

Integrating Clinical, MRI and Arthroscopic Findings for Accurate Diagnosis of Meniscal Tears

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ABSTRACT

Objective: To compare the diagnostic efficacy of clinical examination (joint line tenderness and McMurray test) versus MRI for detection of medial and lateral meniscal tears, by utilizing arthroscopy as the gold standard.

Methodology: This retrospective cross-sectional study was carried out at Shifa International Hospital Islamabad from Sep 2024 to August 2025. Clinical data of 200 patients with suspected meniscus tears subjected to clinical evaluation, MRI, and arthroscopy were included. Clinical examinations including joint line tenderness and McMurray test, MRI and arthroscopic findings were documented. Diagnostic indicator including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated

Results: The clinical examination for medial meniscus tear (n=154 confirmed by arthroscopy) yielded 84.4% sensitivity, 84.8% specificity, 94.9% PPV, 61.9% NPV, and 84.5% accuracy. The sensitivity of MRI was found to be 99.4%, its specificity was 82.6%, its PPV was 95.0%, its NPV was 97.4%, and its accuracy was 95.5%. For lateral meniscal tears (n=57 confirmed on arthroscopy), sensitivity was 73.7%, specificity was 98.6%, and accuracy was 91.5% on physical examination, whereas sensitivity was 91.2%, specificity was 95.8%, and accuracy was 94.5% on MRI. MRI had markedly higher negative predictive value (97.4% medial; 96.5% lateral), while clinical examination showed higher specificity for lateral tears.

Conclusion: MRI proved to be most valid and accurate non-invasive diagnostic tool before arthroscopy for both medial and lateral tears owing to its higher sensitivity, negative predictive value and overall precision in comparison with clinical findings. Clinical assessment is quite facilitative, but it cannot be substituted for MRI as a single diagnostic modality.

Keywords: Meniscal Tears, Clinical, MRI, Arthroscopy, Diagnostic Accuracy.

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Introduction

The menisci are crucial fibrocartilage components of the knee joint, that plays a cardinal role to transmit loads, absorb shock, stabilize the joint, and provide lubrication. Damage to the menisci impairs normal knee biomechanics and makes patients prone to premature joint deterioration, such as osteoarthritis. ¹ Meniscal tears are most frequently occurring orthopaedic pathology. Prevalence of meniscal tears amid younger adults are inclining remarkably due to increase in work and sports related traumas. ² The contact mechanism of knee joint

can be readily modified by these tears. Additionally interference with the metabolism of articular cartilage may arise, elevating the possibility of premature onset of osteoarthritis. ³

Meniscal tears must be accurately and promptly diagnosed to maximize therapy results and avoid long-term complications. The primary physical examination is the groundwork for orthopaedic diagnostic procedure. Clinical evaluation and imaging techniques have historically been used in conjunction to make diagnoses. ⁴ The clinical examination method, which includes

techniques such as joint line tenderness testing and McMurray testing, is commonly employed because of its convenience and affordability. Nonetheless, its accuracy is highly dependent upon the experience level of examiner and patient-specific variables.^{5, 6} Magnetic resonance imaging (MRI) has emerged as the preferred non-invasive diagnostic modality due to its high sensitivity and ability to delineate soft tissue structures. However, diagnostic precision and interpretation of MRI for determining the type of tears varies amongst specialists and type of scanner used. Variation in MRI reading and difference in MRI protocols can affect the outcome of the diagnosis.^{7, 8}

In some cases, a thorough clinical assessment is sufficient to make accurate decision, but mostly clinical tests are not enough to clinch diagnosis. Despite the fact that these tests have been routine parts of knee examination for decades, diagnostic validity of these tests has yet to be explored.^{9, 10} In contrast to arthroscopic findings, MRI exhibit accuracy of 72-98% for diagnosing meniscal injuries.^{11, 12}

The reported diagnostic accuracy of clinical examination and MRI varies, according to prior research, with some studies favouring MRI and others suggesting comparable accuracy with expert clinical evaluation. This discrepancy emphasizes the need for more investigation to determine the relative diagnostic utility of different modalities.

