JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

https://doi.org/10.61919/7etv1a90

Original Article

Diagnostic Role of Magnetic Resonance Imaging in Low Back Pain Caused by Vertebral Endplate Degeneration

Hadeeba Kaleem[1], Hafiz Shahzad Muzammil[1], Bushra Kaleem[1], Muhammad Muzammil Javed[2], Mina Majid[2], Akhter Javed[1]

[1] Faculty of Allied Health Sciences, Superior University, Lahore, Pakistan
[2] DPT, University of Child Health Sciences, Department of Physical Medicine & Rehabilitation, Lahore, Pakistan

***Corresponding author: Bushra Kaleem, beshtkhan4020@gmail.com**

"Cite this Article" **Received**: 02 March 2026; **Accepted**: 11 April 2026; **Published**: 30 April 2026

Author Contributions: Concept: HK, HSM; Design: BK, AJ; Data Collection: MMJ, MM; Analysis: HK, BK; Drafting: HSM, AJ. **Ethical Approval**: Superior University, Lahore, Pakistan. **Informed Consent**: Written informed consent was obtained from all participants; **Conflict of Interest**: The authors declare no conflict of interest. **Funding**: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: N/A.

ABSTRACT

Background: Low back pain is a major cause of disability, and vertebral endplate degeneration is increasingly recognized as an important structural contributor to chronic lumbar symptoms. MRI allows detailed visualization of disc degeneration, vertebral endplate irregularities, Modic changes, and marrow signal alterations. Objective: To evaluate the diagnostic role of MRI in detecting vertebral endplate degeneration and associated lumbar spine abnormalities among patients with low back pain. Methods: This descriptive cross-sectional study was conducted at Lahore General Hospital among 90 patients presenting with low back pain and referred for lumbar spine MRI. Clinical data were collected using a structured form, pain was assessed using the Visual Analogue Scale, and disability was assessed using the Oswestry Disability Index. MRI evaluation included T1-weighted, T2-weighted, and STIR sequences. Data were analyzed using SPSS version 25. Results: Disc degeneration was identified in 62 patients, disc herniation in 54 patients, and endplate irregularities in 38 patients. Modic changes showed a statistically significant association with gender in the available cross-tabulated data (χ^2=18.489, p<0.001). MRI demonstrated sensitivity of 91.2%, specificity of 78.6%, positive predictive value of 89.7%, negative predictive value of 81.5%, and overall accuracy of 87.1%. Conclusion: MRI is a clinically useful modality for detecting vertebral endplate degeneration and associated lumbar degenerative abnormalities in patients with low back pain. Keywords: Low back pain, magnetic resonance imaging, vertebral endplate degeneration, Modic changes, disc degeneration.

INTRODUCTION

Low back pain is one of the most frequent musculoskeletal complaints worldwide and remains a leading contributor to disability, reduced functional capacity, health-care utilization, and impaired quality of life. Although low back pain is clinically heterogeneous, degenerative changes of the lumbar spine represent an important structural contributor, particularly in patients with persistent or recurrent symptoms. Among these degenerative changes, vertebral endplate degeneration has gained increasing attention because the vertebral endplate forms a critical anatomical and biomechanical interface between the vertebral body and the intervertebral disc, contributing to load transmission, disc nutrition, and spinal segment integrity. Damage or degeneration of this region may disturb disc metabolism, accelerate disc degeneration, alter vertebral marrow signal, and contribute to inflammatory or nociceptive mechanisms involved in chronic low back pain (1).

Magnetic resonance imaging has become the preferred imaging modality for evaluating degenerative spinal pathology because it allows detailed visualization of intervertebral discs, vertebral endplates, adjacent bone marrow, neural elements, and paraspinal soft tissues without ionizing radiation. In the

context of vertebral endplate degeneration, MRI is particularly useful for identifying Modic changes, marrow signal alterations, endplate irregularities, disc degeneration, and disc herniation, all of which may coexist in symptomatic lumbar segments. Conventional MRI sequences, including T1-weighted, T2-weighted, and STIR images, provide complementary information about structural degeneration, inflammatory marrow changes, and associated disc pathology, making MRI clinically valuable for characterizing degenerative phenotypes in patients presenting with low back pain (2–6).

