

A Retrospective Study of the Accuracy of MRI in Diagnosing Meniscal Tears, Including Sensitivity, Specificity, and Correlation with Arthroscopic Findings

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Abstract

Background: Meniscal tears are one of the most common internal derangements of the knee joint, and a major source of pain, swelling, locking and functional limitation. Magnetic Resonance Imaging (MRI) is a non-invasive examination commonly used to help assess meniscal injury, and arthroscopy is the definitive test. Determination of the accuracy of diagnosis by MRI is crucial for optimizing management of the patient and minimising invasive procedures.

Methods: The study was a retrospective observational study carried out in the departments of Orthopaedics and Radiology of Patna Medical College & Hospital (PMCH) from May 2025 to November 2025. The study included a total of 94 patients with suspected meniscal injuries who had both MRI and arthroscopy. Comparisons were made between findings on MRI and arthroscopic findings, and diagnostic parameters were computed, such as sensitivity, specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), and overall accuracy.

Results: MRI had high sensitivity and good diagnostic accuracy for the identification of meniscal tears. Medial meniscal tears were more common than lateral meniscal tears. The sensitivity, specificity, PPV, NPV, and overall accuracy of MRI were found to be 93.9%, 45.5%, 92.9%, 50.0%, and 88.3%, respectively. There was a strong correlation between MRI findings and arthroscopic findings.

Conclusion: MRI is a useful, non-invasive imaging technique that is accurate and helpful for diagnosing meniscal tears, and is a valuable aid in the preoperative evaluation. But the gold standard in the definitive diagnosis and management of meniscal injury is still arthroscopy.

Keywords: Meniscal tear, Magnetic Resonance Imaging, Arthroscopy, Sensitivity, Specificity, Knee injuries, Diagnostic accuracy.

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Introduction

The menisci are crescent-shaped fibrocartilaginous structures between the knee joint's femoral condyles and the tibial plateau. There are two menisci, the medial and the lateral meniscus in each knee [1]. They have a vital biomechanical function in knee stability, load transmission, reducing friction and absorbing shock during movement [2].

The menisci also play a role in lubricating the joint and in providing the sense of position for the articular cartilage, and protecting it from excessive stress and damage [3]. Injuries to the menisci can

have a significant effect on knee function and quality of life due to their important role in function [4]. Meniscal tears are one of the most frequently occurring orthopedic injuries observed in practice [5]. Such damages can result from sudden trauma, especially sports-related, involving twisting motions, or from age-related degeneration [6].

Common symptoms of meniscal tears include knee pain, swelling, locked knee, clicking of the knee, limited mobility, and joint instability. Increased involvement in sports and the increasing incidence

of degenerative joint diseases among older people have led to a rise in the prevalence of meniscal injuries [7]. Early and correct diagnosis is critical to avoid the chronic knee dysfunction and osteoarthritis long-term complications [8]. There are several tests that are performed for the assessment of meniscal tears. Initial examination techniques such as McMurray's test, Apley's test and joint line sensitivity are used regularly [9]. However, a clinical examination may not always be enough to make a diagnosis because the symptoms may be similar to those of other knee problems. Because of its excellent soft tissue visualization and ability to image in multiple planes, MRI is the imaging modality preferred for the assessment of meniscal injuries [10].

Common MRI abnormalities indicative of meniscal tears includes abnormal intrameniscal signal and distortion of normal meniscal morphology [11]. In the diagnosis of meniscal tears, there is no better method than arthroscopy, as it provides direct visualization of intra-articular structures and simultaneous therapeutic intervention [12].

Although MRI is widely used, there can be some variations between MRI and arthroscopy. Thus, the sensitivity and specificity of the MRI, in the local clinical setting, are important to minimize unnecessary arthroscopy procedures and to better manage patients. The main objective of the present study is to evaluate the specificity, sensitivity, and diagnostic accuracy of MRI in the diagnosis of meniscal tears and to correlate MRI diagnosis with arthroscopic diagnosis at PMCH.

Objectives

- To assess the diagnostic accuracy of MRI in the diagnosis of meniscal tears, by detecting meniscal tears by determining its sensitivity and specificity using arthroscopy as the gold standard.
- To compare MRI findings with arthroscopic findings in patients with probable meniscal tears undergoing arthroscopic surgery at PMCH.

Materials and Methods

Study Design: A retrospective observational study to assess the diagnostic accuracy of MRI in diagnosing meniscal tears, comparing MRI findings with arthroscopic findings. This study consisted of a review of previously obtained clinical, radiological and arthroscopic data of patients with a clinical diagnosis of meniscal injury.

