Patients Requiring Repeat Surgery Within 6 Months (Group 1) and Between 6-12 Months (Group 2) After the Initial Surgery.

| | Grup 1 (n=18) | Grup 2(n=25) | P Value |
|-----------------------------|----------------------|---------------------|----------------|
| Average Age | 50 (42-57) | 53(37.25-58.25) | 0.856** |
| Gender | | | |
| Women | 4 (17.3%) | 19 (82.6%) | |
| Men | 14(70%) | 6 (30%) | 0.323* |
| Bmi | 30 (28-33) | 30.5(30-31.75) | 0.888** |
| Comorbidity | | | |
| Yes | 8 (40%) | 12 (60%) | |
| No | 10 (43.4%) | 13 (56.5%) | 0.261* |
| HT | | | |
| Yes | 1(0.09%) | 10 (90.9%) | |
| No | 17(43.7%) | 15(46.8%) | 0.331* |
| DM | | | |
| Yes | 3(33.3%) | 6(66.6) | |
| No | 17 (50%) | 17 (50%) | 0.368* |
| Lumbar Level | | | |
| L3-L4 | 3 (100%) | 0 | |
| L4-L5 | 10(35.7%) | 18(64.2%) | 0.161** |
| L5-S1 | 5(41.6%) | 7 (58.3%) | |
| Disc Volume Exceeded | 20(15-20) | 22.5(20-25) | 0.167** |

* Pearson Chi-Square , **Mann-Whitney-U test

Table 2: Comparison of Patients Requiring Recurrence Within 3 Months After the Initial Surgery with Others.

| Recurrent surgery in the first 3 months | YES (n=4) | NO (n=39) | P VALUE |
|---|-------------------|--------------|----------------|
| Average Age | 65(47.5-73.5) | 50(41-56) | 0.049** |
| Gender | | | |
| Women | 2(8.7%) | 21 (91.3%) | |
| Men | 2(10%) | 18(90%) | 0.641* |
| Bmi | 30.5(28.25-32.75) | 30(28-33) | 0.920** |
| Comorbidity | | | |
| Yes | 3(15%) | 17(85%) | |
| No | 1(4.3%) | 22(95.7%) | 0.323* |
| Ht | | | |
| Yes | 1(12.5%) | 7(87.5%) | |
| No | 3(8.6%) | 32(91.4%) | 0.576* |
| Dm | | | |
| Yes | 3(42.9%) | 4(57.1%) | |
| No | 1(2.8%) | 35(97.2%) | 0.261* |
| Lumbar level | | | |
| L3-l4 | 3(% 100) | 0 | |
| L4-l5 | 0 | 28(% 100) | 0.135* |
| L5-s1 | 1(% 8,3) | 11(% 91,6) | |
| Disc volume exceeded | 17.5(15-31.25) | 20(15-25) | 0.984** |

