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Slow Selective Resorption of Multilevel Intervertebral Disc Herniation: A Multi-Image Case Study

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Abstract

Introduction:

Spontaneous reduction of lumbar disc herniation has been increasingly reported, with inflammation-driven mechanisms considered a key factor. Conservative management, combined with patient education and modern physiotherapy, may support this natural healing process.

Material and Methods:

A 16-year-old female presented with progressive lumbar radiculopathy and was diagnosed with three large disc herniations from L3 to S1. Initial conservative treatment with NSAIDs and standard physiotherapy was ineffective, and a follow-up MRI showed enlargement of all herniations. A modified therapeutic approach emphasizing soft tissue therapy, neuromobilization, postural correction, and reduced anti-inflammatory use was introduced.

Results:

Within one month, the patient demonstrated marked improvement in pain, posture, and mobility. After six months, gait normalized and symptoms resolved. Follow-up MRI at 18 months revealed substantial regression of herniations at L3–L4 and L4–L5, with unchanged morphology at L5–S1. Clinical improvement preceded radiological changes.

Conclusions:

This case highlights the potential for delayed, segment-selective spontaneous regression of multilevel lumbar disc herniation following tailored conservative treatment. Understanding the role of inflammation and avoiding excessive suppression may support natural resorption processes. Conservative management should be considered a viable first-line option, particularly in young patients.

Keywords: Disk protrusion; low back pain, intervertebral disc resorption.

Introduction

The self-healing capacity of the human body involves multiple organs and systems. In ancient times, spinal pain and symptoms of nerve root compression and inflammation associated with disc herniation or spinal canal stenosis were believed to be of demonic origin. Over time, Greek and Roman physicians increasingly recognized these symptoms as manifestations of spinal pathology and related lower-limb pain. In those periods, only conservative forms of treatment were available. Historical accounts describe, for example, Julius Caesar suffering from pain resembling modern sciatica, treated with various forms of burnishing and manual manipulations analogous to contemporary manual therapy. Hippocrates also proposed conservative methods such as massage, warmth, rest, dietary modifications, and even music - an approach closely aligned with the modern biopsychosocial model of physiotherapy. Notably, he also observed that certain body postures exerted an analgesic effect. (1,2)

A more modern perspective on this condition began to emerge in the 18th and 19th centuries, when attempts were made to perform surgical interventions. Many patient symptoms were mistakenly attributed to lesions such as enchondromas or osteochondritis dissecans, which were later recognized as intervertebral disc pathology. In 1932, Mixter and Barr performed the first transdural discectomy, followed six years later by Love's intralaminar and extradural approach.

The introduction of CT scanning in the 1970s substantially improved diagnostic accuracy, but also led to surgical procedures being performed at very early stages of disc disease. In subsequent years, however, observations by Weber, Hakelius, and others demonstrated that clinical improvement may occur spontaneously in some patients, even without intervention.

During the 1980s, conservative treatment typically involved anti-inflammatory medication, rest, and gradual mobilization beginning on days 7–10, with attempts to resume normal activity within three months of symptom onset. The 2006 consensus suggested surgical treatment only in cases where conservative management fails. (1–4) Nevertheless, many patients experience durable improvement after this initial period, suggesting the presence of a slow biological process influenced by individual immune-system factors.

The progressive development of MRI technology has enabled increasingly precise observation of intervertebral disc pathology. Quantitative MRI methods, such as T2 mapping and diffusion tensor imaging (DTI), provide objective measures of disc hydration, biochemical composition, and structural integrity. Qualitative MRI assessment of lumbar disc morphology - including disc herniation, reduced disc height, and signal intensity changes on T1- and T2-weighted sequences - has made it possible to monitor disease progression or regression. A notable trend is the significant increase in MRI-related spinal research, from 23 publications in 2000 to over 139 in 2022, underscoring the clinical and scientific value of this imaging modality. (5) Advances in technology and improved accessibility have enhanced the ability to observe disc-related changes in patients with degenerative spinal disorders.

