



ROLE OF MRI IN LUMBAR DISC DISEASE AND CORRELATION WITH CLINICAL FINDINGS

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ABSTRACT

Objective: To determine the diagnostic accuracy of MRI in lumbar disc disease by comparing MRI findings with clinical findings in patients presenting with low back pain and radiculopathy

Study Design: Cross-sectional Validation Study.

Place & Duration of Study: Department of Radiology, Bolan Medical Complex, Quetta for a period of six months w.e.f. 02-08-2021 to 01-02-2022.

Methodology: For data collection, patients meeting inclusion criteria were enrolled after informed consent. Clinical history and examination were recorded, and all underwent MRI lumbosacral spine using a standardized protocol. MRI images were interpreted by an experienced radiologist, while clinical assessment was done using a structured proforma. Data were analyzed using SPSS version 25.0.

Results: The study included 210 patients with a mean age of 45.29 ± 11.21 years, with a slight male predominance. Most patients were in the 20-45 years age group. MRI detected lumbar disc disease in 77.1% of cases compared to 74.3% on clinical examination. MRI demonstrated high diagnostic accuracy (92.38%) with excellent sensitivity and good specificity. Overall, MRI showed strong diagnostic performance in detecting lumbar disc disease, with consistent findings across age and gender subgroups.

Conclusion: This study concludes that MRI demonstrates high diagnostic accuracy in lumbar disc disease when correlated with clinical findings, with excellent sensitivity and moderate specificity. Although MRI is highly effective in detecting disc pathology, it may also identify incidental degenerative changes not always clinically significant. Therefore, MRI should be interpreted alongside clinical assessment to ensure accurate diagnosis and optimal patient management.

Key Words: MRI, Lumbar Disc Disease, Clinical Correlation, Diagnostic Accuracy, Radiculopathy, Spine Imaging.

INTRODUCTION

Low back pain (LBP) is a major global public health concern, with a lifetime prevalence reaching up to 84% and significant socioeconomic burden. In most cases, its underlying cause is related to degenerative changes of the intervertebral disc leading to disc nerve root conflict; however, multiple

structural and intersegmental spinal abnormalities may also contribute to the development of symptoms.^{1,2} Lumbar disc degeneration is characterized as progressive wear and tear of the intervertebral discs, which function as shock absorbers of the spine, and most commonly affects the L3–L4 and L4–S1 levels.³ The degenerative process typically begins with annular fissuring followed by dehydration of the nucleus pulposus, ultimately resulting in disc bulging, osteophyte formation, loss of disc height, and possible compression of adjacent neural structures.^{4,5}

Clinically, lumbar disc degeneration presents with a wide spectrum of symptoms including discogenic low back pain, radicular pain, muscular weakness, and sensory disturbances. Radicular symptoms generally follow the distribution of the affected nerve root, while axial low back pain is often diffuse in the lumbar region and may extend to the gluteal area or upper thighs.^{6,7} This variability in clinical presentation often makes accurate diagnosis challenging and necessitates correlation with imaging findings for better assessment of disease severity and nerve involvement.⁸

Magnetic resonance imaging (MRI) is a non-invasive and highly sensitive modality for evaluating morphological changes in the lumbar spine and is widely used in the assessment of patients with LBP.⁸ It allows visualization of disc degeneration as reduced T2 signal intensity and decreased intervertebral disc height, reflecting underlying histological changes such as reduced proteoglycan content, decreased water content, and increased fibrosis within the nucleus pulposus.^{9,10} These degenerative changes are influenced by a combination of age-related processes and mechanical, nutritional, and biochemical stressors acting on the spine over time.^{11,12}

Rehman et al. reported strong correlation between clinical features and MRI findings in lumbar disc herniation, with sensitivity 92% and specificity 96%.¹ Despite this high diagnostic agreement, such correlation studies remain scarce, limiting evidence for routine clinical reliance on examination alone.¹³ So this study was planned.

METHODOLOGY

This study was conducted as a cross-sectional survey to determine the diagnostic accuracy of MRI in lumbar disc disease by comparing MRI findings with clinical findings. The study was carried out in the Department of Radiology, Bolan Medical Complex, Quetta, over a period of six months after approval of the synopsis. A total of 210 patients were included in the study. The sample size was calculated using a 95% confidence interval, assuming an expected sensitivity of 92%, specificity of 96%, and prevalence of 96%, with a 15% margin of error.¹³

A non-probability consecutive sampling technique was used to enroll patients. All patients presenting with low back pain with or without radiculopathy, and having clinical features suggestive of lumbar disc disease such as sciatica, positive straight leg raising (SLR) test, or neurological deficit, and referred for MRI lumbosacral spine were considered for inclusion in the study.