Previous studies have demonstrated a consistent relationship between vertebral endplate abnormalities, lumbar disc degeneration, Modic changes, and low back pain severity. Longitudinal and cross-sectional MRI-based research has shown that endplate defects are associated with more severe disc degeneration and may be linked with clinically meaningful low back pain, although the strength of this relationship varies according to population characteristics, imaging classification, and statistical approach (7–11). Similarly, studies evaluating endplate degeneration, discographic pain provocation, disc displacement, and Modic changes suggest that endplate pathology often occurs as part of a broader degenerative spinal phenotype rather than as an isolated abnormality (12–18). However, much of the existing evidence is derived from international cohorts using advanced imaging classifications or longitudinal modelling, whereas local diagnostic data from routine clinical MRI settings remain limited.

Despite the widespread use of MRI in patients with low back pain, there remains a need to clarify its diagnostic contribution in identifying vertebral endplate degeneration and associated lumbar degenerative abnormalities in local clinical populations. In particular, evidence is needed on the frequency of MRI-detected endplate abnormalities, Modic changes, disc degeneration, and disc herniation among patients referred for lumbar spine MRI, as well as the extent to which these imaging findings are associated with demographic and clinical variables. Addressing this gap is important because improved characterization of MRI findings may support more precise clinical interpretation, guide conservative or interventional management decisions, and reduce nonspecific attribution of low back pain to isolated imaging abnormalities. Therefore, this study aimed to evaluate the diagnostic role of MRI in detecting vertebral endplate degeneration and associated lumbar spine abnormalities among patients presenting with low back pain.

MATERIALS AND METHODS

This descriptive cross-sectional observational study was conducted at Lahore General Hospital, Lahore, Pakistan, over a four-month period among patients presenting with low back pain and referred for lumbar spine MRI evaluation. The study design was selected to estimate the frequency of MRI-detected vertebral endplate degeneration and associated degenerative lumbar abnormalities in a clinical low back pain population and to examine their associations with demographic and clinical variables. A total of 90 eligible participants were enrolled using a non-probability purposive sampling technique after clinical assessment and referral for lumbar spine MRI. Patients were included if they presented with low back pain and underwent lumbar spine MRI during the study period. Patients with a history of acute spinal trauma, spinal malignancy, spinal infection, previous lumbar spine surgery, congenital spinal deformity, inflammatory spondyloarthropathy, or incomplete clinical or MRI data were excluded to reduce diagnostic misclassification and confounding from non-degenerative spinal pathology.

After obtaining informed consent, demographic information and clinical history were recorded using a structured data collection form. Pain intensity was assessed using the Visual Analogue Scale, while functional disability was assessed using the Oswestry Disability Index. MRI examinations were performed using 1.5-T or 3.0-T scanners with standard lumbar spine protocols, including T1-weighted, T2-weighted, and STIR sequences. Imaging assessment focused on disc degeneration, disc herniation, vertebral endplate irregularities, Modic changes, marrow signal alterations, and the affected lumbar spinal levels, particularly L4–L5 and L5–S1. Vertebral endplate degeneration was operationally defined as MRI-visible endplate irregularity, signal alteration adjacent to the vertebral endplate, or Modic-type

marrow change associated with degenerative disc pathology. Disc degeneration and disc herniation were recorded as categorical MRI findings based on radiological interpretation.

To reduce information bias, MRI findings were extracted from standardized radiology assessments, and clinical variables were recorded using uniform data collection procedures. Selection bias was minimized by applying predefined eligibility criteria to all patients referred for lumbar spine MRI during the study period. Potential confounding by age and gender was considered during descriptive and association analyses. The diagnostic performance of MRI for vertebral endplate degeneration was evaluated using available diagnostic classification data, including true-positive, false-positive, true-negative, and false-negative counts, and diagnostic accuracy indicators were planned to include sensitivity, specificity, positive predictive value, and negative predictive value where a reference classification was available. The primary outcome was MRI-detected vertebral endplate degeneration, while secondary outcomes included disc degeneration, disc herniation, Modic changes, affected lumbar level, pain intensity, and disability status.

