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### Key Words

MRI, degenerative spine, lumbosacral spine, disc herniation, spinal stenosis, Modic changes.

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## The Role of MRI In Diagnosing Degenerative Pathologies Of The Lumbosacral Spine

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### ABSTRACT

Degenerative pathologies of the lumbosacral spine are a leading cause of chronic low back pain and neurological symptoms worldwide. Magnetic resonance imaging (MRI) is the gold standard modality for their assessment due to superior soft-tissue contrast and multiplanar capability. This study evaluates the diagnostic role of MRI in detecting degenerative lumbosacral spine pathologies in 90 patients over a 6-month period. Findings include the distribution of disc degeneration, disc herniation subtypes, facet joint arthropathy, ligamentum flavum hypertrophy, spinal canal stenosis, and Modic changes. MRI proved highly sensitive in detecting early degenerative changes, guiding both conservative and surgical management.

## INTRODUCTION

Degenerative diseases of the lumbosacral spine constitute one of the most frequent causes of disability, affecting middle-aged and elderly populations. They manifest as back pain, radiculopathy, or neurogenic claudication. Pathological entities include intervertebral disc degeneration, disc herniation, facet joint arthropathy, ligamentum flavum hypertrophy, spinal stenosis, and vertebral endplate changes (Modic changes). MRI remains the modality of choice for evaluating these conditions, as it provides detailed visualization of intervertebral discs, vertebrae, spinal canal, and neural elements without ionizing radiation. This study investigates the spectrum of MRI findings in patients with suspected degenerative lumbosacral spine pathology.

## AIMS AND OBJECTIVES

**Aim:** To evaluate the role of MRI in diagnosing degenerative pathologies of the lumbosacral spine.

### Objectives:

- To determine the prevalence of various degenerative changes in the lumbosacral spine.
- To characterize the MRI features of disc degeneration, herniation, facet arthropathy, and spinal canal stenosis.
- To correlate imaging findings with clinical presentation.
- To assess the utility of MRI in treatment planning.

## MATERIALS AND METHODS

This was a prospective observational study conducted in the Department of Radiology, tertiary care hospital, over 6 months. A total of 90 patients with chronic low back pain, radiculopathy, or neurogenic claudication were included. Patients with trauma, infection, neoplasm, or prior spinal surgery were excluded. MRI was performed using a 1.5 Tesla scanner, including T1, T2, and STIR sequences in sagittal and axial planes. Parameters studied were disc hydration, herniation type, facet joint changes, ligamentum flavum hypertrophy, stenosis, and Modic changes.

## RESULTS

**Patient Demographics:** A total of 90 patients with clinical suspicion of degenerative lumbosacral spine disease underwent MRI evaluation during the study period. The mean age of the study population was 49.6 years, with ages ranging from the third to seventh decades of life. There was a slight male predominance, with 52 (57.8%) males and 38 (42.2%) females (Table 1). MRI demonstrated a wide spectrum of degenerative abnormalities affecting the lumbosacral spine.

Table 1: Demographic Characteristics of the Study Population (n = 90)

| Parameter | Number (n=90) | Percentage |
|-----------|---------------|------------|
| Males     | 52            | 57.8%      |
| Females   | 38            | 42.2%      |
| Mean Age  | 49.6 years    | –          |

Table 2: MRI Findings in Patients with Degenerative Lumbosacral Spine Pathologies (n = 90)

| Pathology                     | Cases (n) | Percentage |
|-------------------------------|-----------|------------|
| Disc degeneration             | 72        | 80%        |
| Disc herniation               | 55        | 61.1%      |
| Facet joint arthropathy       | 38        | 42.2%      |
| Ligamentum flavum hypertrophy | 30        | 33.3%      |
| Spinal canal stenosis         | 28        | 31.1%      |
| Foraminal stenosis            | 34        | 37.8%      |
| Modic changes                 | 26        | 28.9%      |

**MRI Findings:** Intervertebral disc degeneration was the most frequent finding, identified in 72 patients (80.0%). Disc herniation was observed in 55 patients (61.1%), making it the second most common pathology. Among the herniated discs, disc protrusion was the predominant subtype, followed by bulge, extrusion, and sequestration (Figure 6). The L4–L5 level was the most commonly involved segment, followed by L5–S1.

