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Original Research Article

Diagnostic Accuracy of MRI Myelogram in Cases of Spinal Stenosis, Keeping Neurosurgical Findings as a Gold Standard

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Abstract: *Lumbar spinal stenosis (LSS) is a prevalent condition associated with neurogenic claudication and radiculopathy, often requiring surgical intervention for definitive management. While conventional MRI is commonly used, MRI myelography offers a non-invasive, contrast-free alternative that may improve diagnostic accuracy. However, its reliability against intraoperative neurosurgical findings, the gold standard, requires validation.* ***Objective:*** *The present study aims to evaluate the diagnostic accuracy of MRI myelogram in detecting spinal stenosis, keeping neurosurgical findings as the gold standard, in patients presenting to a tertiary care hospital in Pakistan.* ***Methods:*** *After the ethical approval from the institutional review board, this cross-sectional study was conducted at the Department of Radiology & Department of Neurosurgery, Jinnah Postgraduate Medical Centre, Karachi from 03/December/2024 to 03/February/2025. Through non-probability consecutive sampling, 123 patients aged 18 years or older, of either gender, presenting with symptoms of spinal stenosis (e.g., neurogenic claudication, radiculopathy, or myelopathy), undergoing MRI myelogram followed by neurosurgical evaluation or intervention, were included in the present study.* ***Results:*** *The sensitivity of MRI myelography for diagnosing spinal stenosis was found to be 91.80%, indicating its strong ability to detect actual positive cases. The specificity was calculated at 87.27%, reflecting its reliability in correctly identifying negative cases. The ROC curve analysis with an AUC of 0.89 of MRI myelography findings in predicting LSS, taking intraoperative neurosurgical findings as the gold standard.* ***Conclusion:*** *MRI myelography is an extremely sensitive imaging technique requiring minimal intervention to diagnose lumbar spinal stenosis.*

Keywords: Neurosurgical Findings, MRI Myelography, Lumbar Spinal Stenosis, Accuracy

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Introduction

Spinal stenosis presents mainly in the lumbar region as a narrowing of the canal that causes nerve compression and constitutes a leading pain and disability condition in elderly patients (1). The numbers of patients who develop lumbar spinal stenosis (LSS) increase with age, resulting in 1.7–2.2% of people between 40–49 years old but rising to 10.3–11.2% in those between 70–79 years old (2).

Proper diagnosis of LSS requires specialized imaging technologies because this forms the basis for effective medical treatment options. Magnetic Resonance Imaging (MRI) myelography is a non-catheter procedure that delivers comprehensive images of both spinal canals and nerve roots (3, 4). A correct diagnosis through this technique remains essential for deciding if surgery will benefit the patient. A meta-analysis of diagnosis findings for lumbar spinal stenosis with magnetic resonance imaging (MRI), computed tomography (CT), and myelography showed MRI sensitivity between 0.81 and 0.97. In contrast, CT sensitivity lay between 0.70 and 1.0, and myelography sensitivity ranged between 0.67 and 0.78 (5). Scientific research demonstrates that MRI detects LSS more effectively than any other investigation method.

Multiple studies have proven MRI's effectiveness in medical diagnosis. A research study demonstrated that the diagnostic accuracy rates between MRI and myelography match for lumbar canal stenosis detection, while myelography routinely uses traditional myelography methods (6, 7). MRI outperforms other invasive tests because it combines non-intrusive examination and the ability to identify all soft tissues throughout the body (8). MRI provides high sensitivity, but its specificity levels differ, and it may generate false-positive diagnoses, specifically during the screening of asymptomatic patients. Clinical scans of asymptomatic patients reveal abnormal findings ranging from 4-28%, which occur more frequently in the elderly population (9). Health professionals should compare MRI results against patient symptoms, since this prevents clinicians from diagnosing erroneously or performing unwanted treatment procedures. All physicians must establish LSS diagnosis by observing surgical conditions directly inside the patient's brain during procedures (10). Surgical procedures enable healthcare providers to directly examine spinal canal constriction and nerve root compression, thus confirming diagnoses based on physical observation. Studies have proved that MRI detection methods show similar results to direct surgical findings, thus establishing MRI as a trustworthy diagnostic tool (11). Various research findings indicate that MRI and myelography play a role in diagnosing lumbar canal stenosis.