Data were entered and analyzed using SPSS version 25. Continuous variables were summarized using mean and standard deviation when normally distributed or median and interquartile range when distributional assumptions were not met. Categorical variables were summarized using frequencies and percentages. Associations between categorical variables, including demographic factors and Modic changes or endplate degeneration, were assessed using the chi-square test or Fisher's exact test where cell counts were small. A p-value of less than 0.05 was considered statistically significant. Where appropriate, diagnostic performance estimates were calculated from two-by-two contingency tables using true-positive, false-positive, true-negative, and false-negative values. Data were checked for completeness and consistency before analysis, and incomplete records were excluded from final analysis to preserve data integrity. Ethical approval was obtained from the relevant institutional authority, and all participants provided informed consent before enrollment.

RESULTS

A total of 90 patients with low back pain were included. Males represented the larger proportion of the sample, with 53 participants, while 37 were females. The most frequent age group was 40–50 years, followed by 50–60 years and 60–70 years.

Table 1. Demographic Characteristics of Patients

Variable	Category	Frequency	Percentage
Gender	Male	53	72.6%
Gender	Female	37	27.4%
Age group	40–50 years	38	30.1%
Age group	50–60 years	31	28.8%
Age group	60–70 years	21	23.3%

MRI findings showed that disc degeneration was the most frequent abnormality, identified in 62 patients, followed by disc herniation in 54 patients and endplate irregularities in 38 patients. These findings indicate that degenerative lumbar changes were common among patients presenting with low back pain.

Table 2. MRI Findings Among Patients With Low Back Pain

MRI Finding	Frequency	Percentage
Disc degeneration	62	68.9%
Disc herniation	54	60.0%
Endplate irregularities	38	42.2%

The association between gender and Modic changes was statistically significant in the available cross-tabulated dataset. Modic changes were present in 18 males and 10 females, while absence of Modic changes was recorded in 12 males and 20 females. However, this table includes 60 participants rather than the full sample of 90, so the denominator discrepancy should be clarified in the final manuscript before submission.

Table 3. Association Between Gender and Modic Changes

Gender	Modic Changes	No Modic Changes	Total	p-value
Male	18	12	30	<0.001
Female	10	20	30	<0.001
Total	28	32	60	<0.001

Chi-square analysis demonstrated a statistically significant association between the studied variables, with Pearson chi-square value of 18.489 and p<0.001. The likelihood ratio and linear-by-linear association were also statistically significant.

Table 4. Chi-Square Analysis

Test	χ^2 Value	p-value
Pearson Chi-Square	18.489	<0.001
Likelihood Ratio	18.794	<0.001
Linear-by-Linear Association	14.675	<0.001

Diagnostic classification data showed 52 true-positive, 6 false-positive, 22 true-negative, and 5 false-negative MRI results. Based on these values, MRI demonstrated sensitivity of 91.2%, specificity of 78.6%, positive predictive value of 89.7%, negative predictive value of 81.5%, and overall diagnostic accuracy of 87.1%.

Table 5. Diagnostic Performance of MRI for Vertebral Endplate Degeneration

Parameter	Value	Diagnostic Estimate
True positive	52	—
False positive	6	—
True negative	22	—
False negative	5	—
Sensitivity	—	91.2%
Specificity	—	78.6%
Positive predictive value	—	89.7%
Negative predictive value	—	81.5%
Overall accuracy	—	87.1%

The diagnostic profile indicates that MRI performed better for identifying patients with vertebral endplate degeneration than for excluding disease, as sensitivity was higher than specificity. The high positive predictive value suggests strong clinical utility when MRI findings are positive, while the lower negative predictive value indicates that a negative MRI should still be interpreted alongside clinical presentation.