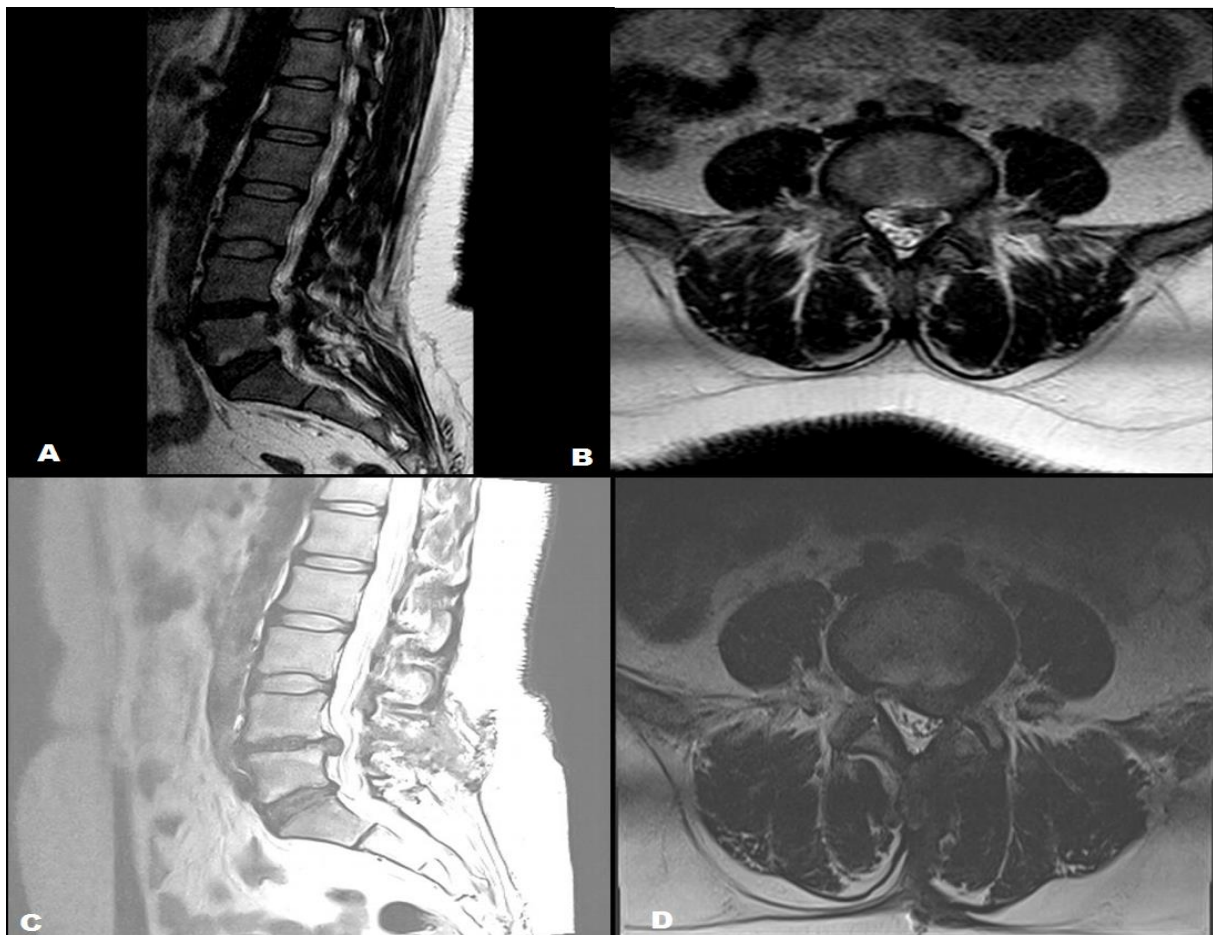


Figure 1: A 35-year-old female patient presented with lower back and left leg radicular pain consistent with left L4-5 lumbar disc herniation (LDH) pathology. 1A - Sagittal T2-weighted image showing downward-migrated LDH view. 1B - Axial T2-weighted image displaying compression on the left L5 nerve root. The patient underwent lumbar discectomy surgery, resulting in a decrease in VAS score from 8 to 1. However, in the eighth month after the surgery, her pain resumed in a similar manner, with a VAS score of 9.1C-D - A subsequent MRI revealed recurrent disc pathology at the same level and side, without contrast enhancement. The patient underwent recurrent LDH surgery, leading to a VAS score improvement to 2. Patient data were obtained from our medical records and MRI, and she was included in the study as a participant in "Group 2."



Figure 2: An illustrative depiction of a common practice in our clinic and many neurosurgery departments, involving volume calculation through the accumulation of excised discs using syringes during surgery. 2A - Visual representation of the average volume of extracted discs after microdiscectomy surgery (10-35 cc). 2B - Visual representation of the volume of excised discs using the sequestrectomy method, more commonly preferred in full endoscopic surgeries (1-3 cc).