Facet joint arthropathy was present in 38 patients (42.2%), while ligamentum flavum hypertrophy was detected in 30 patients (33.3%). These findings frequently coexisted with disc degeneration and contributed significantly to narrowing of the spinal canal.

MRI identified spinal canal stenosis in 28 patients (31.1%), whereas foraminal stenosis was seen in 34 patients (37.8%). Patients with foraminal stenosis commonly demonstrated compression or indentation of the exiting nerve roots, correlating with symptoms of lumbar radiculopathy.

Modic vertebral endplate changes were observed in 26 patients (28.9%). Among these, Type II Modic changes were the most common pattern, followed by Type I and Type III changes (Figure 7), indicating chronic degenerative alterations of the vertebral endplates.

Representative MRI findings are illustrated in Figures 1–4, demonstrating characteristic features including disc dehydration, diffuse disc bulge, posterior annular tears, disc protrusion, facet joint arthropathy, ligamentum flavum hypertrophy, neural foraminal narrowing, and varying degrees of spinal canal stenosis.

Overall, MRI successfully identified both early and advanced degenerative changes involving the intervertebral discs, vertebral endplates, facet joints, spinal canal, and neural foramina. These findings provided detailed anatomical information that was valuable for correlating imaging abnormalities with clinical symptoms and for planning appropriate conservative or surgical management.

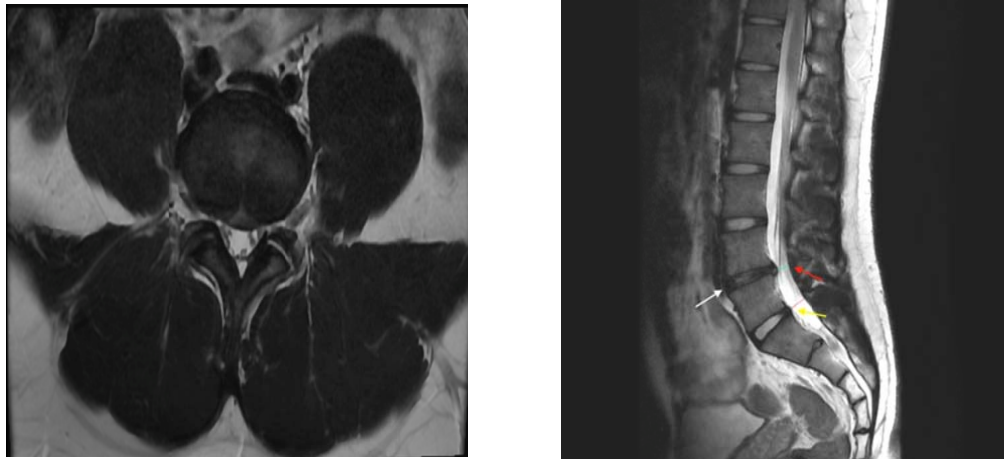


Figure 1: Axial T2-weighted and Sagittal T2-weighted images of the lumbosacral spine demonstrate disc dehydration changes at the L4–L5 level with mild diffuse disc bulge. There is a postero-central disc protrusion with associated posterior annular tear, causing ventral thecal sac indentation and resultant spinal canal narrowing. Bilateral neural foraminal narrowing is noted with compression of the exiting L5 nerve roots.