Relying solely on clinical examination or MRI can affect treatment choices and healthcare costs in clinical practice, particularly in places with limited resources. To support evidence-based decision-making and enhance patient care, it is crucial to determine the relative diagnostic performance of different modalities.

Therefore, this study was conducted to compare the diagnostic performance of clinical examination and MRI against arthroscopy, and to provide evidence-based guidance for optimal diagnostic strategies.

Methodology

This retrospective cross-sectional study was executed at Orthopaedic Department of Shifa International Hospital Islamabad, between September 2024 to August 2025. The institutional review board approved this trial and confidentiality of patients was maintained, ref no: IRB 063-25. Medical records of patients who underwent evaluation for suspected meniscal tears and subsequently had arthroscopy were reviewed. A total of 200 patients

with complete records of clinical examination, MRI findings, and arthroscopic reports were included. Patients with prior knee surgery, ligament reconstruction, or incomplete documentation were excluded.

Recorded clinical findings included joint line tenderness and McMurray test results as documented by treating orthopedic surgeons. A case was considered clinically positive if either McMurray test alone or both tests were positive.

MRI scans were performed using a 1.5 Tesla system with standard knee protocols. Reports documented tear presence, location, and type. Only recorded radiology reports were analyzed (no re-interpretation was performed).

Arthroscopic findings documented in operative notes were considered the gold standard for diagnosis.



Figure 1 MRI of Grade 3 Complex Tear of Lateral Meniscus

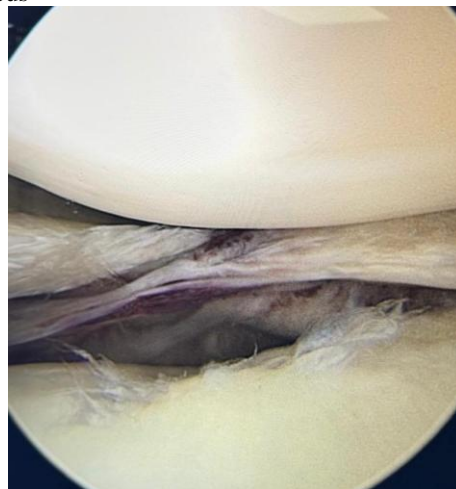


Figure 2. Arthroscopic View of Complex Tear in Posterior Horn of Lateral Meniscus.

Comparison of the records of clinical tests, MRI and arthroscopy was executed. Sensitivity, specificity, NPV,

PPV and accuracy of MRI and clinical examination was analysed using SPSS 26.0.

Results

Amongst 200 patients recruited in this study, ratio of males was higher as compared to females (58.5% vs 41.5%) with the age range of 17 years to 81 years (Mean age= 41.16). Ratio of non-traumatic injuries was higher in comparison with traumatic injuries (74.5% vs 25.5%).

Age and mechanism of injury influenced diagnostic performance. It was observed that younger patients (<40 years) demonstrated higher diagnostic sensitivity on MRI, likely reflecting a greater proportion of traumatic tears with clearer imaging characteristics, whereas older patients showed relatively reduced sensitivity, possibly due to degenerative changes. Gender differences reflected higher prevalence in males, but did not significantly affect accuracy. No notable difference was observed between left and right knee involvement.

Overall, mechanism of injury and age appeared to be the most influential effect modifiers impacting diagnostic performance, particularly for clinical examination. On arthroscopic examination, the most frequently implemented operative procedure was partial meniscectomy (93%) and meniscal repair was performed in smaller proportion of cases (7%). In terms of pattern of tears, most of the cases were identified as horizontal tears, followed by complex and bucket handle tears on MRI as well as arthroscopy.