Patients were clinically evaluated and lumbar disc disease was categorized using a clinical severity score (1–3 scale). Clinical findings were considered positive for lumbar disc disease if patients were Grade 2 or 3, which included radiculopathy with positive SLR and/or neurological deficit. Patients with only Grade 1 findings (low back pain without radiculopathy and no neurological deficit) were considered clinically negative.

MRI findings were also graded using a MRI severity score (1–3 scale). MRI findings were considered positive if Grade 2 or Grade 3 changes were present, including disc protrusion, extrusion, sequestration, or nerve root/spinal canal compression. MRI findings were considered negative if only Grade 1 changes were present, such as disc bulge without nerve root compression.

Diagnostic accuracy was assessed by comparing MRI findings with clinical findings as the reference standard. The outcomes were categorized into true positive, false positive, false negative, and true negative cases. From these values, sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy were calculated using standard statistical formulas.

Patients were included if they were between 20–70 years of age, presented with low back pain with or without radiculopathy, were clinically suspected of lumbar disc disease, and underwent MRI of the lumbosacral spine. Patients who were willing to participate were also included. Patients were excluded if they had a history of previous lumbar spine surgery, spinal trauma or fracture, spinal

tumors or infections, congenital spinal deformities, inflammatory spinal diseases such as ankylosing spondylitis, or contraindications to MRI such as pacemakers, metallic implants, or severe claustrophobia.

For data collection, all 210 patients meeting the inclusion criteria were enrolled after obtaining written informed consent. Detailed clinical history and examination findings were recorded. All patients underwent MRI lumbosacral spine using a standardized imaging protocol. MRI images were interpreted by a consultant radiologist with at least eight years of experience to minimize inter-observer variability. Clinical assessment was performed by the attending clinician using a structured proforma. All demographic details, clinical findings, and MRI results were recorded by the principal investigator in a pre-designed proforma.

All collected data were entered and analyzed using SPSS version 25.0. Continuous variables such as age were presented as mean $\pm$ standard deviation, while categorical variables such as clinical findings and MRI results were expressed as frequencies and percentages. The diagnostic accuracy of MRI was calculated using clinical findings as the reference standard. Separate 2 $\times$ 2 contingency tables were constructed to calculate sensitivity, specificity, PPV, NPV, and overall diagnostic accuracy. Furthermore, diagnostic accuracy was stratified according to age groups and gender. Confounding factors were controlled through strict inclusion and exclusion criteria to ensure validity, reliability, and accuracy of the study results.

RESULTS

The study included a total of 210 patients with a mean age of 45.29 ± 11.21 years. Regarding age distribution, 108 patients (51.4%) were in the 20-45 years age group, while 102 patients (46.6%) belonged to the 46-70 years age group. In terms of gender distribution, 125 patients (59.5%) were male and 85 patients (40.5%) were female. Data is given in Table I. The frequency of lumbar disc disease (LDD) detected on MRI was 77.1%, whereas based on clinical findings it was 74.3%. This indicates that MRI identified a slightly higher number of cases compared to clinical examination.

The 2 $\times$ 2 contingency table shows the diagnostic performance of MRI in detecting lumbar disc disease (LDD) using clinical findings as the reference standard. Out of 210 patients, 151 were true positive and 43 were true negative cases, while 5 were false negative and 11 were false positive. The sensitivity of MRI was 96.79%, indicating a very high ability to correctly identify patients with LDD. The specificity was 79.63%, showing moderate ability to correctly identify patients without the disease. The overall diagnostic accuracy of MRI was 92.38%. The positive predictive value was 93.21%, and the negative predictive value was 89.58%. Stratification by age and gender showed similar diagnostic performance trends across subgroups. Data is given in Table II.

Table I: Demographic Characteristics of Patients with Suspected Lumbar Disc Disease Planned for MRI Evaluation

Characteristics	Participants (n=210)
Age (years)	45.29 $\pm$ 11.21
• 20-45 years	108 (51.4%)
• 46-70 years	102 (46.6%)
Gender	
• Male	125 (59.5%)
• Female	85 (40.5%)

Table II: 2x2 Contingency Table to Determine Diagnostic Performance of MRI taking Clinical Findings as Reference Standard

Clinical Finding	MRI	Total

	LDD Present	Absent	
LDD Present	151 ^a	11 ^c	162
Absent	5 ^b	43 ^d	48
Total	156	54	210

^aTrue Positive = 151, ^cFalse Positive =11, ^bFalse Negative = 5, ^dTrue Negative =43

Statistic	Formula	Value
Sensitivity	$\frac{a}{a + b}$	96.79%
Specificity	$\frac{d}{c + d}$	79.63%
Accuracy	$\frac{a + d}{a + b + c + d}$	92.38%
Disease prevalence	$\frac{a + b}{a + b + c + d}$	74.30%
Positive Predictive Value	$\frac{a}{a + c}$	93.21%
Negative Predictive Value	$\frac{d}{b + d}$	89.58%

