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Original Research Article

Correlation of MRI with Arthroscopic Findings in the Evaluation of Knee Injuries

Abhishek Jaiswal[1], Sanjay Kumar Singh[2], Minal Mrunalkant Panchal[3]

[1]Assistant Professor, Department of Radio-Diagnosis, Netaji Subhas Medical College and Hospital, Adityapur, Jharkhand, India.

[2]Assistant Professor, Department of Radio-Diagnosis, Netaji Subhas Medical College and Hospital, Adityapur, Jharkhand, India.

[3]Assistant Professor, Department of Radio-Diagnosis, Manipal Tata Medical college, Jamshedpur, Jharkhand, India. Consultant, Tata Main Hospital, Jamshedpur, Jharkhand, India.

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Corresponding Author: Dr. Sanjay Kumar Singh

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Abstract:

Background: A knee injury is one of the most prevalent musculoskeletal complaints, and frequently involves the ligaments, menisci, and articular cartilage of the knee. Determining an accurate diagnosis of internal derangements of the knee is crucial for effective treatment planning. There is no best treatment, but arthroscopy is considered the gold standard, and is an invasive procedure, whereas Magnetic Resonance Imaging (MRI) is a non-invasive alternative.

Aim: To evaluate the diagnostic accuracy of MRI in detecting knee injuries by correlating its findings with arthroscopic observations.

Methodology: Prospective observational study was done in department of Radio-Diagnosis, Netaji Subhas Medical College and Hospital Adityapur, Jharkhand for one year. In all, 105 patients were evaluated with an MRI scan and had an arthroscopy performed. The MRI results were correlated with the arthroscopic results, and the sensitivity, specificity, positive predictive value, negative predictive value and accuracy were computed.

Results: MRI was found to be highly accurate in the diagnosis of ligamentous and meniscal injuries and had an excellent correlation with tears of the ACL, PCL, medial meniscus and lateral meniscus. PCL tears had the greatest diagnostic accuracy, and relatively low sensitivity was seen for chondral and osteochondral lesions.

Conclusion: MRI is a very reliable non-invasive imaging tool to assess knee injuries and is a good correlation with arthroscopic findings. It's helpful for diagnosis prior to surgery and can prevent unnecessary diagnostic arthroscopies.

Keywords: Knee Injuries, MRI, Arthroscopy, ACL Tear, Meniscal Tear, Diagnostic Accuracy.

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Introduction

The knee joint is one of the largest, most complex, and most commonly injured joints in the human body, which is essential for mobility, weight-bearing and stability. The knee is highly prone to trauma and degeneration injuries because of its complex anatomical structure and its continuous exposure to mechanical stresses, particularly in athletes, laborers and people who do physically demanding activities. Dysfunction of knee cartilage (particularly in the menisci), the anterior cruciate (and posterior) ligament, and the collateral ligaments is one of the most frequent causes of knee pain, instability, locking, and restricted mobility, compromising patients' functional capacity and quality of life [1,2].

In the last few decades, there has been a significant rise in the number of knee injuries, which is attributed to the surge in road traffic accidents, sporting injuries, work-related injuries, and lifestyle changes. A precise diagnosis of intra-articular knee pathology is imperative to correctly plan the management and prevent late complications like chronic instability, osteoarthritis and disability. The first step in assessing knee injuries is clinical evaluation, but this can be difficult to interpret in the acute phase, when associated with pain and swelling, or when the injury involves multiple knee structures [3,4].

The gold standard for the diagnosis of intra-articular knee lesions is performed by arthroscopy which permits direct visualization of the knee joint's

internal structures. Arthroscopy is used not only for diagnosis, but also for therapeutic interventions, including meniscal repair, ligament reconstruction and debridement, in the same procedure. Although arthroscopy has a high diagnostic rate, it is an invasive procedure that can have associated risks including infection, hemarthrosis, anesthesia-related complications, and neuro-vascular injury. Furthermore, specific use of arthroscopy for diagnostic purposes might not be appropriate in all cases, particularly if there is a non-invasive alternative [5-7].