There were 154 patients with diagnosis of medial meniscal tears confirmed at arthroscopy. Clinical examination accurately detected 130 cases (130 true positives) with 39 true negatives. 7 cases were false

positive (positive clinical assessment but no tear appeared on arthroscopy) and 24 cases were false negative (negative clinical assessment but tear confirmed at arthroscopy). MRI evaluation of medial meniscal tears exhibits remarkable outcomes, 153 true positives, 38 true negatives. There was single case of false negative with 8 false positive cases.

MRI illustrates higher sensitivity, PPV, NPV and overall accuracy for medial meniscal tears as compared to clinical examination. Total 57 patients were identified with lateral meniscal tear on arthroscopy. Clinical examination detected 42 true positives and 141 true negatives. There were 2 false positives and 15 false negatives cases. MRI of the lateral meniscus revealed 52 true positives and 137 true negatives with 6 false positives and 5 false negatives.

Clinical examination for lateral meniscal tears validates to be more specific and reliable but less sensitivity directs missed diagnosis. However, MRI tendered a more equitable performance with remarkable accuracy for both detection and exclusion of tears.

Discussion

The present study evaluated the diagnostic performance of clinical examination and MRI in detecting meniscal

Table II: Cross Tabulation of Medial Meniscal Tears. (n = 154)

Screening Test		Arthroscopy		Total
		Tear Present	Tear Absent	
Clinical Examination	Positive	130 (TP)	7 (FP)	137
	Negative	24 (FN)	39 (TN)	63
Total		154	46	200
MRI	Positive	153 (TP)	8 (FP)	161
	Negative	1 (FN)	38 (TN)	39
Total		154	46	200

Table I: Diagnostic Values of Clinical Examination & MRI for Medial Meniscal Tears.

Test (Medial)	Sensitivity	Specificity	PPV	NPV	Accuracy
Clinical Examination (Tenderness + McMurray)	84.4%	84.8%	94.9%	61.9%	84.5%
MRI (Grades 2+3 positive)	99.4%	82.6%	95.0%	97.4%	95.5%

Table III: Diagnostic Values of Clinical Examination & MRI for Lateral Meniscal Tears.

Test (Lateral)	Sensitivity	Specificity	PPV	NPV	Accuracy
Clinical	73.7%	98.6%	95.5%	90.4%	91.5%
MRI	91.2%	95.8%	89.7%	96.5%	94.5%

Table IV: Cross Tabulation of Lateral Meniscal Tears. (n = 57)

Screening Test		Arthroscopy		Total
		Tear Present	Tear Absent	
Clinical Examination	Positive	42 (TP)	2 (FP)	44
	Negative	15 (FN)	141 (TN)	156
Total		57	143	200
MRI	Positive	52 (TP)	6 (FP)	58
	Negative	5 (FN)	137 (TN)	142
Total		57	143	200

tears, using arthroscopy as the gold standard. The findings revealed that MRI has superior sensitivity, negative predictive value (NPV), and overall diagnostic accuracy compared to clinical examination, particularly for medial meniscal tears. However, clinical examination demonstrated great specificity, particularly for lateral meniscal tears, suggesting that a positive clinical test substantially correlates with actual disease but may overlook a significant percentage of patients.

In this study, MRI achieved a sensitivity of 99.4% for medial meniscal tears and 91.2% for lateral tears, which is higher than clinical examination (84.4% and 73.7%, respectively). Additionally, the NPV of MRI was significantly higher (97.4% medial; 96.5% lateral), demonstrating its dependability in ruling out meniscal disease. These results imply that MRI is particularly valuable as a rule-out test, minimizing unnecessary diagnostic arthroscopies. In contrast, the comparatively lower NPV of clinical examination (61.9% for medial tears) indicates a higher likelihood of missed diagnoses when used alone.