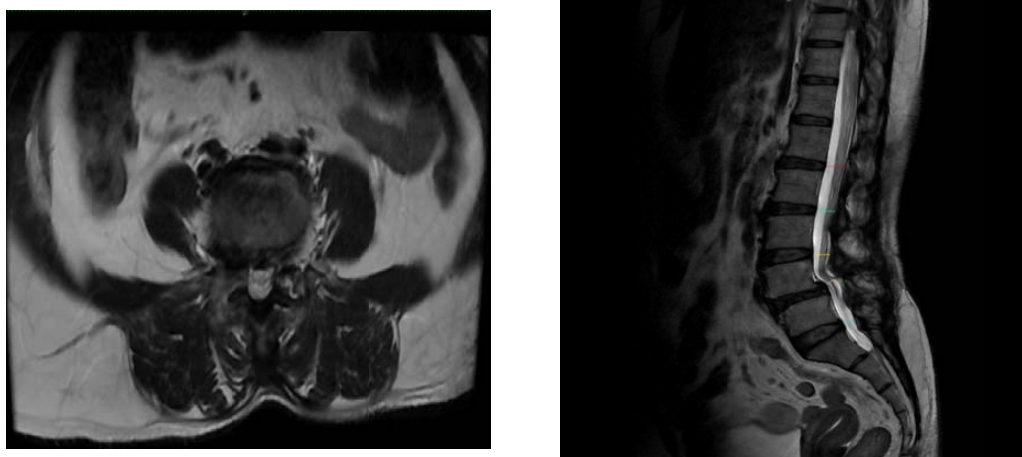


Figure 2: Axial T2-weighted and Sagittal T2-weighted images of the lumbosacral spine demonstrate Grade I anterolisthesis of L4 over L5 with bilateral facet joint arthrosis. Anterior endplate osteophyte formation is noted. At the L4–L5 level, a posterior disc-osteophyte complex is seen causing ventral thecal sac indentation with associated bilateral neural foraminal and lateral recess narrowing, resulting in compression of the right and indentation of the left exiting L5 nerve roots.

## DISCUSSION

The study highlights the spectrum of MRI findings in degenerative lumbosacral spine disease. Disc degeneration (80%) was the most common pathology, while disc herniation (61.1%) was most frequently observed at L4-L5 and L5-S1 levels. Protrusion was the most common herniation subtype (50.9%). Facet arthropathy and ligamentum flavum hypertrophy were significant contributors to spinal canal stenosis (31.1%). Foraminal stenosis correlated well with radicular symptoms. Modic changes were seen in 28.9%, most commonly Type II. MRI remains indispensable for early detection, accurate characterization, and treatment planning. Degenerative disorders of the lumbosacral spine are among the most common causes of chronic

low back pain and disability worldwide. Magnetic resonance imaging (MRI) has become the imaging modality of choice because of its excellent soft-tissue contrast, multiplanar imaging capability, and ability to evaluate both osseous and neural structures without exposure to ionizing radiation. The present study demonstrates the effectiveness of MRI in identifying a wide spectrum of degenerative abnormalities involving the lumbosacral spine.

In the current study, disc degeneration was the most common MRI finding (80%), consistent with previous studies by Pfirrmann et al. and Modic and Ross, who reported that intervertebral disc degeneration is the earliest and most prevalent manifestation of lumbar spondylosis. Progressive loss

of disc hydration and structural integrity contributes to reduced disc height, instability, and subsequent degenerative changes in adjacent spinal structures.

Disc herniation was identified in 61.1% of patients, with the majority occurring at the L4–L5 and L5–S1 levels. These findings agree with those reported by Fardon et al., who described these levels as being subjected to the greatest mechanical stress and therefore most susceptible to disc prolapse. Among the various herniation subtypes, disc protrusion was the most frequent, reflecting the predominance of early and intermediate stages of disc disease in the study population.

Facet joint arthropathy (42.2%) and ligamentum flavum hypertrophy (33.3%) were commonly associated with advanced degenerative changes. These abnormalities contribute significantly to spinal canal and lateral recess narrowing. Similar observations have been reported by Weishaupt et al., who demonstrated that facet joint osteoarthritis frequently coexists with intervertebral disc degeneration and accelerates lumbar spinal stenosis.

The prevalence of spinal canal stenosis (31.1%) and foraminal stenosis (37.8%) observed in this study highlights the importance of MRI in evaluating neural compression. MRI not only identifies the anatomical site and severity of stenosis but also demonstrates nerve root compression, which correlates well with clinical manifestations such as radiculopathy and neurogenic claudication. This information is essential for selecting appropriate treatment strategies, including conservative management or surgical decompression.