The most useful non-invasive imaging technique in the assessment of internal derangements of the knee has been the Magnetic Resonance Imaging (MRI) technique. MRI is useful for detailed imaging of ligaments, menisci, cartilage, bone marrow, synovium and surrounding soft tissues, and uses no ionizing radiation. It is now the imaging modality of choice to assess suspected meniscal tears, anterior cruciate ligament (ACL) injuries, posterior cruciate ligament (PCL) injuries, collateral ligament injuries, and osteochondral lesions [8,9].

There are several studies that have shown that MRI is highly sensitive, specific and accurate when it comes to knee disease diagnoses. In different populations, MRI's accuracy in the diagnosis of meniscal and ligamentous injuries ranges from 77% to 96%. Previous studies by Mackenzie and Oei showed sensitivity of >90% for ACL tears and meniscal injuries on MRI [10,11]. Topics similar to this study have been performed in Asian nations and yielded similar findings, demonstrating the value of MRI as an effective pre-arthroscopic diagnostic tool. But there are some inconsistencies between MRI and arthroscopic results, especially in partial tears, complex meniscal lesions and chondral injuries, and the reliability of MRI should be continually evaluated [12].

The present study aimed at assessing the diagnostic accuracy of MRI in knee injuries and compared the MRI findings with arthroscopic findings in the Department of Radio-Diagnosis, Netaji Subhas Medical College and Hospital, Adityapur, Jharkhand, India. The aim of this study is to identify the sensitivity, specificity and overall reliability of MRI for the detection of common intra-articular knee lesions and its usefulness as a pre-operative diagnostic tool in a clinical setting.

Methodology

Study Design: This study was designed as a prospective observational study to evaluate the diagnostic accuracy of Magnetic Resonance Imaging (MRI) in detecting knee injuries and to correlate the findings with arthroscopic examination, which was considered the gold standard.

Study Area

The study was conducted in the Department of Radio-Diagnosis, Netaji Subhas Medical College and Hospital, Adityapur, Jharkhand, India, in collaboration with the Orthopedics

Study Duration: The study was carried out over a period of one year from June 2025 to May 2026.

Sample Size: A total of 105 patients were included in the study.

Sample Population: The study population comprised patients presenting with clinical suspicion of internal derangement of the knee, including ligamentous injuries, meniscal tears, and other intra-articular pathologies, who were advised MRI and subsequently underwent arthroscopy.

Data Collection: Data were collected prospectively from patients attending the orthopedic outpatient department and referred to for MRI evaluation of knee injuries. Demographic details, clinical history, mechanism of injury, MRI findings, and arthroscopic findings were recorded in a structured proforma. MRI was performed prior to arthroscopy, and the imaging findings were interpreted by experienced radiologists. Arthroscopic findings were documented by orthopedic surgeons and used for comparison.

Inclusion Criteria

- Patients of all age groups with suspected knee injuries based on clinical examination.
- Patients who underwent MRI evaluation followed by arthroscopy of the same knee.
- Patients willing to provide written informed consent for participation in the study.

Exclusion Criteria

- Patients with previous surgery or arthroscopy on the same knee.
- Patients with congenital deformities or severe osteoarthritis of the knee.
- Patients with contraindications to MRI such as pacemakers, metallic implants, or claustrophobia.
- Patients are unwilling to participate or provide written consent.

Procedure: All selected patients with clinically suspected knee injuries underwent MRI examination of the affected knee using standard imaging protocols in the Department of Radio-Diagnosis. The MRI scans were evaluated by radiologists for the presence of meniscal tears, ligament injuries, cartilage defects, and other associated intra-articular abnormalities. Following MRI evaluation, all patients underwent diagnostic or therapeutic arthroscopy performed by experienced orthopedic surgeons. The arthroscopic findings were recorded systematically and considered as the gold standard

for comparison. The MRI findings were then correlated with arthroscopic findings and categorized as true positive, true negative, false positive, and false negative to assess the diagnostic performance of MRI in the evaluation of knee injuries.

Statistical Analysis: The collected data were entered into Microsoft Excel 2016 and analyzed statistically. Diagnostic parameters such as sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of MRI were calculated using standard formulas:

- Sensitivity = TP / (TP + FN) × 100
- Specificity = TN / (TN + FP) × 100
- Positive Predictive Value (PPV) = TP / (TP + FP) × 100
- Negative Predictive Value (NPV) = TN / (TN + FN) × 100
- Accuracy = (TP + TN) / (TP + TN + FP + FN) × 100

The MRI findings were compared with arthroscopic findings to determine the diagnostic reliability of MRI in evaluating knee injuries".

