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Original Article

Magnetic Resonance Imaging Findings of Recurrent Hernia and Other Postoperative Complications After Lumbar Disc Herniation Surgery: A Retrospective Study

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ABSTRACT

Objectives: This study addresses low back pain, prevalent in 80% of adults, often caused by lumbar disc herniation (LDH). Emphasizing magnetic resonance imaging (MRI)'s crucial role in LDH diagnosis and postoperative monitoring, the research underscores its significance in detecting complications, particularly recurrence, following LDH surgery.

Methods: Our study focused on patients who had LDH surgery but were referred to our imaging center for new complaints. Retrospectively evaluating MRI images captured from May 2021 to October 2023, we investigated cases with issues like low back pain and motor or sensory deficits.

Results: In our study involving 48 patients who underwent total laminectomy or hemi-laminectomy (21 males, 27 females, aged 19-80, mean age 50 ± 15 years), those with recurrent LDH had a higher average age, though not statistically significant ($P = .183$). No significant gender-recurrence relationship was observed ($P = .503$). Likewise, recurrent LDH cases showed no significant association with degenerative vertebral changes ($P = .712$). Notably, a significant link was identified between left-sided laminectomy and recurrence ($P = .009$).

Conclusion: There are many studies in the literature that reveal different results regarding recurrence risk factors. The discrepancy in age and gender as risk factors for recurrent LDH suggests the need for further research, the findings of this study may contribute to clinical practices to understand and prevent recurrence in surgical interventions.

Keywords: Low back pain, intervertebral disc displacement, laminectomy

Introduction

Back pain is a symptom that occurs at least once in approximately 80% of the adult population throughout their lifetime.[1] Approximately, 90%-95% of patients with back pain have unexplained back pain, except in important pathologies such as fractures and malignancies, which may cause secondary back pain due to nerve root compression.[2] Determining the underlying pathology of back pain is critically important in guiding treatment. For this reason, the number of patients examined with magnetic resonance imaging (MRI) along with computed tomography (CT) has increased noticeably. However, since morphological changes are frequently observed in some patients even though they are asymptomatic, it can be challenging to evaluate whether the morphological changes and other pathologies identified in MRI are the true cause of back pain.[3] One of the challenges in evaluating the diagnostic accuracy of MRI data is the deficiency of a generally acknowledged gold standard test.[4] Indeed, studies in the literature have identified many pathologies with MRI even in individuals without complaints of back pain.[5-7] Ultimately, while MRI plays a significant role in determining the cause of back pain, the question of which pathologies identified with MRI constitute the true etiology of back pain is still debated.[8,9] A herniated lumbar disc is a general degenerative pathology of the vertebral column and one of the most common causes of back pain. Earlier researches have presented that the frequency of lumbar disc herniation (LDH) leading to back pain varies between 1% and 3%, with these patients most commonly belonging to the people aged between 30 and 50 years.[10] The average age of patients diagnosed with LDH requiring surgical intervention has been determined to be 42 years.[11] Patients with herniated lumbar disc might be asymptomatic, but

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symptomatic individuals most frequently complain of back and leg pain. In advanced cases of herniation, motor and sensory disturbances may accompany the condition. Depending on the degree of herniation, patients may present with various cases secondary to nerve root or thecal sac compression. In patients examined for low back pain, degenerative changes in their vertebrae can be detected with MRI and CT scans.[12] However, undoubtedly, MRI is the most important imaging technique for the diagnosis and monitoring of LDH due to its high spatial resolution in soft tissues and the ability to demonstrate the components of the intervertebral disc (collagen, proteoglycans, and especially water content) in T2-weighted series. Magnetic resonance imaging enables the assessment of the structure of the intervertebral disc and confirms the severity of suspected herniation through clinical examination, facilitating the identification of patients requiring surgical treatment for thecal sac or nerve root compression. Back pain unresponsive to physical activity restriction, medication, and physiotherapy, leading to motor or sensory deficits due to nerve root or thecal sac compression, primarily constitutes indications for surgery. Micro-endoscopic discectomy (MED), full-endoscopic discectomy (FED), and open discectomy (OD), microdiscectomy (MD), and are currently the most widely applied and accepted surgical procedures in lumbar disc surgery. However, despite medical and surgical treatment, some patients may not achieve permanent improvement. In this research, we intended to demonstrate the significance of MRI as an imaging modality in detecting postoperative complications in cases operated on owing to LDH, with a focus on recurrence.