MRI myelography is a sensitive diagnostic method that conducts examinations without invasive procedures to evaluate lumbar spinal stenosis. Followed by clinical evaluations, the information provided by MRI allows healthcare providers to detect essential details that align with what surgeons find during operations to develop practical treatment approaches for LSS patients (12). The present study aims to evaluate the diagnostic accuracy of MRI myelogram in detecting spinal stenosis, keeping neurosurgical findings as the gold standard, in patients presenting to a tertiary care hospital in Pakistan.

Methodology

After the ethical approval from the institutional review board, this cross-sectional study was conducted at the Department of Radiology and the Department of Neurosurgery, Jinnah Postgraduate Medical Centre, Karachi, from 03/December/2024 to 03/February/2025. Through non-probability consecutive sampling, 123 patients aged 18 years or older, of either gender, presenting with symptoms of spinal stenosis (e.g., neurogenic claudication, radiculopathy, or myelopathy), undergoing MRI myelogram followed by neurosurgical evaluation or intervention, were included in the present study. Patients with contraindications to MRI (e.g., pacemaker, claustrophobia) or a previous history of spinal surgery were

excluded from the present study. Informed consent was obtained from all participants before their enrollment in the study.

MRI myelograms were performed on all included patients to visualize the spinal canal and nerve root compression. The MRI images were interpreted by an experienced radiologist (more than 5 years of experience), blinded to the patients' clinical history and surgical findings. The radiologist's diagnosis was recorded as either positive or negative for spinal stenosis. Following the radiological evaluation, patients undergoing surgical management for spinal stenosis had their intraoperative neurosurgical findings recorded. During surgery, the neurosurgeon confirmed the presence or absence of spinal stenosis through direct visualization of anatomical structures, including the degree of spinal canal narrowing and nerve compression. Patient demographics, clinical symptoms, MRI myelogram results, and neurosurgical findings were documented in a structured proforma. Data were analyzed using the IBM SPSS v. 26.0 and Microsoft Excel 365. Descriptive statistics such as mean ± standard deviation (SD) were used for continuous variables such as age and duration of symptoms. Frequency and percentages were used to describe the proportion of categorical variables such as gender, catchment, MRI Findings, and presence of spinal stenosis (neurosurgical findings). A 2 by 2 table was drawn, and the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were calculated.

Results

The study included 123 participants with a mean age of 55.5 ± 9.98 years. The gender distribution was nearly equal, with 62 males (50.4%) and 61 females (49.6%). The average duration of symptoms among participants was 9.68 ± 3.17 months. Clinically, neurogenic claudication was the most commonly reported symptom, affecting 74 individuals (60%), followed closely by radiculopathy in 73 participants (59%) and myelopathy in 49 individuals (39.8%) (Table 1).

MRI myelography findings were compared against intraoperative neurosurgical findings, considered the gold standard for diagnosing spinal stenosis (Table 2). Among the 123 participants, MRI detected spinal stenosis in 69 cases, of which 62 were confirmed surgically, while 7 were false positives. On the other hand, MRI missed 6 cases of spinal stenosis that were confirmed intraoperatively, while correctly identifying 48 cases as negative. The sensitivity of MRI myelography for diagnosing spinal stenosis was found to be 91.80%, indicating its strong ability to detect actual positive cases. The specificity was calculated at 87.27%, reflecting its reliability in correctly identifying negative cases. The positive predictive value (PPV) stood at 89.86%, meaning that when MRI identified spinal stenosis, there was a high likelihood of actual disease presence. The negative predictive value (NPV) was 88.89%, signifying that when MRI indicated an absence of spinal stenosis, it was highly probable that the condition was not present. Overall, the diagnostic accuracy of MRI myelography in detecting spinal stenosis was determined to be 89.43%, demonstrating its effectiveness as a non-invasive diagnostic modality. Figure 1 shows the ROC curve analysis with an AUC of 0.89 of MRI myelography findings in predicting LSS, taking intraoperative neurosurgical findings as the gold standard.