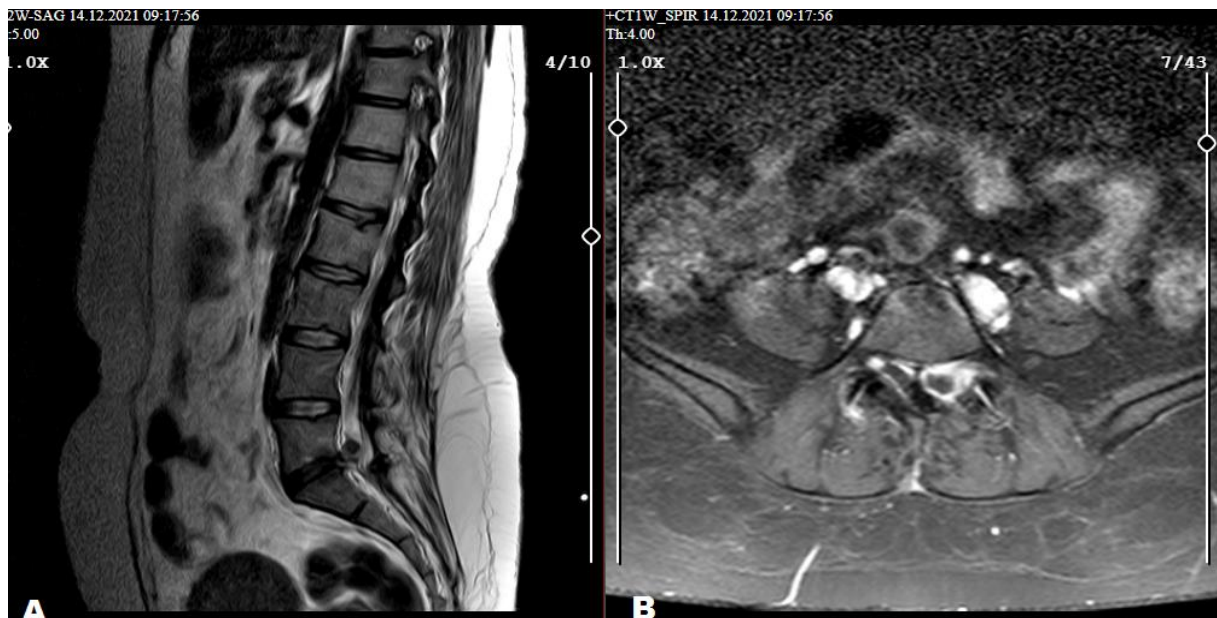


Figure 3: Evaluation of a patient who reported the re-emergence of pain 32 days after the initial surgery using contrast-enhanced lumbar MRI. 3A - Sagittal T2-weighted image demonstrating upward-migrated disc pathology and compression on neural tissues. 3B - Axial contrast-enhanced T1-weighted image showing neural compression and an early contrast-enhancing lesion. Although the radiology report initially interpreted the findings in favor of scar tissue, a second surgery was performed due to compression. Postoperatively, the VAS score improved to 1. The patient was included in the study as a participant in "Group 1."

4. Discussion

In our study, we evaluated 43 patients who underwent recurrent surgery between 1-12 months post-surgery from a pool of 856 patients treated in our clinic from 2011 to 2022. Consequently, we identified our early recurrence rate as 5%. This rate aligns with the general recurrence rates cited in the existing literature, which range between 5-15%¹⁻³. Hence, our clinic's recurrence rates are consistent with those documented in the literature.

Traditionally, studies analyzing early recurrence in Lumbar Disc Herniation (LDH) patients tend to focus on those undergoing Full Endoscopic Lumbar Discectomy (FELD). However, our research took a different route; all patients classified under "Early Recurrence" had undergone Microscopic Lumbar Discectomy (MLD). Despite this deviation, our findings align interestingly with the broader research landscape; while FELD surgeries report a 7% early recurrence rate, our MLD patient cohort exhibited a slightly lower rate of 5%. This finding is noteworthy as it indicates comparable early recurrence rates between the endoscopic and microscopic assessment routes.