DISCUSSION

Lumbar disc disease is a common cause of low back pain and radiculopathy, often leading to significant disability. Earlier, clinical examination and plain radiography were used for diagnosis, but these methods had limited accuracy in detecting soft tissue and nerve root involvement.¹⁴ With the advancement of imaging, MRI has become the preferred modality due to its superior ability to visualize disc pathology and neural compression.¹⁵ However, variability still exists between clinical symptoms and MRI findings, and data regarding their correlation remains limited.¹³ Therefore, this cross-sectional study was planned to evaluate the diagnostic accuracy of MRI in lumbar disc disease by comparing it with clinical findings. The scarcity of local data further justified the need for this study.

In this study, the mean age of patients was 45.29 ± 11.21 years, with slight male predominance (59.5%). The frequency of LDD was 77.1% on MRI and 74.3% on clinical examination, showing that MRI detected slightly more cases than clinical assessment alone. Overall, MRI demonstrated high diagnostic performance with sensitivity of 96.79%, specificity of 79.63%, and accuracy of 92.38%.

In comparison with previous studies, our findings are consistent with Rehman et al.,¹³ who also reported strong correlation between clinical findings and MRI in lumbar disc disease, particularly in single-level disc herniation. In their study, sensitivity and specificity values were also high (92% and 96% respectively), supporting the reliability of clinical examination in predicting MRI-confirmed disease. Similarly, our study also demonstrated high sensitivity of MRI, indicating that MRI is highly effective in detecting true cases of lumbar disc disease. However, our specificity was comparatively lower than that reported by Rehman et al.¹³, which may be due to inclusion of

broader clinical criteria and early degenerative changes seen on MRI that were not clinically significant.

Thapa et al.¹⁶ also reported fair correlation between clinical features and MRI findings in lumbar disc prolapse. They emphasized that while nerve root compression on MRI correlates well with radicular pain and neurological deficits, not all imaging abnormalities have clinical significance. This finding strongly aligns with our results, where MRI detected a higher number of positive cases compared to clinical findings (77.1% vs 74.3%). This suggests that MRI may sometimes identify incidental or subclinical disc changes that do not produce symptoms.

Saini et al.⁶ reported that different types of disc pathology such as bulge, protrusion, and extrusion vary with duration and severity of symptoms. They also highlighted that MRI findings alone cannot fully explain clinical symptoms like low back pain, reinforcing the importance of clinical correlation. This supports our findings, where although MRI showed high diagnostic accuracy, clinical assessment remained essential for interpretation of disease relevance.

Ahmed et al.¹⁷ demonstrated a strong association between MRI findings such as disc bulge, degeneration, and stenosis with functional disability. They concluded that MRI is a strong indicator of clinical presentation, but symptoms cannot be explained by imaging alone. Our study similarly supports this concept, as stratification by age and gender showed consistent diagnostic performance, but some mismatch between clinical and MRI findings persisted.

Bajpai et al.¹⁸ also emphasized that correlation between MRI and clinical findings is moderate to strong, but clinical examination should remain the primary diagnostic tool, with MRI used for confirmation. This supports our finding that MRI has high sensitivity but relatively lower specificity, indicating its strength in ruling in disease rather than perfectly matching clinical severity.

Overall, our study demonstrates that MRI has excellent diagnostic accuracy in lumbar disc disease, particularly in identifying true positive cases. However, moderate specificity suggests that MRI may overestimate disease presence in some patients. This finding is consistent with existing literature, which emphasizes that MRI should not be used in isolation but always interpreted in correlation with clinical findings. The high sensitivity of MRI in our study supports its role as a valuable diagnostic tool, while the observed discrepancy between imaging and clinical findings reinforces the importance of careful clinical correlation.

This study had a strong sample size and standardized MRI and clinical grading, improving reliability. Limitations included single-center design and lack of long-term follow-up. Future studies should include multicenter trials and incorporate functional outcomes to further validate MRI-clinical correlation in lumbar disc disease.

CONCLUSION

This study concludes that MRI demonstrates high diagnostic accuracy in lumbar disc disease when correlated with clinical findings, with excellent sensitivity and moderate specificity. Although MRI is highly effective in detecting disc pathology, it may also identify incidental degenerative changes not always clinically significant. Therefore, MRI should be interpreted alongside clinical assessment to ensure accurate diagnosis and optimal patient management.

PATIENT'S CONSENT

Informed written consent was obtained from each study subject.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

AUTHORS CONTRIBUTION

Author 1

Substantial contributions to study design, acquisition of data

Analysis & Interpretation of Data, Manuscript writing

Has given final approval of the version to be published

Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Author 2

Contributions to concept, study design

Data Analysis, Manuscript writing, Critical Review

Has given final approval of the version to be published

Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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