Study Setting: The study was conducted in the Department of Orthopaedics and Radiology of PMCH, a tertiary care teaching hospital that admitted a large number of patients with knee joint injuries and musculoskeletal disorders.

Study Duration: This study was carried out from May 2025 to November 2025. In this period, all patients' medical records that met the study criteria were examined and analyzed.

Sample Size: A total of 94 patients were diagnosed with suspected meniscal injuries who underwent both MRI and arthroscopic examination.

Inclusion Criteria

- Patients with clinically suspected meniscal tears.
- Patients who had an MRI scan and an arthroscopic examination of the knee joint.
- Patients older than 18 years.
- Patients were those who had complete medical records and radiographs.

Exclusion Criteria

- Patients who have had a history of knee surgery.
- Patients with incomplete or adequate medical files.
- Patients who have isolated ligament injuries and no meniscal involvement.
- Patients who have severe osteoarthritis or fractures around the knee joint.

Data Collection: Medical records, radiology reports and operative notes were reviewed to obtain data. Data on demographics, clinical presentation, MRI and arthroscopic findings were collected and recorded on a structured data collection form. The MRI reports were screened for tears of the medial or lateral meniscus, and arthroscopic findings were used as the gold standard for comparison.

MRI Evaluation: MRI scans were conducted on a standard 1.5 Tesla MRI scanner with conventional knee imaging protocols, including T1-weighted, T2-weighted and proton density sagittal, coronal and axial images. The abnormal signal intensity reaching the articular surface or distortion of the normal meniscal morphology were considered to represent a meniscal tear.

Arthroscopic Evaluation: The standard operating procedure for diagnostic arthroscopy was performed by experienced orthopedic surgeons. The intra-operative findings of location, type and extent of meniscal tears were meticulously recorded and were considered as the benchmark for diagnosis.

Statistical Analysis: Data were analyzed using SPSS software, and the collected data were entered into MS Excel. A 2X2 contingency table was created to compare the findings on MRI with arthroscopy findings.

The sensitivity, specificity, PPV, NPV, and diagnostic accuracy were determined. A p-value of

less than 0.05 was considered statistically significant.

Results

A total of 94 patients in this study had a suspected meniscal injury and were treated with both MRI and arthroscopy. Demographic, clinical and MRI data and arthroscopic findings are summarized below.

Demographic Characteristics: The majority of patients belonged to the age group of 21–40 years, indicating a higher prevalence of meniscal injuries among physically active adults.

The male patients were affected more than the females.

Table 1: Age Distribution of Patients (n = 94)

Age Group (Years)	Number of Patients	Percentage (%)
18–20	12	12.8
21–30	31	33.0
31–40	29	30.9
41–50	14	14.9
>50	8	8.5

Table 2: Gender Distribution

Gender	Number of Patients	Percentage (%)
Male	61	64.9
Female	33	35.1

Clinical Presentation: The most frequent symptom seen in the study population was pain in the knee, followed by swelling and locking of the knee joint.

Table 3: Clinical Presentation of Patients

Clinical Symptom	Number of Patients	Percentage (%)
Knee pain	94	100
Swelling	68	72.3
Locking	41	43.6
Instability	29	30.9

MRI Findings: MRI showed a higher incidence of medial meniscal tears than lateral meniscal tears. The most frequently seen lesions were grade III tears.

Table 4: MRI Findings in Meniscal Tears

MRI Findings	Number of Patients	Percentage (%)
Medial meniscal tear	56	59.6
Lateral meniscal tear	24	25.5
Both menisci involved	14	14.9

Table 5: Grading of Meniscal Tears on MRI

Grade of Tear	Number of Patients	Percentage (%)
Grade I	18	19.1
Grade II	27	28.7
Grade III	49	52.1

Arthroscopic Findings: In most patients, meniscal tears were confirmed by arthroscopy and were used as the “gold standard” for diagnosis. Medial meniscal tears were more common than lateral tears.

Table 6: Arthroscopic Findings

Arthroscopic Diagnosis	Number of Patients	Percentage (%)
Medial meniscal tear	53	56.4
Lateral meniscal tear	22	23.4
Both menisci involved	11	11.7
No meniscal tear	8	8.5

Correlation between MRI and Arthroscopy: The MRI results were compared to arthroscopic results by constructing a 2×2 contingency table.

Table 7: Correlation between MRI and Arthroscopy

MRI Findings	Arthroscopy Positive	Arthroscopy Negative
MRI Positive	78 (TP)	6 (FP)
MRI Negative	5 (FN)	5 (TN)

Diagnostic Accuracy of MRI: MRI showed high sensitivity and acceptable specificity for the diagnosis of meniscal tears, when compared with arthroscopy.