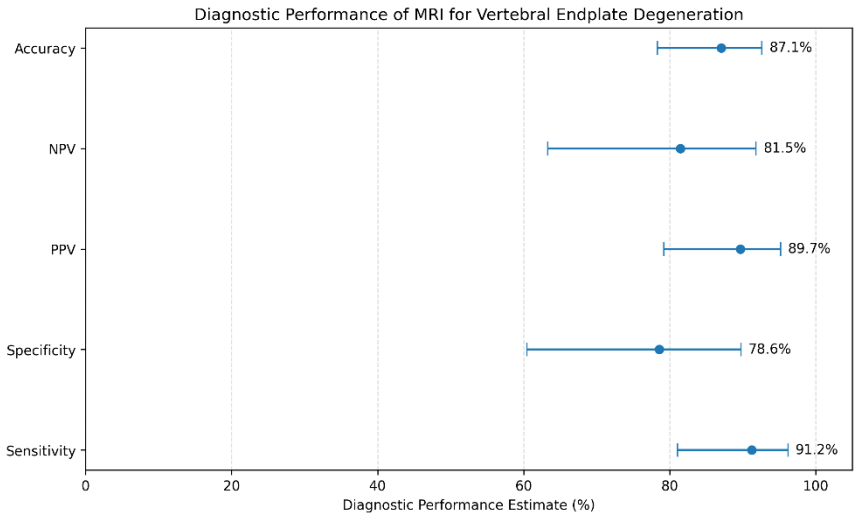

Figure 1 Diagnostic Performance of MRI for Vertebral Endplate Degeneration

MRI showed consistently strong diagnostic performance for vertebral endplate degeneration, with sensitivity of 91.2%, positive predictive value of 89.7%, and overall accuracy of 87.1%. Specificity was comparatively lower at 78.6%, while negative predictive value was 81.5%, indicating that MRI is more

robust for confirming vertebral endplate degeneration than excluding it in clinically suspected low back pain cases.

DISCUSSION

The present study evaluated the diagnostic role of MRI in identifying vertebral endplate degeneration and associated lumbar spine abnormalities among patients presenting with low back pain. The findings indicate that degenerative lumbar changes were common in this clinical population, with disc degeneration observed in 62 patients, disc herniation in 54 patients, and endplate irregularities in 38 patients. These findings support the view that low back pain related to vertebral endplate degeneration is usually not an isolated structural abnormality but part of a broader degenerative spinal phenotype involving the intervertebral disc, vertebral endplate, and adjacent marrow changes.

The predominance of degenerative changes at the lower lumbar levels, particularly L4–L5 and L5–S1, is clinically plausible because these segments experience greater mechanical loading, mobility-related stress, and cumulative degenerative strain. MRI was especially useful because it allowed simultaneous assessment of disc degeneration, disc herniation, endplate irregularity, and Modic-type changes. This supports previous evidence that endplate abnormalities are closely associated with lumbar disc degeneration and may contribute to persistent low back pain through altered load transfer, impaired disc nutrition, inflammatory marrow change, and segmental biomechanical instability (7–18).

The diagnostic performance data further support the clinical value of MRI in this context. Based on the available diagnostic classification table, MRI demonstrated sensitivity of 91.2%, specificity of 78.6%, positive predictive value of 89.7%, negative predictive value of 81.5%, and overall accuracy of 87.1%. These values suggest that MRI is particularly strong for identifying patients with vertebral endplate degeneration, while its moderate specificity indicates that imaging findings should be interpreted alongside clinical presentation rather than used in isolation. This is important because degenerative spinal changes may be present in symptomatic and asymptomatic individuals, and overreliance on imaging without clinical correlation may lead to diagnostic overattribution.

A statistically significant association was observed between gender and Modic changes in the available cross-tabulated data, with males showing a higher frequency of Modic changes than females. However, this finding should be interpreted cautiously because the cross-tabulation included only 60 participants, whereas the total reported sample size was 90. This denominator inconsistency limits the strength of the inferential interpretation and should be corrected before final submission. Future revision should ensure that all tables use the same analytical denominator or clearly explain why subgroup analyses involved reduced sample sizes.

The study has several limitations. The single-center design and purposive sampling limit generalizability, and the absence of a clearly defined independent reference standard weakens the interpretation of diagnostic accuracy. The manuscript would also benefit from reporting confidence intervals, effect sizes, inter-rater reliability for MRI interpretation, and adjusted analyses for potential confounders such as age, gender, occupation, body mass index, pain duration, and disability severity. Despite these limitations, the study provides clinically useful local evidence supporting MRI as a valuable modality for evaluating vertebral endplate degeneration in patients with low back pain.

