



Original Article

## Diagnostic Accuracy of Magnetic Resonance Imaging Compared with Arthroscopy in Meniscal Injuries of the Knee: A Prospective Comparative Study

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Received: 13-02-2026

Accepted: 16-03-2026

Available online: 23-03-2026

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### ABSTRACT

**Background:** Meniscal injuries are a common cause of knee pain, locking, and internal derangement. MRI is widely used for preoperative evaluation, whereas arthroscopy remains the reference standard.

**Objectives:** To document MRI findings and arthroscopic findings in meniscal injuries of the knee and to determine the diagnostic performance of MRI using arthroscopy as the reference standard.

**Methods:** This prospective comparative study was conducted in the Department of Orthopaedics at Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, from May 2024 to November 2025. Thirty patients with clinically suspected traumatic internal derangement of the knee underwent MRI followed by arthroscopy. Cross-tabulated data were used to calculate sensitivity, specificity, positive predictive value, negative predictive value, diagnostic accuracy, and kappa agreement for medial and lateral meniscal tears.

**Results:** Most participants were male [80.0%], aged 31-40 years [40.0%], and had right knee involvement [80.0%]. Trauma was the most frequent mechanism of injury [43.3%]. MRI detected more tears than arthroscopy for both menisci. For medial meniscal tears, MRI showed 90.0% sensitivity, 70.0% specificity, 60.0% positive predictive value, 93.3% negative predictive value, 76.7% accuracy, and kappa of 0.533. For lateral meniscal tears, corresponding values were 100.0%, 73.1%, 36.4%, 100.0%, 76.7%, and 0.419.

**Conclusion:** MRI was a useful noninvasive diagnostic adjunct but showed only moderate agreement with arthroscopy in this cohort. MRI tended to overdiagnose meniscal tears, particularly lateral lesions, and should be interpreted alongside clinical findings. Arthroscopy remains essential when imaging and clinical assessment do not correlate or when operative treatment is planned.

**Keywords:** Arthroscopy; diagnostic accuracy; knee; magnetic resonance imaging; meniscal tear.

### INTRODUCTION

Meniscal injuries are among the most frequent causes of internal derangement of the knee and contribute substantially to pain, locking, recurrent swelling, functional limitation, and early degenerative joint change. The menisci are essential for load transmission, shock absorption, joint stability, lubrication, and preservation of tibiofemoral cartilage. Damage to these fibrocartilaginous structures disturbs joint biomechanics and increases the risk of progressive osteoarthritic change, particularly when tissue is resected or tears are overlooked [1-3].

Accurate diagnosis of meniscal tears remains clinically important because treatment decisions depend on the presence, side, location, and morphology of the lesion. Although careful history taking and physical examination continue to have value, isolated clinical assessment is sometimes insufficient in patients with pain, hemarthrosis, guarding, or associated ligament injuries [4-6]. Magnetic resonance imaging (MRI) is therefore widely used as the principal noninvasive investigation for suspected meniscal injury. MRI provides multiplanar assessment of the menisci and other intra-articular structures without ionizing radiation and can assist preoperative planning [4-8].

Despite these advantages, MRI is not infallible. Diagnostic performance varies across studies according to scanner strength, imaging protocol, chronicity of injury, tear configuration, concomitant anterior cruciate ligament injury, and radiologist experience [5-10]. False-positive MRI interpretations can occur because of intrasubstance degeneration, contusion, and signal alteration that mimic surface-disrupting tears, whereas false-negative results are particularly reported for peripheral posterior horn lesions, unstable tears, and certain lateral meniscal injuries [7,8,11-13]. Several comparative studies have also shown that clinical examination can equal or even outperform MRI in selected settings, especially when interpreted by experienced clinicians [9,10,14].

Arthroscopy remains the reference standard because it permits direct visualization of intra-articular pathology and simultaneous treatment when required [4,6,9]. However, arthroscopy is invasive and resource intensive, which underscores the need to understand how reliably MRI reflects operative findings in individual practice environments. Region-specific evidence is especially relevant in tertiary care institutions serving mixed traumatic and degenerative knee pathology. Against this background, the present prospective comparative study was undertaken to evaluate MRI findings against arthroscopic findings in meniscal injuries of the knee. The objectives were to document MRI findings, document arthroscopic findings, and determine the diagnostic performance of MRI for medial and lateral meniscal tears using arthroscopy as the reference standard.