In the existing literature, there are extensive series of studies evaluating the outcomes of Full Endoscopic Lumbar Discectomy (FELD) procedures in the early phases of Lumbar Disc Herniation (LDH)^{1-3, 12-14}. A sequestrectomy is the most common method employed in FELD, during which the volume of the removed disc seldom exceeds 3 cc. The lower volume of removed disc in full endoscopic approaches often takes the blame for early recurrences; however, there is no statistical data to back this claim. In our study, all patients underwent Microscopic Lumbar Discectomy (MLD) with the average volume of the removed disc being 19.35 cc (ranging from 10 to 35 cc). Surprisingly, our early post-operative recurrence rates mirror those reported in FELD studies. This leads us to infer that early recurrence in LDH patients is not tied to the volume of the removed disc, thereby adding valuable data to the existing body of literature.

Several studies in the literature have sought to determine the volume of disc removed during LDH surgeries by analyzing pre-operative and post-operative lumbar MRI scans^{10, 11, 16, 17}. In a departure from this norm, our study employed volume measurements taken during the operation, evaluating the disc material collected in a 50 cc syringe (Figure 2). This innovative method stands as a potential alternative to radiological assessments and could be embraced in forthcoming studies.

In studies examining risk factors associated with recurrent lumbar disc herniation (LDH), variables such as age, gender, and body mass index have been identified as significant contributors^{3-5, 12, 15}. In our research, we sought to determine whether these notable factors for recurrence hold significance for early recurrence as well. Contrary to findings from other publications, no factors emerged as significant in influencing early recurrent surgery in our study (Table

1). When we isolated cases categorized as 'very early recurrence'-those involving reoperation within the initial three months-only the age factor demonstrated notable variation, with older patients being more predominant (Table 2). Past literature indicates a heightened risk of recurrence for FELD cases involving pathologies between the L4-5 and L5-S1 vertebrae, especially when evaluating early recurrences¹²⁻¹⁵. In our dataset, the limited number of patients (n: 4) experiencing 'very early recurrence' necessitates validation through studies with larger cohorts. Despite this limitation, our study carries weight for its potential to augment other research projects, as it diverges from the prevalent trend of analyzing early recurrent LDH surgery patients in broader time frames-either within one year post initial surgery, or bifurcated into 1-6 months and 6-12 months categories. Our initial assessment aligned with this methodology. Notwithstanding, the secondary layer of our analysis, which contrasts patients undergoing early recurrent surgery within the first 3 months against those revisiting between 3-12 months, fills a gap in the current literature.

In our clinic, each LDH patient slated for surgery undergoes preliminary flexion-extension and anteroposterior scoliosis radiographic evaluations. Those exhibiting severe degenerative lumbar pathologies such as listhesis or scoliosis, alongside LDH, were excluded from the study based on these radiographs. Likewise, patients demonstrating instability during their first recurrent surgery through similar diagnostic procedures, and who subsequently underwent stabilization procedures, were also excluded. This exclusion strategy aimed to obviate potential instability among the study participants, warranting a focus on other factors pertinent to early recurrences in cases devoid of instability⁹⁻¹¹. The focal point of our study is to scrutinize the characteristics of early recurrences in the absence of instability.

Radiographic studies are critical in diagnosing recurrent lumbar disc herniation (LDH). However, it's important to note whether they are being used to actually diagnose recurrence or to rule out other pathologies. Simple radiographs are used to exclude other causes of lower back or sciatic pain such as listhesis, fractures, and stenosis. Radiographic evidence of instability includes movement of 3 mm in the L1-4 vertebrae or 5 mm in the L5-S1 intervertebral space, or angulation of >10° in adjacent vertebrae⁹. In our study, all participating patients have been evaluated for instability, and those without instability have been included in our study.

Gadolinium-enhanced MRI is the preferred imaging method for evaluating recurrent lumbar disc herniation (LDH). This allows for the differentiation of recurrent disc herniation from other disease processes such as epidural fibrosis, arachnoiditis, abscess, and hematoma. Although theoretically the variables of recurrence and scar tissue can be identified in MRI, it's not always radiologically possible to distinguish

between recurrence and scar tissue under postoperative conditions (Figure 3). However, diagnosing recurrence becomes much easier when evaluated along with clinical signs. Indeed, if a patient whose postoperative pain has resolved subsequently experiences a return of pain, and if there is radiological compression consistent with the pain, decompression surgery is recommended. Therefore, MRI findings should be compared with the patient's complaints and physical examination. Radiological evaluation alone is not sufficient for a diagnosis of "recurrence," just as clinical evaluation alone would not be sufficient. Indeed, it has been shared in the literature that MRI findings can be abnormal in up to 20% of asymptomatic patients¹⁶.