Modic endplate changes were observed in 28.9% of patients, with Type II changes being the most common. These findings are comparable with the observations of Modic et al., who described Type II changes as representing chronic fatty replacement of the vertebral marrow and being strongly associated with long-standing degenerative disc disease. Recognition of these changes is clinically important because they may be associated with persistent low back pain and disease progression.

The findings of the present study further emphasize that multiple degenerative abnormalities frequently coexist rather than occurring in isolation. MRI provides a comprehensive evaluation of intervertebral discs, vertebral endplates, facet joints, ligamentum flavum, spinal canal, neural foramina, and nerve roots in a single examination. This comprehensive assessment improves diagnostic confidence and assists clinicians in accurately correlating imaging findings with patient symptoms.

A major strength of this study is the prospective evaluation of a broad spectrum of MRI findings in patients with clinically suspected degenerative lumbosacral spine disease. However, the study has

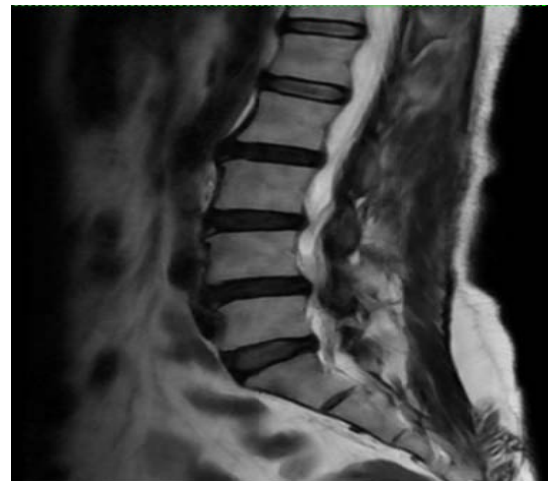


Figure 3: Sagittal T2-weighted image of the lumbosacral spine demonstrates Grade I anterolisthesis of L4 over L5 with bilateral facet joint arthropathy. At the L3–L4 level, a left postero-central annular tear is noted. There is diffuse disc bulge with associated dehydration changes, causing ventral thecal sac indentation and bilateral neural foraminal narrowing, with indentation of the left exiting L4 nerve root.

certain limitations. It was conducted at a single tertiary care center with a relatively modest sample size, and long-term clinical follow-up was not performed. Future multicenter studies involving larger patient populations and longitudinal follow-up are warranted to establish the prognostic significance of MRI findings and their relationship with treatment outcomes.

Overall, the present study confirms that MRI is a highly sensitive and reliable imaging modality for detecting degenerative lumbosacral spine disorders. Its ability to identify both early and advanced pathological changes makes it indispensable for accurate diagnosis, disease characterization, therapeutic planning, and follow-up evaluation in patients with chronic low back pain and associated neurological symptoms. Disc herniation was identified in 61.1% of patients, with the majority occurring at the L4–L5 and L5–S1 levels. These findings agree with those reported by Fardon et al., who described these levels as being subjected to the greatest mechanical stress and therefore most susceptible to disc prolapse. Among the various herniation subtypes, disc protrusion was the most frequent, reflecting the predominance of early and intermediate stages of disc disease in the study population. This information is essential for selecting appropriate treatment strategies, including conservative management or surgical decompression.