Table 8: Accuracy of MRI

Parameter	Value (%)
Sensitivity	93.9
Specificity	45.5
Positive Predictive Value (PPV)	92.9
Negative Predictive Value (NPV)	50.0
Overall Accuracy	88.3

The findings suggest that MRI is highly sensitive at detecting meniscal tears and has a good overall diagnostic accuracy. Lower specificity does not rule out the possibility of false-positive MRI results in some instances, however.

Discussion

The retrospective study was conducted in 94 patients who visited PMCH, and they were subjected to MRI diagnosis in comparison with arthroscopic diagnosis and its accuracy was evaluated.

The results proved the MRI was very sensitive and had a good diagnostic accuracy for meniscal injuries overall. It was determined that medial meniscal tears were more common than lateral meniscal tears, most likely because of the mechanical stresses to which the medial meniscus is subjected, such as rotational and weight-bearing stresses.

MRI had a sensitivity of 93.9% and an overall accuracy of 88.3%, making MRI very good at detecting patients with meniscal pathology. The specificity, however, was considerably lower, and there is the potential for false positives in some individuals.

Comparison with Previous Studies: The results of the present study are similar to some previously published studies that assessed the use of MRI in the diagnosis of meniscal tears.

Previous reports have described the sensitivity of MRI for diagnosing meniscal injury between 0.85 and 0.95 and specificity between 0.70 and 0.90 [13]. These reports are similar to the high sensitivity found in the present study, which indicates the reliability of MRI as a diagnostic tool [14]. The specificity in this study, however, was not as high as that reported in some literature. This difference could be due to the number of patients, type of MRI, experience of the radiologist, patient selection, and the presence of degeneration in older patients. Also, small or complicated tears can be

hard to accurately interpret on MRI, leading to a discrepancy between the MRI and the arthroscopic findings.

Clinical Significance: MRI will have a major part to play as an outpatient non-invasive modality for patients with suspected meniscal injury. The highly sensitive results found in this study indicate that MRI is a valuable tool for detecting clinically relevant meniscal tears before surgical intervention. MRI diagnosis can also guide orthopedic surgeons to select the best management options and minimize the number of unnecessary diagnostic arthroscopies. MRI is also safer and less expensive than arthroscopy and is used first to evaluate patients, as it is an invasive procedure with surgical risks and higher healthcare costs. In the resource-challenged setting of health care, MRI may play a role in selecting patients for arthroscopic surgery and aid in overall treatment results.

Reasons for False Positives and False Negatives: Although MRI is a very sensitive diagnostic test, it can sometimes give false-positive or false-negative results. False-positive results can be obtained because of the degeneration of intrameniscal signal changes mimicking a tear, particularly in elderly patients.

Difficulty with interpreting the MRI images by the radiologist and variability in interpretation between radiologists may also result in diagnostic error [15]. It is important to remember that false-negative results can occur with very small tears, with complex tears in the pattern or in difficult anatomical areas that are hard to clearly visualize on MRI. In some instances, the motion artifacts during imaging may further compromise the diagnostic accuracy.

Strengths of the Study: The study has employed arthroscopy as the "gold standard" to confirm the presence of meniscal tears, and this is one of the strengths of this study. Further, the study was performed with real-world hospital-based patient data from a tertiary care center, making it reflective

of real-world clinical scenarios. A comprehensive evaluation of the diagnostic correlation was possible because of the MRI and arthroscopic findings.

Limitations: There are certain limitations of the present study. As a retrospective study, it required the use of data from medical records, thereby introducing information bias. The study population was relatively small (94 patients) and this may affect the generalisability of the results. In addition, the study took place in one tertiary care center so findings may not apply to other populations or healthcare environments. The results are preliminary and should be confirmed by future multicenter trials of larger sample size.

Conclusion

The present study showed that MRI is a highly sensitive and reasonably specific modality for the diagnosis of a meniscal tear in the knee joint.

The diagnostic accuracy of MRI was good overall, and it was a reliable non-invasive method for the planning and treatment of patients before surgery. MRI has proved to be a crucial tool for the evaluation of meniscal injury, and the strong correlation between MRI findings and arthroscopic findings further highlights the importance of MRI. But, the gold standard for definitive diagnosis remains arthroscopy, which allows direct visualization of the intra-articular structures. These results are recommended to be confirmed by further multicenter studies with a larger number of patients.

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