Numerous scholarly investigations underscore the critical need for differentiating between recurrent lumbar disc herniation (LDH) and epidural fibrosis. Furthermore, these investigations commonly assert that the presence of epidural scarring or fibrosis correlates with adverse clinical outcomes following subsequent surgical interventions^{9-11, 16}. Characteristically, an epidural scar manifests an isointense appearance relative to the intervertebral space and demonstrates early heterogeneous uptake of contrast material. The anatomical interrelationship between the dura mater and the lesion predominantly involves traction of the dura mater towards the lesion. While the differentiation between an epidural scar and disc herniation holds clinical significance, the clinical implications of the presence of an epidural scar remain indeterminate. Research conducted by Rönnerberg et al. indicates an absence of direct correlation between the existence of scar tissue and clinical outcomes¹⁷.

In our study, two patients who were re-operated on due to the presence of symptomatic compression, despite the radiological interpretation of "scar tissue" in early-phase contrast-enhanced MRI, were considered to have "recurrent" cases based on significant improvement in their postoperative VAS scores (Figure 3). Although this specific point is not the primary focus of our study, the positive surgical outcomes in these two patients, who were initially diagnosed radiologically with 'Scar Tissue,' could contribute to ongoing debates in the literature regarding this issue^{10, 11, 16, 17}. Consequently, our study defines recurrent LDH as follows: patients whose pain subsides following the initial surgery, exhibit no new symptoms during standing evaluations on the 20th day postoperatively, but later experience the re-emergence of radiculopathy symptoms. New MRI findings at the same level and on the same side as the initial surgery demonstrate radicular compression that aligns with the patient's symptoms and neurological examination, are considered to have 'Recurrent LDH.'

5. Conclusions

Key findings of our study are as follows:

-Our study addresses the concept of early recurrence, delving into variables of this disconcerting topic for every surgeon.

-It emphasizes that the literature supports similar early recurrence risk profiles for both full endoscopic and microscopic techniques.

-Our study pioneers the utilization of a commonly used practical method for measuring the volume of the disc removed during surgery in the academic literature.

-It highlights the potential insignificance of the volume of the disc removed during surgery in the development of early recurrence (though, of course, this must be definitively stated through a comparison of surgeries performed at the same center).

-It provides recommendations for planning future studies (such as evaluating LDH patients who require surgery within the first three months, referred to as very early LDH surgery).

-Our study introduces an independent definition of "recurrent LDH" that is applicable to patients presenting with LDH recurrence, particularly within the first six months, regardless of the terms "scar tissue?", "recurrence?", or "residue?" in contrast-enhanced lumbar MRIs.

Limitations of the Study

We are aware of the limitations of our study. Specifically, its retrospective design and the limited number of patients necessitate caution in generalizing our findings. In future studies, it would be beneficial to assess the impact of these factors in larger patient populations and within a prospective design.

Acknowledgement

The authors of the study have no financial relationships or grants with any institutions.

Conflict of Interests

There are no conflicts of interest between the authors and the institutions.

Financial Support

No.

Author Contributions

Study design: DKG, Sample collection: DKG, Data collection and/or Processing: DKG, BG, Writing Original Manuscript: DKG, BG, contributed to revising the work and providing approval of the final version of the manuscript.

Ethical Approval

This study, being a retrospective study, does not require ethical approval. However, it is currently under evaluation by the Selçuk University Faculty of Medicine Ethics Committee (04.09.2023).

Data sharing statement

Data supporting the findings of this study can be made available upon request from the corresponding author.

Consent to participate

Participation consent has been obtained from the patient and control groups involved in the study.

Informed Statement

Patients and control groups who agreed to participate in the study have signed the informed consent form.

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