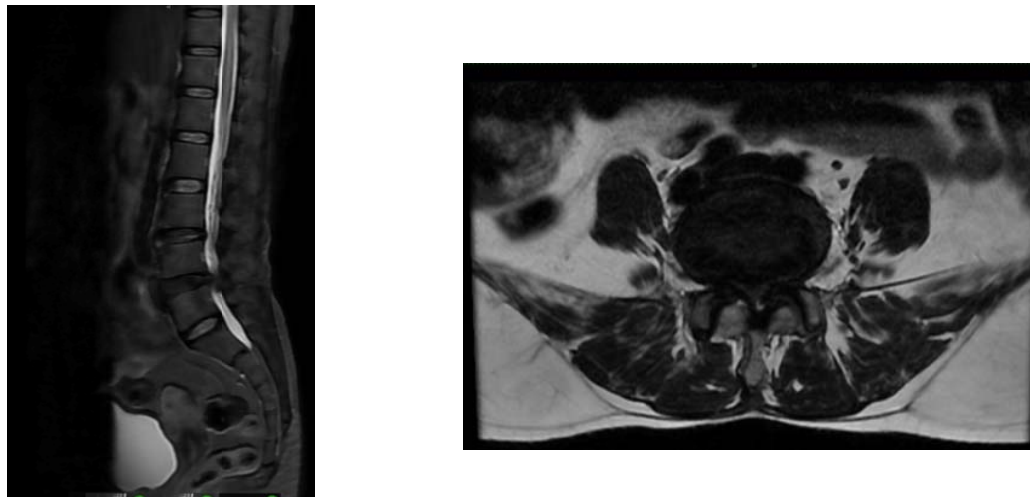


Figure 4: Sagittal T2-weighted and Axial T2-weighted images demonstrates Anterior endplate osteophytes involving all lumbar vertebrae. Diffuse disc bulge at L2-L3 and L5-S1 level causing ventral thecal sac indentation and no neural compromise. Diffuse disc bulge with posterocentral annular tear at L3-L4 level causing ventral thecal sac indentation and bilateral neural foraminal narrowing and mild spinal canal narrowing causing indentation of right and compression of left exiting nerve roots. Bilateral facet joint arthrosis. Diffuse disc bulge at L4-L5 level causing ventral thecal sac indentation and bilateral neural foraminal narrowing and lateral recess narrowing causing indentation of right traversing L5 and compression of bilateral L4 exiting nerve roots. Bilateral facet joint arthrosis noted.

Distribution of Degenerative Pathologies in Lumbosacral Spine (n=90)

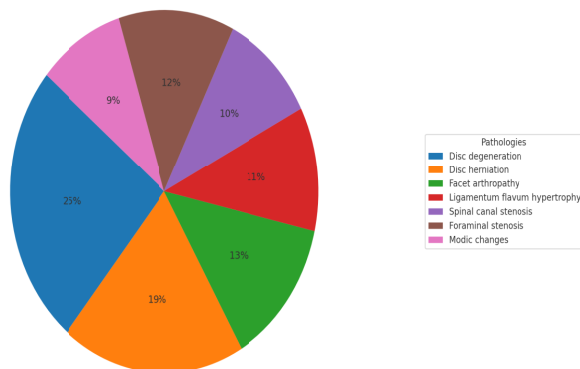


Figure 5: Distribution of Degenerative Pathologies in Lumbosacral Spine (n=90).

Distribution of Disc Herniation Subtypes (n=55)

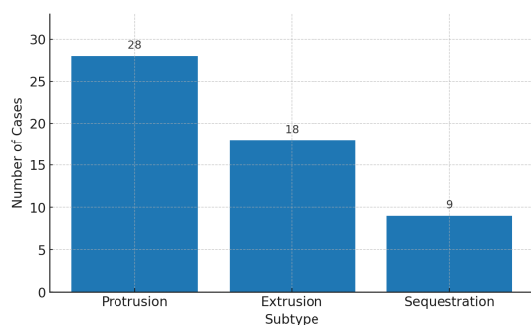


Figure 6: Distribution of Disc Herniation Subtypes (n=55).

Distribution of Modic Endplate Changes (n=26)

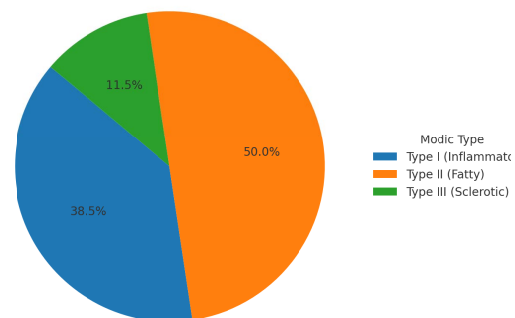


Figure 7: Distribution of Modic Endplate Changes (n=26).

## CONCLUSION

MRI is an invaluable modality in diagnosing degenerative pathologies of the lumbosacral spine. It provides a comprehensive assessment of intervertebral discs, vertebral endplates, spinal canal, and neural structures. Early recognition of degenerative features aids in clinical correlation and facilitates timely management, improving outcomes.

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