Multiple theories have attempted to explain the mechanisms of spontaneous disc healing, and numerous factors - both promoting and inhibiting this process - have been proposed over recent decades. Current literature increasingly describes cases of spontaneous reduction and resorption of disc herniation, although the underlying mechanisms remain incompletely understood. Among the proposed theories are mechanical retraction of the herniated fragment and gradual disc dehydration reducing hernia volume. However, the most widely supported mechanism at present involves inflammation-driven neovascularization and macrophage-mediated phagocytosis. This requires the presence of inflammation, which contradicts earlier recommendations from the 1980s that emphasized suppressing inflammatory processes. Since 1984, an increasing number of MRI-based studies have demonstrated spontaneous reduction of disc protrusions, extrusions, and sequestrations within 3–12 months.

Thus, alleviating symptoms without excessively suppressing inflammation may represent a new therapeutic direction. Conservative treatment based on patient education and modern physical and manual therapy techniques can significantly improve functional status and psychological well-being, which is especially important in the context of pain management. (6) Current recommendations include individualized home-based exercise programs, incorporating breathing exercises that provide short-term symptom relief, as well as stretching. (7,8) In outpatient settings, soft tissue therapy is recommended as part of multimodal treatment; however, evidence remains inconclusive regarding whether combining soft tissue therapy with exercise yields superior outcomes compared with exercise alone. (7) Although physiotherapists are not trained to provide psychotherapy or cognitive-behavioral therapy, patient education regarding pain self-management and mindfulness-based strategies may be beneficial. (9)

In this publication, we present a two-year process of gradual reduction in the size of a multilevel lumbar disc herniation achieved through soft tissue therapy, targeted exercise, and pain-management strategies aimed at reducing reliance on anti-inflammatory medications - an approach that may have facilitated partial, delayed, selective resorption of the herniated disc.

Material and methods.

A 16-year-old female patient began conservative treatment due to severe, progressively worsening lumbar pain radiating into the right lower limb, accompanied by sensory disturbances in the right ankle. Initial first-line management consisted of nonsteroidal anti-inflammatory drugs (NSAIDs). Owing to a lack of clinical improvement, an MRI scan was performed three months after symptom onset. The MRI revealed three large disc herniations spanning L3 to S1. At the L3–L4 level, a central–lateral disc herniation with annular rupture narrowed the spinal canal to 5.2 mm, compressing both nerve roots (right greater than left). At L4–L5, a central–lateral herniation with annular rupture narrowed the dural sac to 5.6 mm, also compressing both roots. At L5–S1, a small central herniation deforming the dural sac was present, adjacent to the right S1 root in the lateral recess. The conus medullaris appeared normal.
The initial MSU grading was:
L3–L4: 2AB,
L4–L5: 3A,
L5–S1: 2A.
Conservative management - pharmacotherapy, physical therapy, and manual therapy—was continued; however, the patient's condition progressively deteriorated. A follow-up MRI performed three months later demonstrated significant trunk decompensation manifested by leftward lateral deviation and notable asymmetry in psoas major muscle tension. All herniations showed enlargement, with updated MSU classifications:
L3–L4: 2A (enlarged),
L4–L5: 3AB (enlarged),
L5–S1: 2A (enlarged).
During this period, gait was severely impaired. The straight leg raise (Lasegue) test could not be performed due to persistent forced flexion in both the hip and knee. Any attempt at knee extension provoked sharp radicular pain. Neurosurgical consultation resulted in modification of the therapeutic plan, emphasizing soft tissue therapy, targeted exercises, and structured patient education.
The patient was referred to our clinic six months after symptom onset. Physiotherapy was initiated, focusing on restoring body symmetry and recovering hip and knee extension range. Soft tissue therapy targeted the left quadratus lumborum, psoas major, tensor fascia lata, rectus femoris, and soft tissues along the sciatic nerve pathway (muscular septa, deep gluteal musculature, and distal nerve branches). Recommendations were modified to improve daily ergonomics and to reduce NSAID intake. Pain-management strategies, including therapeutic positioning, were introduced. Physical exercise was not feasible at this stage due to the patient's inability to assume adequate starting positions.