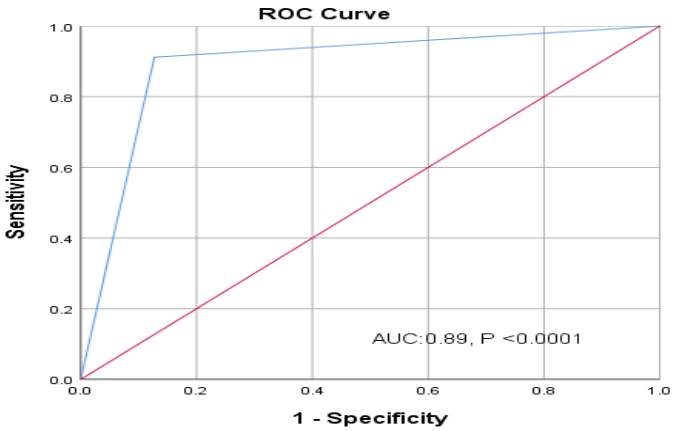
Table 1: Demographic and clinical parameters

Variable	Mean and Frequency (n=123)
Age (years)	55.5±9.98
Gender	
Male	62 (50.4%)
Female	61 (49.6%)
Duration of Symptoms (months)	9.68±3.17
Neurogenic Claudication	74 (60%)
Radiculopathy	73 (59%)
Myelopathy	49 (39.8%)

Table 2: 2 by 2 table

MRI Myelogram Findings	Neurosurgical Findings (Gold Standard)		
	Yes	No	Total
Yes	62	7	69
No	6	48	54
Total	68	55	123
Sensitivity	91.80%		
Specificity	87.27%		
PPV	89.86%		
NPV	88.89%		
Accuracy	89.43%		

Figure 1: A ROC Curve Analysis



Discussion

The diagnostic accuracy of MRI myelography is strong for spinal stenosis diagnosis because it achieves a sensitivity of 91.80% and a specificity of 87.27%. Research findings match previously documented examinations, demonstrating that MRI provides a trustworthy approach to diagnosing spinal stenosis.

The research analysis showed MRI offered 81–97% sensitivity in spinal stenosis diagnosis, while CT provided 70–100% sensitivity and myelography 67–78%. MRI showed variable specificity levels since abnormal test results appeared in 4–28% of asymptomatic patients who primarily belonged to elderly groups (13). The studies demonstrate that MRI delivers outstanding diagnostic capability for lumbar spinal stenosis. However, its ability to produce false results requires medical practitioners to combine assessment findings with clinical evaluation to prevent incorrect diagnoses and avoid invasive procedures (14).

Studies conducted since then have demonstrated the diagnostic capabilities of MRI. Scientific studies validate the equivalence between MRI and myelography results when diagnosing patients with lumbar stenosis. The noninvasive character of MRI, combined with its ability to show complete soft tissue structures, outperforms the alternative procedure of myelography (15).

MRI demonstrates excellent sensitivity, although its specificity levels change, which leads to sometimes inaccurate positive test results, especially in patients without symptoms. Research indicates that asymptomatic patients show abnormal MRI results at rates ranging from 4% to 28%, and this pattern occurs more frequently among elderly adults (16). Safely detecting spinal conditions requires that MRI findings receive validation from clinical examination to prevent misdiagnosis, leading to wasteful procedures (17).

Operating room neurosurgical observations serve as the best possible method to establish a lumbar spinal stenosis diagnosis (18). During surgical procedures, healthcare providers can directly observe spinal canal narrowing together with nerve root compression zones, which leads to concrete diagnostic information. Competitive studies show that MRI scans produce results that support direct surgical observations, thus validating MRI as a dependable diagnostic method. Various published

research indicates that MRI exams match the diagnostic accuracy of myelography for detecting lumbar canal stenosis (19).

Conclusion

MRI myelography is an extremely sensitive imaging technique that requires minimal intervention to diagnose lumbar spinal stenosis. MRI produces vital diagnostic information along with clinical evaluation data that matches operational findings, allowing doctors to develop proper strategies for lumbar spinal stenosis patients.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-TCHMKR-03-24)
Consent for publication
Approved
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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

***AB** (Resident), **SS** (HOD)*
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***AS** (Resident), **FM** (Consultant)*
Study Design, manuscript review, and critical input.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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