Methods

This study has taken approval from the Ethics Committee of the University of Health Sciences Bakırköy Dr. Sadi Konuk Training and Research Hospital (Approval no: 391, Date: October 16, 2023). All patients gave informed consent and the research was carried out according to the principles of the Helsinki Declaration. The population of this retrospective and single-center study consists of patients who were referred to our imaging center after examination by orthopedic and traumatology specialists due to LDH and ongoing or newly developed complaints such as back pain, motor or sensory deficits. The MR images obtained between May 2021 and October 2023 for these patients were retrospectively evaluated. Totally 48 patients, with ages ranging from 19 to 80 years and the mean age of 50 years (±15 years), included 21 males and 27 females, were involved in this research.

Magnetic resonance images were obtained using a spinal coil with a 1.5 Tesla Optima system (General Electric Company, Boston, Mass, USA). The standard imaging protocol included sagittal and axial T2-weighted images (TR: 3367 ms, TE: 85 ms, FOV: 28 × 28 mm, 352 × 288 pixels, flip angle: 160, slice thickness: 3 mm, slice gap: 1 mm, NEX: 2.0), sagittal Short Tau Inversion Recovery (TR: 3614 ms, TE: 42 ms, 352 × 288 pixels, FOV: 28 × 28 mm, flip angle: 142, slice thickness: 3 mm, slice gap: 1 mm, NEX: 2.0), and sagittal T1-weighted images (TR: 477 ms, TE: 15 ms, 320 × 256 pixels, FOV: 28 × 28 mm, flip angle: 160, slice thickness: 3 mm, slice gap: 1 mm, NEX: 2.0). Additionally, after the administration of contrast agent, T1-weighted images were obtained in sagittal and axial planes.

Statistical Analysis

In the statistical analyses, the Statistical Package for Social Sciences version 26.0 software (IBM Corp.; Armonk, NY, USA) was used. Continuous data were presented in terms of mean and standard deviation, while categorical data were expressed in numbers and percentages. Prior to intergroup comparisons, normal distribution of data was checked. Values with $P > .05$ in the Shapiro–Wilk normality test were considered normal, and parametric tests were applied in subsequent stages. Additionally, kurtosis and skewness values were examined to ensure they fell within the range of −1 to +1. For pairwise group comparisons, independent samples *t*-test and the Mann–Whitney *U*-test were used according to whether the data were parametric or nonparametric. The Fisher's exact test was utilized for the comparison of categorical data. The results were evaluated with reference to the 95% confidence interval and the $P < .05$ significance level.

Results

As a result of operations performed on the right or left side, a total of 48 patients underwent unilateral laminectomy or hemi-laminectomy. The mean age for patients diagnosed with recurrent LDH was 53 ± 16, while it was 46 ± 17 for cases without recurrence. Among male patients diagnosed with recurrent LDH, the average age was 58.25 ± 15.22, and for female patients, it was 49.78 ± 16.39. In cases without recurrence, the average age for male patients was 42.67 ± 17.00, and for female patients, it was 51.00 ± 11.68. No significant effect of the age of the patients on the recurrent LDH was detected ($P = .183$). Recurrence was observed in 30 patients, with 12 males and 18 females experiencing recurrence. Among the 18 cases without recurrence, 9 were male, and the remaining 9 were female. The relationship between LDH recurrence and gender was found to be insignificant ($P = .503$). In patients diagnosed with recurrent LDH and those without recurrence, there was no significant relationship observed in terms of spondylolisthesis ($P = .102$), degenerative changes in the vertebrae ($P = .712$), facet joint degeneration ($P = .825$), spinal canal stenosis ($P = .398$), granulation tissue ($P = .063$), and postoperative infectious pathologies ($P = .277$). Laminectomy was performed at a single level in 40 patients, at 2 levels in 6 patients, and at 3 levels in 2 patients. No significant relationship was found between the number of laminectomy defects and recurrence ($P = .294$). There was no significant relationship found between the level of operation and recurrence ($P = .294$). Among the 30 patients with recurrence, the laminectomy side was on the right in 10 cases and on the left in 20 cases. In the 18 cases without recurrence, the laminectomy side was on the right in 13 cases, and in the remaining 5 cases, it was on the left. The relationship between left-sided laminectomy and LDH recurrence was found to be significant ($P = .009$).