Such evaluation can clarify whether MRI can safely guide decision-making, help avoid unnecessary diagnostic arthroscopy, and identify clinical situations in which persistent symptoms warrant arthroscopic confirmation despite negative or equivocal imaging. The findings are intended to support evidence-based, cost-conscious, and context-appropriate management of meniscal injuries in routine orthopaedic practice.

## **MATERIALS AND METHODS**

**Study design and setting.** The present prospective comparative study was conducted in the Department of Orthopaedics, Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh, India, over an 18-month period from May 2024 to November 2025. The study population comprised patients presenting with knee symptoms after trauma and clinical suspicion of internal derangement who subsequently underwent MRI evaluation followed by arthroscopy. A total of 30 patients were enrolled using a purposive sampling approach.

**Eligibility criteria.** Adults aged 18-50 years with a history suggestive of traumatic internal derangement of the knee were eligible. Patients with major knee trauma other than internal derangement, non-traumatic knee pathology, prior knee surgery, or severe systemic illness were excluded.

**Clinical assessment.** All participants underwent detailed history taking and physical examination. Particular attention was paid to joint-line tenderness, McMurray's test, and Apley's grinding test, along with general musculoskeletal and systemic evaluation. Routine preoperative work-up included plain radiography of the affected knee in anteroposterior and lateral views, with Schuss view when required, in addition to hematological and biochemical investigations, urine examination, electrocardiography, chest radiography, and pre-anaesthetic assessment.

**MRI assessment.** MRI of the knee was performed before arthroscopy using standard institutional sequences, including localizer images in sagittal, coronal, and axial planes, fat-suppressed T2 axial turbo spin-echo images, and T1 spin-echo sagittal images. MRI findings were reviewed for the presence or absence of medial and lateral meniscal tears and for associated internal derangement. MRI is widely used as a first-line noninvasive investigation in similar comparative studies, although its performance varies according to lesion type and imaging context [4-8].

**Arthroscopic assessment.** All arthroscopic procedures were performed under spinal anaesthesia using standard anterolateral and anteromedial portals and a 4-mm 30-degree arthroscope. The knee was systematically examined through the suprapatellar pouch, medial gutter, medial compartment, intercondylar notch, posteromedial compartment, lateral compartment, and lateral gutter/posterolateral compartment. Arthroscopy was considered the reference standard because it permits direct visualization of meniscal pathology, as adopted in prior diagnostic accuracy studies [4-10,14]. Presence or absence of medial and lateral meniscal tears and additional intra-articular findings were documented intraoperatively.

**Statistical analysis.** MRI findings were cross-tabulated against arthroscopic findings to classify observations as true positive, true negative, false positive, and false negative. Sensitivity, specificity, positive predictive value, negative

predictive value, and diagnostic accuracy were calculated separately for medial and lateral meniscal tears. Agreement between MRI and arthroscopy was assessed using Cohen's kappa. Data were compiled and analysed using IBM SPSS version 22. In the present manuscript, diagnostic indices were recalculated directly from the reported 2 × 2 tables to ensure internal consistency of the final results section.

## RESULTS

A total of 30 patients with clinically suspected meniscal injury who underwent both MRI and arthroscopy were analysed. The cohort was predominantly male [24/30, 80.0%], with the highest representation in the 31-40 year age group [12/30, 40.0%]. Right knee involvement was more common than left knee involvement [80.0% vs 20.0%]. Trauma was the leading mechanism of injury [13/30, 43.3%], followed by domestic fall [23.3%], sports injury [20.0%], and repetitive activities [13.3%] [Table 1].