After one month of therapy (three sessions at weekly intervals), the first significant clinical improvement was observed: correction of posture, reduction in pain, improved symmetry, and increased hip and knee extension. These clinical findings were confirmed by repeat MRI, which demonstrated stability of MSU grades and no further herniation progression (L3–L4: 2A; L4–L5: 3AB; L5–S1: 2A). Between January 2024 and July 2024, therapy continued with emphasis on restoring proper postural patterns, maintaining soft tissue mobilization, and introducing rotational thoracic mobility work, sciatic nerve neuromobilization, and strengthening of weak muscle groups. Pain resolved completely. The straight leg raise test improved progressively - from complete inability to extend the limb, to achieving nearly 0°, and eventually to 40°, enabling restoration of a normal gait pattern. The patient discontinued routine NSAID use, taking medication only occasionally due to anxiety related to prolonged outings. She returned to typical daily activities, such as walking, shopping, and attending school (having previously relied on remote learning). The initial therapeutic phase was completed with recommendations regarding ergonomics, continuation of home exercises, and range-of-motion–oriented activities. A follow-up appointment was scheduled after six months. At the evaluation in February 2025, the patient was symptom-free, and the straight leg raise improved further to 60°. A follow-up MRI performed in July 2025 demonstrated:

L3–L4: distinct herniation reduction; MSU grade improved to 1AB,

L4–L5: clear regression of herniation; MSU grade improved to 2AB, accompanied by reduced canal stenosis and decreased dural sac compression,

L5–S1: no significant morphological change.

The sizes of the herniations, intervertebral space heights, spinal canal dimensions, and their changes over time are presented in Table 1

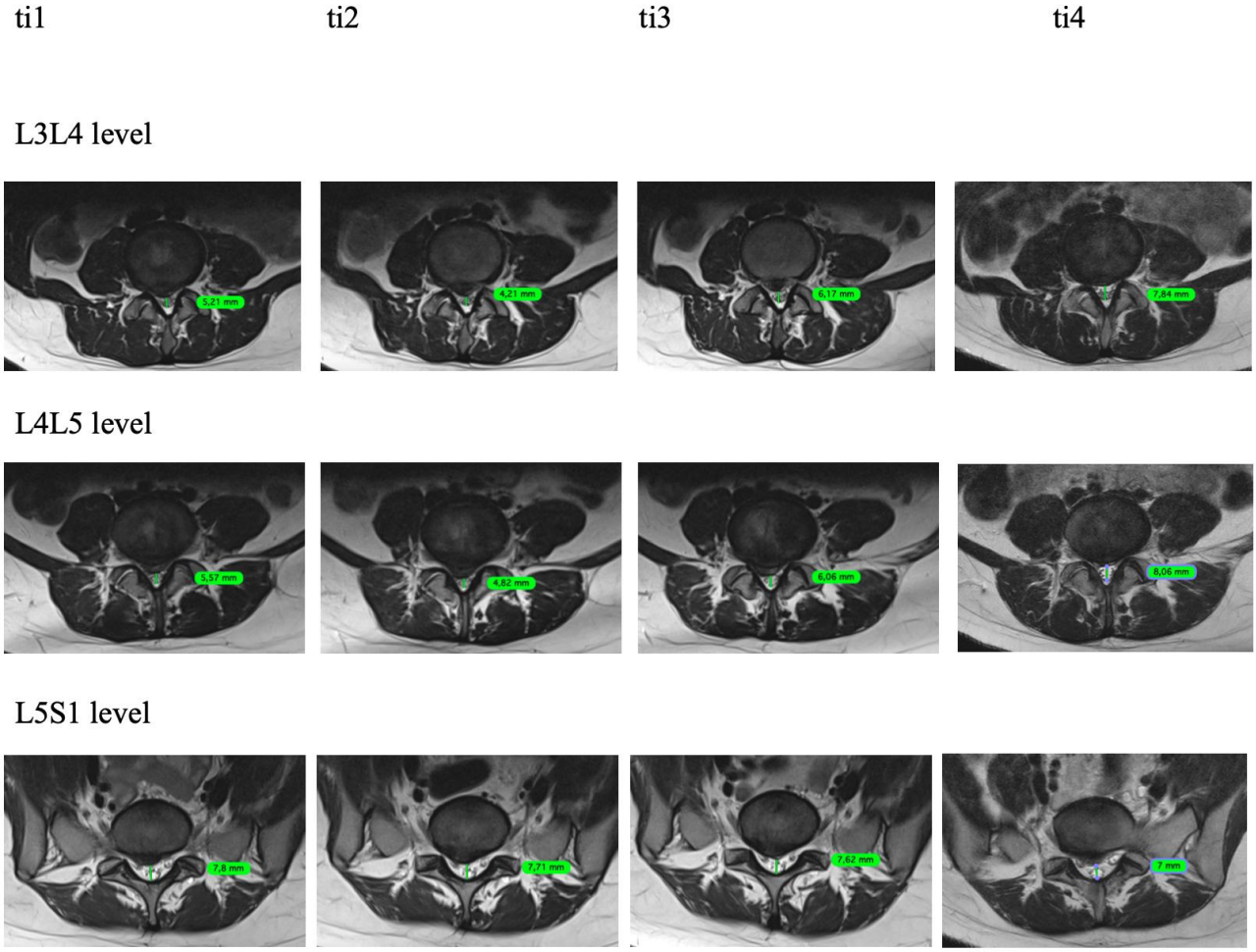
Table 1. Results of measurements of the intervertebral space height, sagittal hernia dimensions, and spinal canal cross-section.