Demographic information and postoperative findings determined by MRI for the patients are summarized in Table 1.

Discussion

Intervertebral disc herniation is the displacement of components such as the cartilage, annulus fibrosus, and nucleus pulposus of the the intervertebral disc beyond the boundaries of the disc. Lateral recess stenosis is a common issue, particularly in elderly individuals.[13] With age, the stability of the vertebral column is compromised, leading to an increased frequency of instability. This condition can contribute to facet joint hypertrophy and arthrosis, causing bulging in the disc and additional stress on the ligamentum flavum. All these mechanisms can contribute to lateral recess stenosis or spinal stenosis. While facet joint degeneration and ligamentum flavum hypertrophy are the most common causes of neural foraminal or spinal canal stenosis, degenerative etiologies such as disc herniation and spondylolisthesis can also lead to this constriction.[14] Spondylolisthesis refers to the forward displacement of one vertebra over the one below it and is typically observed, often at the L4-L5 level. This displacement may result from spondylolysis or facet sliding associated with facet arthrosis. Extraforaminal nerve compression is observed in approximately 5% of cases, and the primary cause is often lateral herniation of the disc.[15,16]

One of the most prevalent degenerative spinal pathologies causing lower back pain is LDH. While a significant portion of disc herniations

Table 1. Descriptive Data of the Cases and Magnetic Resonance Imaging Findings

	Recurrent Lumbar Disc Herniation (n = 30)	Non-recurrent LDH (n = 18)	*P*
Age (mean ± SD)	53 ± 16 E: (58.25 ± 15.22) K: (49.78 ± 16.39)	46 ± 17 E: (42.67 ± 17.00) K: (51.00 ± 11.68)	0.183[a]
Gender			0.503[b]
Male	12	9	
Female	18	9	
Disc bulging without nerve root compression*	19	9	0.369[b]
Bulging with nerve root compression			
Nerve root compression	11	4	0.301[b]
Cauda equina syndrome	5	1	0.265[b]
Spondylolisthesis			0.102[b]
Anterolisthesis	6	7	
Retrolisthesis	2	5	
Degenerative changes	15	8	0.712[b]
Facet joint degeneration	16	9	0.825[b]
Spinal canal stenosis	4	1	0.398[b]
Other postoperative changes			
Granulation tissue	10	11	0.063[b]
Postoperative subcutaneous effusion	0	0	-
Postoperative infective pathologies	2	3	0.277[b]
Laminectomy level			0.068[c]
L2-L3	3	0	
L3-L4	4	6	
L4-L5	22	12	
L5-S1	10	2	
Number of laminectomy defect(s)			0.294[c]
1	23	16	
2 and more	7	2	
Laminectomy side			**0.009[c]**
Right	10	13	
Left	20	5	

The values given in bold indicate statistically significant differences at the 0.05 level.
[a]Student's *t*-test.
[b]Mann–Whitney *U*-test.
[c]Pearson chi-square test.

may manifest without clear symptoms, symptomatic ones often present with both back and leg pain. In advanced cases of herniation, motor and sensory deficits may occur simultaneously. Surgical intervention is considered for patients experiencing persistent back pain that does not respond to activity restriction, medication, and physiotherapy. Additionally, individuals with motor or sensory deficits owing to compression of nerve roots or the thecal sac are also considered suitable candidates for surgery (Figure 1).

Micro-endoscopic discectomy, FED, MD, and OD are currently the most commonly applied and accepted surgical procedures in lumbar disc surgery. A review comparing systematically the complications of these surgical procedures has demonstrated that the average prevalence of recurrent LDH and reoperations and wound complications is similar for all techniques. The frequency of complications associated with durotomy is shown to be relatively higher in OD compared to other procedures.[17] According to this review, the incidence of nerve root

Figure 1. Thirty-seven-year-old male patient diagnosed with preoperative lumbar disc herniation. (A) Sagittal T2-weighted magnetic resonance (MR) image showing a central broad-based protruded disc herniation at L4-L5. (B) Sagittal T1-weighted MR image showing a central broad-based protruded disc herniation at L4-L5. (C) Axial T2-weighted MR image showing a central broad-based protruded disc herniation compressing the right S1 nerve root.