**Table 1. Demographic and injury characteristics of the study participants [n = 30]**

Characteristic	Number	Percentage
<i>Sex</i>		
Male	24	80.0
Female	6	20.0
<i>Age group [years]</i>		
21-30	8	26.7
31-40	12	40.0
41-50	10	33.3
<i>Side involved</i>		
Right knee	24	80.0
Left knee	6	20.0
<i>Mode of injury</i>		
Trauma	13	43.3
Domestic fall	7	23.3
Sports injuries	6	20.0
Repetitive activities	4	13.3

MRI identified medial meniscal tears in 15 patients [50.0%] and lateral meniscal tears in 11 patients [36.7%]. Arthroscopy confirmed medial meniscal tears in 10 patients [33.3%] and lateral meniscal tears in 4 patients [13.3%]. Thus, MRI detected a greater number of tears than arthroscopy for both menisci, suggesting a tendency to overestimate meniscal pathology in this series [Tables 2 and 3].

**Table 2. Distribution of meniscal tears on MRI**

Meniscus	Tear present	Tear absent	Total
Medial meniscus	15	15	30
Lateral meniscus	11	19	30

**Table 3. Distribution of meniscal tears on arthroscopy**

Meniscus	Tear present	Tear absent	Total
Medial meniscus	10	20	30
Lateral meniscus	4	26	30

For medial meniscal tears, MRI yielded 9 true-positive, 14 true-negative, 6 false-positive, and 1 false-negative results when compared with arthroscopy [Table 4]. Recalculated diagnostic indices showed a sensitivity of 90.0%, specificity of 70.0%, positive predictive value of 60.0%, negative predictive value of 93.3%, and overall accuracy of 76.7%. Agreement between MRI and arthroscopy for medial meniscal tears was moderate, with a kappa value of 0.533 [Tables 5 and 8].

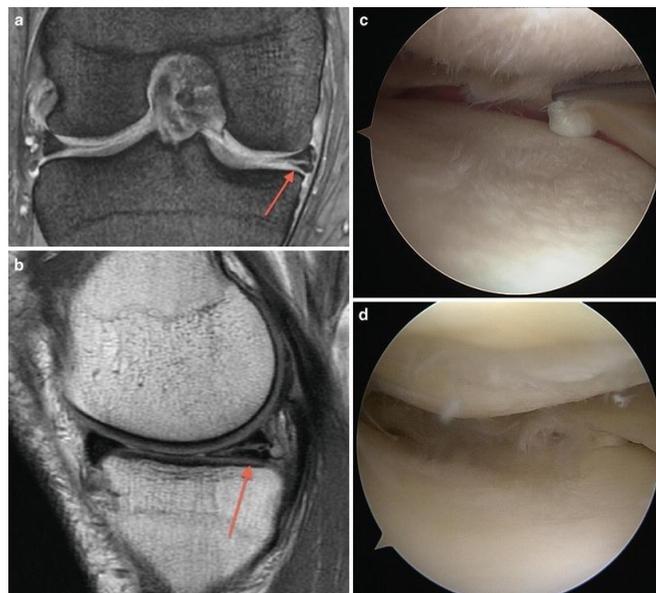
**Table 4. Cross-tabulation of MRI and arthroscopic findings for medial meniscal tears**

MRI finding	Arthroscopy present	Arthroscopy absent	Total
Tear detected	9	6	15
Tear not detected	1	14	15
Total	10	20	30

**Table 5. Diagnostic performance of MRI for medial meniscal tears**

Parameter	Value
Sensitivity	90.0%
Specificity	70.0%
Positive predictive value	60.0%
Negative predictive value	93.3%
Accuracy	76.7%

For lateral meniscal tears, MRI yielded 4 true-positive, 19 true-negative, 7 false-positive, and no false-negative results [Table 6].



**Figure 1: COMPARISON OF MRI & ARTHROSCOPY MEDIAL MENISCUS TEAR**

Recalculated sensitivity was 100.0%, specificity 73.1%, positive predictive value 36.4%, negative predictive value 100.0%, and overall accuracy 76.7%. Agreement between MRI and arthroscopy for lateral meniscal tears was also moderate, with a kappa value of 0.419 [Tables 7 and 8]. Overall, MRI was useful as a screening investigation, but the number of false-positive interpretations limited its standalone confirmatory value.