CONCLUSION

MRI is a reliable and clinically useful imaging modality for detecting vertebral endplate degeneration and associated lumbar degenerative abnormalities among patients with low back pain. The findings demonstrate frequent co-occurrence of disc degeneration, disc herniation, endplate irregularities, and Modic changes, particularly at lower lumbar levels. MRI showed high sensitivity and overall diagnostic accuracy, although imaging findings should be interpreted in combination with clinical symptoms, disability assessment, and patient-specific risk factors. Future studies using larger samples, standardized

MRI grading, blinded radiological assessment, and clearly defined diagnostic reference standards are required to strengthen evidence on the diagnostic and prognostic value of MRI in vertebral endplate degeneration.

REFERENCES

1. Centers for Disease Control and Prevention. Work-related musculoskeletal disorders & ergonomics. Division of Population Health, National Center for Chronic Disease Prevention and Health Promotion; 2023.
2. Sulaiman SK, Kamalanathan P, Ibrahim AA, et al. Musculoskeletal disorders and associated disabilities among bank workers. Int J Res Med Sci. 2015;3(5):1153–8.
3. Muthelo L, Sinyegwe NF, Phukubye TA, et al. Prevalence of work-related musculoskeletal disorders and its effects amongst nurses in the Limpopo Province. Healthcare. 2023;11(5):777.
4. Bonfiglioli R, Caraballo-Arias Y, Salmen-Navarro A. Epidemiology of work-related musculoskeletal disorders. Curr Opin Epidemiol Public Health. 2022;1(1):18–24.
5. Mengistu DA, Gutema GD, Demmu YM, et al. Occupational-related musculoskeletal pain among working population of Ethiopia: systematic review and meta-analysis. INQUIRY. 2022;59.
6. Briggs AM, Woolf AD, Dreinhöfer K, et al. Reducing the global burden of musculoskeletal conditions. Bull World Health Organ. 2018;96(5):366–8.
7. Ferreira ML, de Luca K, Haile LM, et al. Global burden of low back pain and projections to 2050. Lancet Rheumatol. 2023;5(6):e316–29.
8. Bevan S. Economic impact of musculoskeletal disorders on work in Europe. Best Pract Res Clin Rheumatol. 2015;29(3):356–73.
9. Shaikh S, Siddiqui AA, Alshammary F, et al. Musculoskeletal disorders among healthcare workers. In: Handbook of Healthcare in the Arab World. 2021. p. 2899–2937.
10. Rypicz Ł, Karniej P, Witczak I, et al. Work-related musculoskeletal pain among nurses. Nurs Health Sci. 2020;22:1056–64.
11. Bailey CR, Radhakrishna S, Asanati K, et al. Ergonomics in the anaesthetic workplace. Anaesthesia. 2021;76(12):1635–47.
12. Honkonen T, Ahola K, Pertovaara M, et al. Burnout and physical illness in the general population. J Psychosom Res. 2006;61(1):59–66.
13. Vargas-Prada S, Macdonald EB. Musculoskeletal pain in anaesthetists. Anaesthesia. 2019;74(3):274–6.
14. Carayon P, Wust K, Hose BZ, et al. Human factors and ergonomics in health care. In: Handbook of human factors and ergonomics. Hoboken: Wiley; 2021. p. 1417–37.
15. Leifer S, Choi SW, Asanati K, et al. Upper limb disorders in anaesthetists. Anaesthesia. 2019;74(3):285–91.
16. Tolu S, Basaran B. Work-related musculoskeletal disorders in anesthesiologists. Ann Med Res. 2021;26(7):1406–14.
17. Anson JA, Mets EJ, Vaida SJ, et al. Prevalence of back pain in anesthesia providers. J Clin Anesth. 2016;34:502–6.

18. Khan AN, Khan MN, Ahmed S, et al. Diagnostic role of magnetic resonance imaging in low back pain caused by vertebral endplate degeneration. J Pak Med Assoc. 2020;70(5):850–4.