Level	Intervertebral Space Height (mm)				Hernia Size (Sagittal plane) (mm2)	Canal Diameter (mm)	Sacral slope SS (deg)	Timepoint
	PLL	Central	ALL	średni			39	ti1
L3L4	9	11	8,8	9,6	90,2	5,2		
L4L5	11	12,2	7,5	10,2	93,3	5,6		
L5S1	10	9,1	6,5	8,5	42,3	7,8		
							36	ti2
L3L4	7,9	9,4	6,9	8,1	97,6	4,2		
L4L5	10,7	11,3	8,5	10,2	123	4,8		
L5S1	10	9	7,7	8,9	41,8	7,7		
							38	ti3
L3L4	7,6	10,6	8,5	8,9	96	6,2		
L4L5	9,8	12,3	8	10	95,6	6,1		
L5S1	8,9	7,8	7,2	8	43	7,6		
							38	ti4
L3L4	7,1	9,5	7	7,9	56,8	7,8		
L4L5	9,6	10,5	6,5	8,9	68,9	8,1		
L5S1	8,6	7,8	5,8	7,4	45,9	7		

PLL - measurement at the level of the posterior longitudinal ligament; central - measurement at the center of the vertebral body; ALL - measurement at the level of the anterior longitudinal ligament; SS - sacral slope; ti1-4 - period in which MRI scans 1–4 were performed

Across the first and second MRI examinations, the sagittal hernia area increased at L3–L4 and L4–L5, while the L5–S1 increase remained within measurement error. During the improvement period (between the second and third MRI scans), the sagittal spinal canal diameter at its narrowest point increased by 2.0 mm at L3–L4 and by 1.3 mm at L4–L5. The L5–S1 level showed a slight decrease, also within measurement error. In the final MRI, canal width increased substantially - by 3.6 mm at L3–L4 and 3.3 mm at L4–L5 - relative to the worst stage. The L5–S1 level decreased by 0.8 mm; however, signal changes suggested ongoing active remodeling. Figure 1 presents transverse-plane MRI cross-sections at each stage of the examination.