**Table 6. Cross-tabulation of MRI and arthroscopic findings for lateral meniscal tears**

MRI finding	Arthroscopy present	Arthroscopy absent	Total
Tear detected	4	7	11

MRI finding	Arthroscopy present	tear	Arthroscopy absent	tear	Total
Tear not detected	0		19		19
Total	4		26		30

**Table 7. Diagnostic performance of MRI for lateral meniscal tears**

Parameter	Value
Sensitivity	100.0%
Specificity	73.1%
Positive predictive value	36.4%
Negative predictive value	100.0%
Accuracy	76.7%

**Table 8. Agreement between MRI and arthroscopy for meniscal tears**

Meniscus	Kappa value	Level of agreement
Medial meniscus	0.533	Moderate
Lateral meniscus	0.419	Moderate

## DISCUSSION

The present study assessed the diagnostic performance of MRI against arthroscopy in 30 patients with suspected meniscal injury of the knee. Three patterns deserve emphasis. First, the cohort was predominantly male, most patients were in the 31-40 year age group, right-sided involvement was common, and trauma represented the principal mechanism of injury. This demographic pattern is consistent with earlier reports showing greater exposure of young and middle-aged men to sports participation, travel-related trauma, manual work, and pivoting knee injuries [4,7,9-11].

Second, MRI detected more tears than arthroscopy for both menisci, indicating a tendency toward overcalling pathology in this series. Such overestimation has been described previously and is often related to intrasubstance degeneration, signal changes that do not reach the articular surface, complex background injury, and interpretive variation [5-8,12]. In the present data, medial meniscal tears were identified in 15 patients on MRI but in 10 on arthroscopy, whereas lateral meniscal tears were reported in 11 patients on MRI but only 4 on arthroscopy. This discrepancy reinforces the need to interpret MRI findings in conjunction with history and examination rather than in isolation.

Third, the recalculated diagnostic profile of MRI showed different strengths for the two menisci. For medial meniscal tears, MRI demonstrated high sensitivity and high negative predictive value, suggesting that it was useful for screening and that a negative study was relatively reassuring. However, specificity and positive predictive value were lower, indicating a meaningful false-positive burden. For lateral meniscal tears, MRI achieved perfect sensitivity within this small sample but only modest specificity and a low positive predictive value because many MRI-positive lateral lesions were not confirmed arthroscopically. The moderate kappa coefficients for both menisci further indicate only fair-to-moderate concordance in routine practice. Comparable variability across meniscal side, site, and tear pattern has been reported in modern series [4-8,14].

The literature also explains why disagreement tends to be greater for lateral and posterior horn lesions. Peripheral posterior horn tears, unstable tears, and lesions associated with ACL injury are particularly prone to under-recognition or misclassification on MRI [7,8,12,13]. At the same time, carefully performed clinical examination continues to show strong diagnostic value and, in some reports, performs as well as or better than MRI for meniscal injury detection [9-11,14]. The present findings therefore support a balanced diagnostic strategy. MRI remains a valuable noninvasive adjunct for suspected meniscal injury, preoperative planning, and assessment of associated pathology, but arthroscopy remains indispensable when mechanical symptoms persist, when MRI and clinical findings disagree, or when therapeutic intervention is already anticipated.

## LIMITATIONS

The study was limited by a small sample size and single-center design, which restrict external generalizability. Tear morphology, chronicity, and associated ligament injuries were not stratified in the final analysis. Interobserver variability

in MRI interpretation was not assessed. Confidence intervals were unavailable from the source dataset. These constraints reduce precision of subgroup interpretation and limit broader extrapolation of the diagnostic estimates.

## CONCLUSION

MRI provided useful preoperative information in patients with suspected meniscal injury, but its agreement with arthroscopy was only moderate in this cohort. MRI identified more tears than arthroscopy, indicating overdiagnosis, especially for lateral meniscal lesions. Recalculated diagnostic indices showed better screening utility than confirmatory value, with strong negative predictive values but lower positive predictive values. Medial tears were more frequent than lateral tears on arthroscopy. These findings support continued use of MRI as a noninvasive adjunct in evaluating internal derangement of the knee, while emphasizing that imaging should not supersede careful clinical assessment. Arthroscopy remains the definitive reference standard when symptoms persist, imaging is equivocal, or surgical management is contemplated.

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