Figure 2. Forty-nine-year-old female patient with postoperative recurrent lumbar disc herniation. (A) Sagittal T2-weighted magnetic resonance (MR) image showing a broad-based disc extrusion at the right paramedian-foraminal region of L3-L4. (B) Sagittal T1-weighted contrast-enhanced MR image demonstrating significant contrast enhancement around the herniated disc periphery. (C) Axial T2-weighted MR image revealing a disc extrusion at L3-L4 on the right paramedian-foraminal region, accompanied by hypertrophy of the ligamentum flavum on the left side, causing compression of the dural sac.

injury and neurological complications is also reported to be lower for MD (0.3% and 2.8%) compared to MED (0.8% and 4.5%) and FED (1.2% and 4.9%). One of the most common reasons for the recurrence of symptoms in patients after surgery is the recurrence of disc herniation. In the literature, the incidence of recurrence after LDH surgery has been shown to range from 5% to 15%. A herniation at the same level after a 6-month asymptomatic period, independent of ipsilateral or contralateral herniation, is defined as recurrent LDH (Figure 2).[18-23]

In the pathophysiology of recurrence, the reason is the incomplete closure of the annular gap with surgery, leading to continued exposure of the defect to changes in intradiscal pressure. Risk factors previously reported in the literature for recurrent disc herniation include structural weakness in the annular defect, repetitive weight lifting or exposure to vibration, excessive heavy lifting, smoking, advanced age, size and degree of preoperative disc herniation, and the appearance of herniation during surgery.[24-28]

In this research, we observed that the average age of cases showing recurrence was higher than those without recurrence; however, no significant relationship was found. As a result, we determined that age and gender are not significant risk factors for recurrence. This finding is consistent with the study by Swartz and Trost[23], which showed that age and gender are not associated with recurrent LDH. However, this contradicts some other studies in the literature that identify male gender as a risk factor for postoperative recurrence.[29,30] Additionally, in this research, we did not find a significant relationship between degenerative changes in the spine and the recurrence of LDH. However, this contradicts a study by Yaman et al,[31] in which they stated that Modic changes in cases of LDH recurrence were more pronounced than in cases without recurrence. In a different study, Kim et al[32] suggested that Modic changes could be a risk for recurrence in cases undergoing percutaneous endoscopic lumbar discectomy after open discectomy. The discrepancies in findings might be attributed to factors such as sample size, methodological differences, or population variations. A notable finding in this study is the significant relationship observed between left laminectomy and recurrence. Several reasons could account for this. Ito and colleagues, in their studies on LDH, predicted that the center of gravity of elderly individuals who experience falls could significantly deviate from the center of gravity of healthy individuals when they stand on their toes. A similar mechanism post-laminectomy is thought to play a role in possible changes in patients' vertebral center of gravity, impacting surgical recurrence. Additionally, surgical technique or anatomical differences may also play a role in this scenario.

There are several limitations within the methodological framework of this study. First, a retrospective design was used. The sample size is limited, including only 48 patients, which restricts the generalizability of the findings. Being a single-center study may limit external validity and reduce the applicability of the study to different demographic groups. Furthermore, previous surgical procedures of the patients and parameters such as body mass index that may affect recurrence were not included.

Conclusion

The most well-known cause of lower back pain is LDH, and surgical intervention is considered as an option for patients experiencing persistent back pain or developing motor-sensory deficits. Various surgical methods are available, and the return of symptoms after surgery is defined as recurrent LDH. There are numerous studies in the literature regarding risk factors. The discrepancy in age and gender as risk factors for recurrent LDH suggests the need for further research. The findings of this study may contribute to clinical practices in understanding and preventing recurrence in surgical interventions. However, future studies conducted in larger and more diverse populations are necessary to enhance the generalizability of these results.

Ethics Committee Approval: Ethics committee approval was received for this study from University of Health Sciences Bakırköy Dr. Sadi Konuk Training and Research Hospital (Approval no: 391, Date: October 16, 2023)

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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