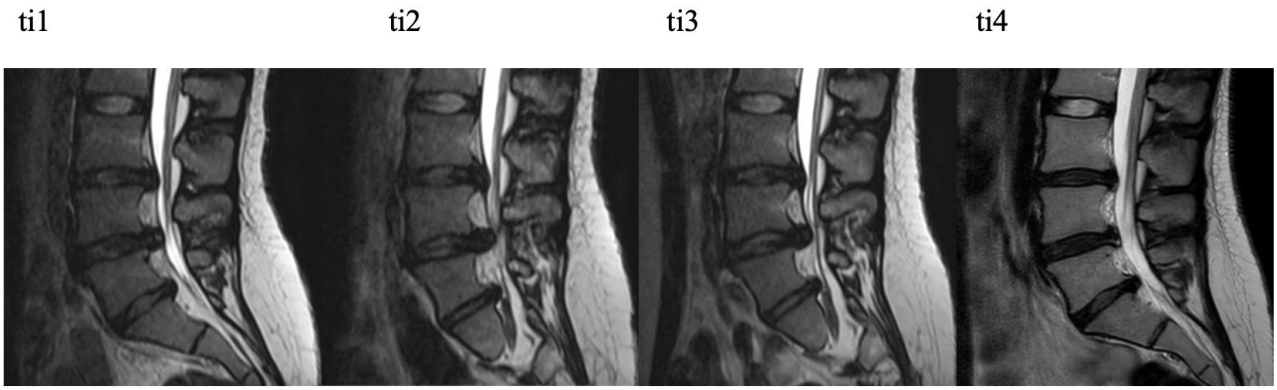
Figure 1: Transversal MRI images at levels L3L4, L4L5, and L5S1 at individual stages of the examination (ti1–ti4).



ti1-4 - observation period in which the magnetic resonance imaging 1-4 was performed

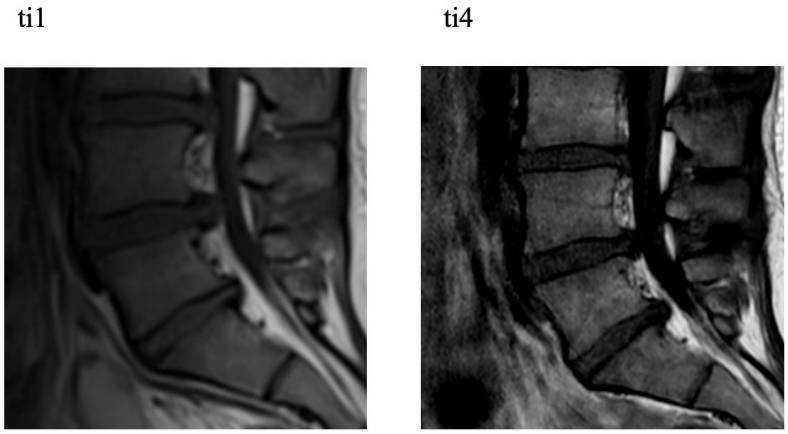
The sacral slope (SS) demonstrated only minimal variation during the period of worst symptoms and impaired limb extension, potentially reflecting compensatory posterior pelvic tilt associated with pain avoidance.
Figure 2 illustrates the changes in intervertebral disc dimensions in the sagittal plane over time.

Figure 2: Sagittal MRI images at levels L3L4, L4L5, and L5S1 at individual stages of the examination (ti1–ti4).



Due to lateral trunk decompensation observed in the second MRI and decreasing decompensation in the third, identical imaging planes could not be maintained; nonetheless, the sequential images clearly demonstrated progressive improvement at L3–L4 and L4–L5, with minimal change at L5–S1. Despite the multilevel herniation, the displacement of the dural sac was most pronounced at L5–S1, correlating with the patient's predominant S1 dermatome symptoms, including sensory disturbances and radicular pain.

Figure 3: T1-weighted MRI images showing displacement of the dural sac in the first and final examination periods.



Lateral trunk decompensation is commonly observed as a compensatory mechanism to reduce radicular pain and typically occurs toward the side opposite the herniation. In this patient, during the period of maximal symptoms, the lumbar Cobb angle measured 20°, gradually decreasing alongside clinical improvement, as shown on Figure 4.

