

## MRI VERSUS ARTHROSCOPIC FINDINGS IN ACL AND MENISCAL INJURIES OF THE KNEE - A COMPARATIVE STUDY

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### ABSTRACT

**Background:** The knee joint is one of the most commonly injured joints due to its anatomical configuration, susceptibility to external forces, and the functional demands placed upon it. Historically, orthopedic surgeons have relied heavily on clinical assessments to diagnose internal derangements of the knee. However, with the advent of advanced clinical techniques for identifying ligament injuries and cartilage defects, there is a notable scarcity of studies comparing the diagnostic accuracy of magnetic resonance imaging (MRI) and arthroscopy in establishing a conclusive diagnosis. **Objective:** This prospective research aimed to compare MRI findings with arthroscopic findings in anterior cruciate ligament (ACL) and meniscal injuries of the knee. **Methods:** This prospective study enrolled 70 individuals who sustained knee injuries and were admitted to the Department of Orthopedics at our tertiary care hospital from January 2021 to December 2021. Individuals aged 18-60 years with ACL and meniscus injuries who underwent MRI scans and surgery were included in the study. **Results:** The sensitivity and specificity of MRI in diagnosing ACL tears were 88.66% and 81.45%, respectively. For detecting medial meniscus injuries, the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of MRI were 93.67%, 87.92%, 89.64%, 81.34%, and 86%, respectively. Similarly, the sensitivity, specificity, PPV, NPV, and accuracy of MRI in detecting lateral meniscus injuries were 74.63%, 86.79%, 71.23%, 87.54%, and 83%, respectively. **Conclusion:** MRI is a reliable and non-invasive technique for evaluating ligamentous injuries, making it a suitable initial investigative approach for individuals with knee injuries, including ligamentous tears.

**Keywords:** ACL, meniscal injuries of the knee, MRI, arthroscopy



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### INTRODUCTION

In the modern age, the knee joint is frequently compromised by road accidents and sports injuries. Damage to the anterior cruciate ligament (ACL) and meniscus disrupts the knee's stability and normal movement, leading to instability and impeding an individual's ability to perform everyday tasks. Thus, it is crucial to accurately diagnose these injuries and treat them promptly, whether through surgical or non-surgical methods.(1)ACL or combined ACL and meniscal injuries are among the most common. Until

the late 1960s and early 1970s, orthopedic surgeons primarily relied on physical examinations for diagnosing and treating knee conditions. However, studies began to illustrate the benefits of arthroscopy in diagnosing and treating various knee issues.(2)

The introduction of magnetic resonance imaging (MRI) has significantly enhanced the ability to diagnose ACL and meniscal tears without resorting to arthroscopy. MRI offers several advantages over

arthroscopy. As a non-invasive imaging technique, MRI provides a comprehensive view of the knee joint, enhancing the understanding of the menisci and other soft tissue structures. Its widespread availability and cost-effectiveness make it an attractive initial diagnostic option.(3)

Conversely, research indicates that MRI may lack the same level of sensitivity and specificity as other diagnostic methods, potentially resulting in misdiagnoses. Arthroscopy, while invasive, allows for direct visualization and immediate therapeutic interventions, making it the preferred method for definitive diagnosis when MRI results are ambiguous or inconsistent. However, arthroscopy is associated with higher costs and inherent risks, and it may not always be the optimal choice for initial diagnosis.(4)

For identifying knee injuries resulting from accidents, arthroscopy is the preferred technique. Despite its precision, arthroscopy is an invasive and costly procedure that requires hospitalization and either general or regional anesthesia. It can lead to complications, such as infections, nerve damage, blood vessel injury, and harm to the knee's internal structures. A significant number of knee arthroscopies are performed annually in India, and this number is projected to rise until a non-invasive method for diagnosis is developed that avoids an intra-articular approach.(5) Therefore, the aim of our research was to compare MRI findings with arthroscopic findings in ACL and meniscal injuries of the knee.

## METHODS

This prospective study recruited 70 individuals who suffered from knee injuries and were admitted to the Department of Orthopedics at our tertiary care hospital from January 2021 to December 2021. Individuals aged 18-60 years with ACL and meniscal injuries who underwent MRI scans and arthroscopic surgery were included in the study.

Patients with knee injuries but no instability in any plane, negative McMurray test, unfitness for anesthesia, or contraindications to MRI (e.g., intracerebral aneurysmal clips, cardiac pacemakers, metallic foreign bodies in the eye, implants in the middle ear) were excluded.