Our results are consistent with previous studies. Hashemi et al. reported MRI sensitivity of 93.7% and specificity of 96.3%, supporting MRI as a highly reliable diagnostic modality. For diagnosing both medial and lateral meniscal tears in comparison with clinical tests. However, Thessaly test in clinical examination proved to be reliable test for detecting meniscal tears.⁵

In comparison with the study conducted by Durgesh et al., several similarities and notable differences were observed. Both investigations exhibited similarities regarding demography, with more meniscal damage occurring among young males as well as predominance of medial tears, with Durgesh et al. reporting a medial-to-lateral ratio of 66.6% to 33.3%. A slightly higher incidence of damage on the left side was also noted (53% against 47%) compared to the present investigation. However, Durgesh et al. indicated low clinical test accuracy of about 75% sensitivity and approximately 60% specificity for medial and lateral tears. Contrarily, high clinical sensitivity and significantly high specificity, especially for lateral tear, was obtained in the current investigation, in addition to an exceptionally accurate MRI evaluation, where sensitivity was 99.4% and 91.2% for medial and lateral tears, respectively.¹³

However, contrasting evidence exists in the literature. Antinolfi et al. reported that clinical examination performed by an expert surgeon yielded equal or superior

outcomes for diagnosing meniscal injuries compared to MRI, as the sensitivity and specificity of clinical examination was higher than that of MRI (91 vs 85% and 87 vs 75% respectively).¹⁴ Likewise, Somani et al. found clinical examination to be comparable or slightly superior in diagnosing medial meniscal tears. Clinical assessment had higher sensitivity (77.77% vs. 69.23%) and diagnostic accuracy (87.85% vs. 87.54%) in contrast with MRI findings. Similar outcomes were observed by Abhishek Kumar who conducted prospective observational study.¹⁶ Conversely our investigation proved that MRI is superior to clinical examination owing to its greater sensitivity and NPV, hence being more reliable in ruling out pathology.

One significant outcome of this research is that the sensitivity of diagnosing medial and lateral meniscal lesions differs significantly. The MRI technique yielded high sensitivity for both lesions, while clinical tests revealed low sensitivity when assessing lateral tears. This may be due to the anatomical complexity and reduced accessibility of the lateral meniscus during physical examination, leading to higher false-negative rates.

Additionally, the function of effect modifiers was also investigated. Due to more pronounced tear patterns, younger patients and those with catastrophic injuries demonstrated increased diagnostic sensitivity, especially on MRI. On the other hand, older patients with degenerative tears were difficult to diagnose through clinical examination, thus lowering sensitivity.

A major strength of this study is the relatively large sample size (n=200), which enhances the statistical power and improves the reliability of the findings, allowing more robust estimation of diagnostic accuracy. Additionally, the use of arthroscopy as the gold standard for diagnosis strengthens the validity of the results.

The study has several limitations, including its retrospective design, which may introduce selection and information bias. Inter-observer variability in clinical examination and MRI interpretation could not be controlled. Additionally, the time interval between MRI and arthroscopy may have allowed progression of pathology, affecting diagnostic correlation. The exclusion of advanced clinical tests, such as the Thessaly test, may also have influenced the overall accuracy of clinical assessment.

The findings of this study support the use of MRI as the preferred non-invasive diagnostic modality for meniscal tears, particularly when ruling out pathology. However,

clinical examination remains an essential first-line tool due to its accessibility and cost-effectiveness. In resource-limited settings, a combination of clinical assessment and selective use of MRI may provide an optimal diagnostic approach.

This study provides region-specific evidence from a tertiary care center and reinforces the complementary roles of clinical examination and MRI. It highlights the superior diagnostic reliability of MRI while emphasizing the continued relevance of clinical skills in orthopedic practice.

Conclusion

In conclusion this study illustrates that although clinical examination persists as a beneficial tool in the initial evaluation of suspected meniscal tears, MRI offers higher sensitivity, negative predictive value for medial as well as lateral meniscal tears, when contrasted with arthroscopy leading as a gold standard. Clinical tests can prove to be advantageous for primary diagnostic guide, especially amid resource-limited setting, but cannot be used as a substitute for MRI as an absolute diagnostic modality.

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