Result

A table of diagnostic performance of MRI compared with findings found at arthroscopy, in 105 patients with knee injuries, is presented in Table 1. MRI was also highly accurate for ligamentous injuries with sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of 92.3%, 95.8%, 94.1%, 94.5%, and 94.3%, respectively, for ACL tears and 100%, 98.9%, 98.9%, 100%, and 99.0%, respectively, for PCL tears. MRI in meniscal injuries, had an overall sensitivity of 93.8%, a specificity of 90.2% and an overall accuracy of 92.4% for medial meniscus tears and 82.6%, 91.7% and 88.6% for lateral meniscus tears respectively. For the type of medial meniscal tear, posterior horn tears had the highest sensitivity (88.5%) and the highest specificity (85.4%), whereas bucket handle tears had a lower sensitivity (75.0%) but the highest specificity (98.0%) and body tears had an accuracy of 94.3%. In the same fashion, posterior horn tears had superior diagnostic values in comparison to bucket handle tears, which were 92.4% and 95.2%, respectively. MRI was less sensitive for chondral and osteochondral lesions (40.0%), but still had high specificity (97.8%), and an overall accuracy of 87.6%. Overall, the present results suggest that MRI is a very reliable non-invasive diagnostic procedure for the diagnosis of knee ligamentous and meniscal injuries, but less sensitive for chondral lesions.

Table 1: MRI correlation with Arthroscopic findings in knee injuries, N=105

Structures involved	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy (%)
ACL[a] Complete tear	92.3	95.8	94.1	94.5	94.3
PCL[b] Complete tear	100	98.9	90	100	99
Medial Meniscus[c] Overall tear	93.8	90.2	89.6	94.2	92.4
Posterior horn tear	88.5	85.4	82.1	90.7	86.7
Bucket handle tear	75	98	85.7	95.2	93.3
Body tear	87.5	96.1	77.8	98	94.3
Lateral Meniscus[d] Overall tear	82.6	91.7	79.2	93.2	88.6
Posterior horn tear	85.7	94.8	75	97.3	92.4
Bucket handle tear	66.7	98.9	80	96.8	95.2
Chondral/Osteochondral lesions	40	97.8	80	89.8	87.6

Discussion

The present study showed that MRI is a very useful diagnostic tool for evaluation of knee injuries when compared to arthroscopy. MRI had a very good diagnostic performance for anterior cruciate ligament (ACL) tears: 92.3%, 95.8% and 94.3% for sensitivity, specificity and accuracy, respectively, in our series of 105 patients. Results are similar to the multicenter study by Fischer et al., [13] which showed overall diagnostic accuracy of 93% in more than 1000 patients with ACL tears. Rayan et al., [7] also showed a diagnostic accuracy of 88% in diagnosing ACL injuries and Mahajan et al., found a sensitivity of 90% in detecting high-grade ACL tears. Our results are supported by a systematic review by Smith et al., in which they analyzed over 7000 MRI scans of ACL tears and found an overall diagnostic accuracy ≥ 85%. The high sensitivity and specificity demonstrated in our study further support the use of MRI as a useful preoperative evaluation method for assessing ACL. There may be some differences between MRI and arthroscopy, however, as some tears may be missed or some complete tears may be interpreted as partial tears, as has been pointed out in past studies".

Our study revealed that MRI had the highest diagnostic values in posterior cruciate ligament (PCL) injury with sensitivity of 100%, specificity of 98.9% and accuracy of 99%. The results of these studies are consistent with those of Rubin et al [14] with sensitivity and specificity of 93% and 96%, respectively, for PCL tears. High accuracy rates have also been reported by De Smet et al., [15] for MRI in the detection of PCL injuries (98% - 100%). The advantages of MRI in PCL injuries are likely related to the low signal appearance of the homogeneous PCL and its unique anatomical orientation in the knee that allows for the detection of discontinuity or abnormal signal changes. While our results are very similar to these studies, we acknowledge that there are fewer numbers of PCL injuries in our cohort, which may be taken into account when analyzing our results.