During the examination, the McMurray and Apley tests were conducted to assess meniscal injuries. To

evaluate an ACL injury, the Lachman and anterior drawer tests were performed. If collateral ligament damage was suspected, a varus or valgus stress test was conducted. Each MRI scan utilized a standard MR protocol of 1.5 Tesla with MRI machines. The sequences included T1 and T2 images in both coronal and sagittal planes. A radiologist interpreted the MRI scans. The condition of the cruciate ligaments, articular cartilage, and menisci were documented.

The extent of the meniscal injury was categorized based on the classification system from Mayo 2000:

- Grade I tear: The meniscal lesion is globular in shape and does not extend to the articular surface.
- Grade II tear: The tear is linear and remains within the meniscus, showing no contact with the articular surface.
- Grade III tear: There is a heightened signal intensity within the meniscus that reaches the articular surface.
- Grade IV tear: The tear is complex, including findings of grade III tears in addition to distortions.

Arthroscopy was performed with the patient in a supine position, with lateral support to the proximal thigh. A tourniquet was applied to the proximal thigh in each case. The surgeon conducting the arthroscopy was not informed of the MRI findings.

To classify the location of the meniscal tear during arthroscopy, each meniscus was segmented into three equal parts:

1. The anterior 1/3 or anterior horn
2. The middle 1/3 or body
3. The posterior 1/3 or posterior horn

The collateral ligaments, ACL, and PCL were examined for any disruption or complete tears.

## Statistical Analysis

The collected data was tabulated and statistically analyzed using SPSS software (IND Version 22) to

correlate it with MRI results, subsequently classified into four distinct categories:

1. True-positive: when the MRI diagnosis was validated through arthroscopy.
2. True-negative: when the MRI indicated no lesions, which was corroborated by arthroscopy.
3. False-positive: when the MRI identified a lesion, yet arthroscopy yielded a negative result.
4. False-negative: when arthroscopy revealed a positive finding, while the MRI indicated a negative result.

## RESULTS

This study was conducted on patients aged 18 to 60 years, with a mean age of  $36.7 \pm 6.48$  years at the time of admission. The right knee was affected in 67% of cases and the left knee in 33%. The most common etiology was road traffic accidents (65%), followed by self-fall (19%) and sports injury (16%). Seventy cases of traumatic ACL and meniscal injuries were evaluated and prospectively reviewed with MRI followed by arthroscopic surgery.

**Table 1 Shows Accuracy of MRI findings as compared to arthroscopic examination**

|                                  | ACL tear | Medial meniscus tear | Lateral meniscus tear |
|----------------------------------|----------|----------------------|-----------------------|
| <b>Sensitivity</b>               | 88.66    | 93.67                | 74.63                 |
| <b>Specificity</b>               | 81.45    | 87.92                | 86.79                 |
| <b>Positive predictive value</b> | 89.74    | 89.64                | 71.23                 |
| <b>Negative predictive value</b> | 73.11    | 81.34                | 87.54                 |
| <b>Accuracy</b>                  | 88       | 86                   | 83                    |

## DISCUSSION

MRI knee joint scanning is a non-invasive alternative to diagnostic arthroscopy. In current clinical practice, MRI scans are routinely utilized to confirm ACL or meniscal injury diagnoses before

arthroscopic surgery. Identifying meniscal tears can be challenging to interpret and may depend on the observer and the scanner's sensitivity.(6) Radiographs, arthrograms, and ultrasound offer precise insight into the knee's internal functions compared to any other imaging technique. In situations where the articular cartilage remains unharmed, arthroscopy may not detect osteochondritis dessicans, inferior surface tears, or peripheral meniscal tears.(7)

**Table 2 Shows the observations from MRI and Arthroscopy: from magnetic resonance imaging (MRI) and joint imaging (arthroscopy): true positive, true negative, false positive and false negative**

|                       | ACL tear | Medial meniscus tear | Lateral meniscus tear |
|-----------------------|----------|----------------------|-----------------------|
| <b>True positive</b>  | 48       | 36                   | 16                    |
| <b>True negative</b>  | 13       | 24                   | 42                    |
| <b>False positive</b> | 4        | 5                    | 6                     |
| <b>False negative</b> | 5        | 5                    | 6                     |