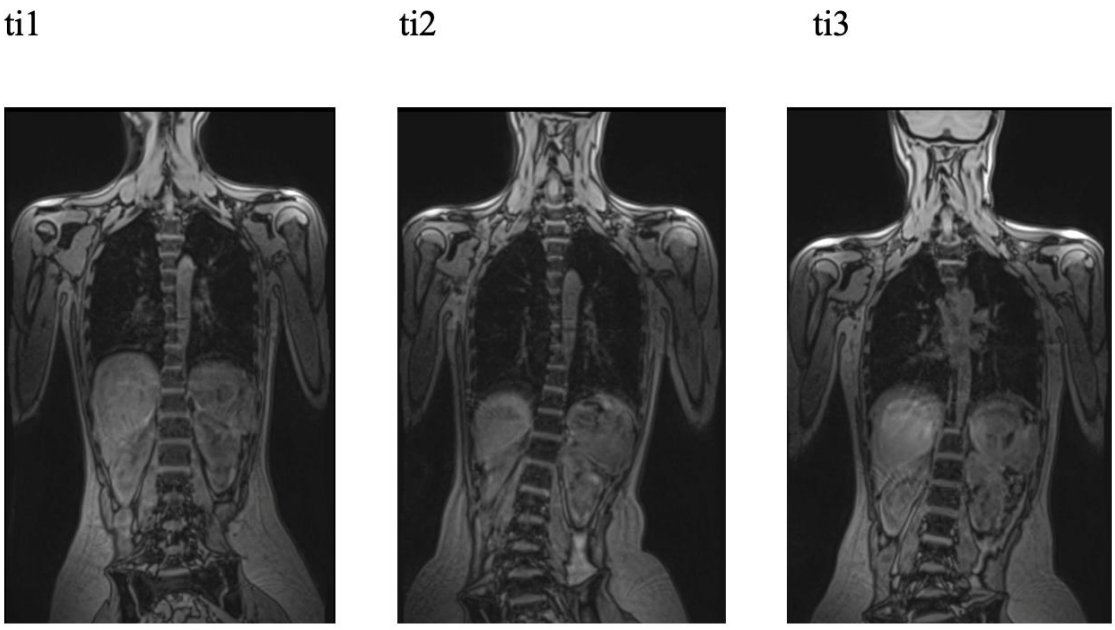


Figure 4. Coronal MRI images during periods ti1, ti2, and ti3.

Discussion

The topic of spontaneous reduction of intervertebral disc herniation has been increasingly discussed in recent literature. Numerous authors have attempted to identify factors that promote or inhibit herniation resorption; however, no consensus has yet been reached. In the present case, MODIC changes were absent. As noted by Shan Z. et al., the absence of these changes may represent a favorable prognostic factor for disc resorption. Nevertheless, because MODIC changes do not occur uniformly across spinal levels, they do not explain the selective improvement observed in this patient. (10) Research by Kawaguchi et al. suggests a potential association between endplate damage and the likelihood of neovascularization and increased macrophage infiltration. However, in our case, no segment-specific differences of this kind were noted. It should be emphasized, though, that reductions in intervertebral disc height may indicate progressive disc dehydration, which can reduce disc dimensions, including the protruding portion, thus contributing to regression. (11) This mechanism, highlighted by Oktay K. et al., appears inconsistent with the pattern observed in our patient, as intervertebral height measurements taken at the anterior, middle, and posterior vertebral margins demonstrated reductions at all levels compared to baseline. (12) Another proposed factor that may facilitate hernia regression is involvement of the anterior longitudinal ligament, possibly via increased inflammatory response. In our patient, partial resorption occurred only at levels where the dural sac was significantly compressed by the herniated fragment through the ligamentous plane.

The size of the herniated disc is also debated as a potential predictor of resorption. Conflicting findings exist: Erly et al. reported more frequent resorption among larger herniations, whereas Ahn et al. emphasized the greater relevance of preligamentous extension rather than hernia size itself. (13,14)

Additional factors potentially predicting rapid disc resorption include sacral slope. Although our patient's sacral slope of 39° should theoretically have favored early regression, improvement occurred much later. Another factor identified as unfavorable for rapid resorption is the presence of multilevel herniations, which aligns with our patient's clinical picture. (15) Our observations indicate that only some of these criteria were met. A potential genetic predisposition (a family history of multilevel lumbar disc herniations) may also have influenced the disease course. Mechanisms such as traction-induced reduction or dehydration-mediated shrinkage of the disc are unlikely given the nature of the treatment and the uniform dehydration observed across all levels - affecting not only the segments where resorption occurred. Furthermore, no traction or manipulative interventions were used during therapy.