In terms of meniscus injuries, the MRI was found to have a high overall accuracy of 92.4% for tears of the medial meniscus, a sensitivity of 93.8% and a specificity of 90.2%. These results agree with the results of Rose et al., [16] which found the sensitivity was 93% and specificity was 88% for medial meniscal tears. Similarly, Kumar et al., [17] reported the MRI sensitivity and specificity for medial meniscal injuries as 92.3% and 100%, respectively, respectively, which is in good agreement with our findings. Of the subtypes, posterior horn tears had the highest sensitivity (88.5%) and specificity (85.4%) and this is because the posterior horn tears are the most common meniscal tears, as they are subjected to more biomechanical stress. The MRI had good accuracy in detecting localized meniscal lesions (94.3%) when compared with body tears. The sensitivity, however, was relatively low for the bucket handle tears (75%), with a high specificity (98%), suggesting that MRI may fail to detect displaced fragments, particularly when the fragment is small or minimally displaced.

Our data revealed that comparatively low sensitivity (82.6%) but good specificity (91.7%) and overall accuracy (88.6%) were obtained for lateral meniscal tears. Crawford et al., [18] reported similar pooled sensitivities and specificities of 79% and 95%, respectively, for lateral meniscus tears. Bohnsack et al., also reported that there was a lower sensitivity for the lateral meniscus injury than for the medial meniscus and suggested that this was due to the greater mobility and anatomical variability of the lateral meniscus. In our study, the ability to diagnose posterior horn tears of the lateral meniscus was superior in terms of accuracy (92.4%) than that of the bucket handle tear of the lateral meniscus (95.2%, but lower sensitivity of 66.7%). This is in line with previous studies, which indicate that the interpretation of complex tear patterns, especially bucket handle tears, is difficult. These are confirmed by the relative low sensitivity for lateral meniscus injuries seen in our study.

However, MRI had relatively poor sensitivity (40%) for chondral and osteochondral lesions in our study but maintained a very high specificity (97.8%) and overall accuracy (87.6%). This finding is close to the 42% sensitivity, and 73% specificity MRI has been reported to have for the detection of chondral lesions (Rubin et al.,). Similarly, Potter et al., [19] reported sensitivity of 45% to 52% for cartilage lesions, indicating that subtle cartilage lesions are often missed in MRI. The relative insensitivity of our study may be attributed to the fact that the 1.5 Tesla conventional MRI is not a sensitive tool to detect superficial cartilage defects and early degenerative changes. While the use of advanced cartilage specific MRI sequences has enhanced the diagnostic accuracy of MRI, arthroscopy is still better suited for direct visualization of chondral pathology.

The results of the present study are mostly congruent with previously published studies and meta-analyses, reinforcing the value of MRI as a very good non-invasive diagnostic imaging modality for ligamentous and meniscal injuries of the knee. MRI is also well correlated with arthroscopy, thereby offering useful value in preoperatively planning surgeries and avoiding unnecessary diagnostic arthroscopies. In cases of chondral lesions, however, the present study revealed relatively few PCL injuries, and there was a limitation of the ability to detect these lesions, so caution must be used in interpretation. Despite its constraints, MRI is a very useful etiological tool in the initial work-up of knee injuries.

Conclusion

In conclusion, the present study suggests that Magnetic Resonance Imaging (MRI) is a very useful and reliable imaging technique in diagnosing the internal derangements of the knee when compared with the arthroscopic examination. MRI proved to be very accurate for ligamentous injuries, including tears of the anterior and posterior cruciate ligaments, and meniscal injuries, including tears of the medial meniscus. The results revealed a high correlation between MRI and arthroscopy, confirming the crucial role of MRI in the preoperative evaluation and treatment planning. MRI, however, was less sensitive for detecting chondral and osteochondral lesions and arthroscopy had greater sensitivity in this area because of direct visualization. In summary, MRI has significant potential to decrease the number of potentially avoidable diagnostic arthroscopies, and it is a valuable first line of investigation in patients with suspected knee pathology, which can be used to aid in early diagnosis and appropriate management.

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