In the present study, patients ranged from 18 to 60 years, with a tendency for males to be injured and operated on more frequently than females. Similarly, Avcu et al. revealed that the right knee is more frequently injured than the left. Knee injuries are more common in males due to their involvement in sports.(8)

In the present study, sensitivity of 88.66% and specificity of 81.45 % for the MRI imaging diagnosis of ACL tears was observed. Similarly, Rubin et al reported 93% sensitivity for diagnosing isolated ACL tears.(9) Previous studies have shown a sensitivity ranging from 92-100% and a specificity of 93-100% for MR imaging in diagnosing ACL tears. Kulkarni et al study observed sensitivity, specificity, PPV and accuracy of MRI scan in detecting ACL injury to be 90.90%, 78.26, 93.33% and 88% respectively.2 Ahmed et al study 2017 reported the accuracy of MRI in diagnosing the ACL to be 91.89%, with sensitivity of 93.33%, specificity of 85.71%, PPV of 96.55% and the NPV of 75%.(10)

In the present study, the sensitivity, specificity, PPV, NPV and accuracy of MRI scan in detecting medial meniscus injuries were 93.67%, 87.92%, 89.64%, 81.34% and 86%. Similarly, Kulkarni et al 2011 observed sensitivity, specificity, PPV, NPV and accuracy of MRI scan in detecting medial meniscus injuries to be 86%, 85%, 89.65%, 80.95% and 86% respectively.(2) Approximately two-thirds of knee-related issues stem from meniscal injuries.(11) Likewise, a ruptured anterior cruciate ligament can lead to significant knee instability. Despite being the most frequently injured ligament in the knee, the clinical diagnosis of this ligament can be quite difficult. In cases of such internal injuries, magnetic resonance imaging (MRI) is frequently the preferred diagnostic method due to its noninvasive nature and lack of radiation exposure.(12)

In the present study, the sensitivity, specificity, PPV, NPV and accuracy of MRI scan in detecting lateral meniscus injuries were 74.63%, 86.79%, 71.23%, 87.54% and 83%. Similarly, Kulkarni et al 2011 observed sensitivity, specificity, PPV, NPV and accuracy of MRI scan in detecting lateral 73.33%, 87.14%, 70.96%, 88.41%, 83% meniscus injuries to be 86%, 85%, 89.65%, 80.95% and 86% respectively.(2)

The interpretation of MRI scans is significantly influenced by the radiologist's experience and training. In the context of knee MRI, previous studies, have utilized arthroscopy as the standard reference point. Arthroscopy is recognized as a technically challenging procedure in contemporary clinical practice, with outcomes heavily reliant on the surgeon's expertise, particularly in complex cases.(13) MRI stands out as the most effective diagnostic modality, with reported accuracy for identifying ACL tears ranging from 70% to 100%. Due to the oblique orientation of the ACL as it crosses the knee joint, it is uncommon for a single MRI scan in the true sagittal plane to capture the entire ligament.(8)

Arthroscopy ought to be regarded as a diagnostic tool that complements a comprehensive patient history, an exhaustive physical examination, and relevant radiographic studies. It is intended to act as an adjunct rather than a substitute for a meticulous clinical assessment. Prior to the procedure, various surgical options are thoroughly reviewed with the patient, and the conclusive surgical intervention is

performed concurrently with the arthroscopic evaluation.(14)

Our research demonstrated a high level of sensitivity, specificity, and accuracy in diagnosing ACL and meniscal injuries of the knee joint. MRI is highly effective for identifying ACL and meniscus injuries, serving as a suitable screening tool for therapeutic arthroscopy, thereby rendering diagnostic arthroscopy unnecessary for most patients.(15) MRI is a precise and non-invasive method for evaluating ligamentous and meniscal injuries, making it an ideal first-line investigation for individuals with knee injuries, including ligament and meniscus tears. Studies comparing MRI with arthroscopy for the identification of meniscal tears reveal the nuanced advantages and disadvantages of each imaging modality.(16)

## CONCLUSION

MRI is a reliable and non-invasive method for diagnosing ligamentous injuries of the knee, making it an ideal initial investigation for individuals with knee injuries, including ligamentous tears. Moreover, MRI has proven beneficial in diagnosing other internal knee derangements, including the articular cartilage and ligament injuries, while also identifying hidden fractures or bruises. The present study emphasizes the role of MRI in evaluating the knee joint for ACL and meniscal injuries. It often precludes the need for diagnostic arthroscopy, reserving the latter for when arthroscopic intervention is necessary.

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