The most plausible mechanism for the observed improvement appears to be inflammation-mediated neovascularization following the cessation of anti-inflammatory medication, which had been used extensively during the initial phase when the patient's condition worsened. However, the selective nature of herniation regression complicates interpretation of the role of macrophage infiltration. The greatest degree of resorption occurred at the L4–L5 level. All herniations were large, a characteristic that should theoretically favor resorption, as should the presence of a higher T2-weighted signal, as reported by Erly W. et al. (13) Nonetheless, in this case resorption did not occur across all segments, aligning more closely with the findings of Splendiani A. et al. (16). The patient's young age (16 years at symptom onset) and possible genetic susceptibility may have further influenced the progression and resolution of pathology. During the intake interview, the patient reported that both her father and paternal aunt had a history of multilevel lumbar disc herniations.

A common dilemma faced by multidisciplinary therapeutic teams - including neurosurgeons, physiotherapists, and psychotherapists - involves determining whether and when surgical intervention is warranted. Although established guidelines exist, evolving understanding of spontaneous disc healing may reduce the frequency of neurosurgical procedures in the future. Clear indications for urgent surgery include cauda equina syndrome and significant neurological deficits; however, the recommended duration of conservative management varies among authors. Wang Y. et al., in a review of 38 studies, suggest monitoring patients for 4–10.5 months before determining further treatment direction. (17)

In our patient, the first MRI at three months and the follow-up at six months showed worsening pathology. Nevertheless, at eleven months after symptom onset, despite significant clinical improvement, radiological changes remained modest. This underscores the need for coordinated decision-making, as modern physiotherapy incorporates functional assessments that extend beyond traditional clinical measures and may indicate a favorable clinical trajectory. (18)A study by Albert B. Hanna et al. showed that avoiding anti-inflammatory drugs can result in substantial hernia reduction within 12 months. In contrast, our patient used high doses of NSAIDs daily for more than 12 months, which may have delayed spontaneous resorption. Ultimately, regression became radiologically evident approximately 1.5 years after symptom resolution. This suggests that spontaneous regression may occur not only within the often-cited early period (<3 months) or intermediate window (3–12 months), but also much later. (19) An additional noteworthy observation is that, despite root compression at L5–S1, the dural sac was displaced ventrally by the more cranial herniations, possibly contributing to the lack of visible response at this level on T1-weighted imaging.

The dynamics of disc morphology change are highly variable. Our clinical observations support the findings of Seo JY et al., who emphasized that symptom relief may occur with conservative treatment even when herniation volume changes over time. This highlights the importance of offering patients with lumbar disc herniation the opportunity for non-surgical management while informing them that herniation size may change during daily activity or exercise. (20)
Various forms of exercise, strengthening programs, and motor control training - appropriately tailored to the patient's age, abilities, and condition - should not be portrayed as burdensome or excessively demanding. Numerous therapeutic options currently exist to improve spinal function. (21)
Further research is needed to deepen understanding of these mechanisms, which may enable more precise clinical decision-making, reduce unnecessary surgeries, and optimize pain-management recommendations during initial patient encounters. According to Dagenais et al., acute low back pain should initially be managed with patient education, short-term use of paracetamol or NSAIDs, or spinal manipulation. In chronic low back pain, additional interventions such as exercise, behavioral therapy, and short-term opioid use may be appropriate. (22)

Conclusions.
Conservative treatment may serve as a highly effective first-line approach for lumbar disc herniation when combined with appropriate pain-management strategies, patient education, and an understanding that inflammation is not inherently detrimental but can contribute to natural tissue repair. Although this process is often difficult to accept due to the presence of significant pain - and therefore readily targeted for suppression - growing evidence suggests that the ultimate therapeutic goal may be the gradual reduction of the herniated disc itself.

Disclosure:
Author's contribution
Conceptualization, M.S.; methodology, M.S.,A.S.; validation, A.L. investigation, M.S..; resources, M.S.,A.S.,A.L. writing—original draft preparation, M.S.,A.S..; writing—review and editing, M.S.,A.S. and A.L.

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The authors declare that they have no conflicts of interest.

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