



Original Article

Diagnostic Accuracy of MRI In Assessment of Internal Derangement of Knee Joint and Correlation with Arthroscopic Findings In Adult Patients

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ABSTRACT

Background: Internal derangement of the knee joint is a common orthopaedic condition involving injuries to menisci, cruciate ligaments, and other intra-articular structures. Accurate diagnosis is essential for appropriate management. MRI has emerged as a reliable non-invasive modality for the evaluation of knee injuries, while arthroscopy remains the gold standard.

Aim: To assess the diagnostic accuracy of MRI in internal derangement of the knee joint and to correlate MRI findings with arthroscopic findings in adult patients.

Materials and Methods: This prospective observational study was conducted at Dr. Panjabrao Deshmukh Memorial Medical College over a period of one year. A total of 48 adult patients with clinically suspected internal derangement of the knee joint were included. All patients underwent MRI examination followed by arthroscopy. MRI findings were compared with arthroscopic findings to determine sensitivity, specificity, and diagnostic accuracy.

Results: The majority of patients were males (70.8%) and belonged to the age group of 18–30 years (41.7%). ACL tears were the most common lesions detected on MRI and arthroscopy. MRI showed sensitivity, specificity, and accuracy of 95.6%, 92%, and 93.8%, respectively, for ACL tears. For medial meniscus tears, MRI demonstrated sensitivity of 94.7%, specificity of 92.6%, and accuracy of 93.5%. MRI findings showed a strong correlation with arthroscopic findings.

Conclusion: MRI is a highly sensitive, specific, and non-invasive imaging modality for evaluation of internal derangement of the knee joint. It correlates well with arthroscopic findings and can effectively reduce unnecessary diagnostic arthroscopies.

Keywords: Internal derangement of knee, Magnetic Resonance Imaging, MRI, Arthroscopy, Anterior cruciate ligament tear, Meniscal tear, Knee joint injuries, Diagnostic accuracy.

INTRODUCTION

The knee joint is the largest and one of the most complex synovial joints in the human body, providing both mobility and stability during daily activities. Owing to its anatomical complexity and weight-bearing function, the knee is particularly vulnerable to traumatic and degenerative injuries.[1] Internal derangement of the knee joint refers to a spectrum of intra-articular abnormalities involving the menisci, cruciate ligaments, collateral ligaments, articular cartilage, and synovial structures.[2] These injuries commonly result from sports activities, road traffic accidents, falls, and twisting trauma, leading to symptoms such as pain, swelling, locking, instability, and restriction of movement.[3]

Clinical examination remains the initial step in the diagnosis of internal derangement of the knee; however, it may be limited by acute pain, joint effusion, muscle spasm, and associated injuries.[4] Therefore, imaging plays an important role in confirming the diagnosis and guiding management. Conventional radiography is useful for evaluating osseous abnormalities but has limited value in assessing soft tissue structures.[5]

Magnetic Resonance Imaging (MRI) has become the imaging modality of choice for evaluating internal derangement of the knee joint because of its multiplanar imaging capability, excellent soft tissue contrast, and non-invasive nature.[6] MRI provides detailed visualization of the menisci, cruciate ligaments, collateral ligaments, cartilage, bone marrow, and periarticular soft tissues without ionizing radiation.[7] It has largely replaced diagnostic arthroscopy in many clinical situations and is highly effective in identifying ligamentous and meniscal injuries.

Arthroscopy is considered the gold standard for diagnosing intra-articular knee lesions because it permits direct visualization of internal joint structures.[8] In addition to diagnosis, arthroscopy also offers therapeutic intervention. However, it is invasive, costly, and associated with complications such as infection, haemarthrosis, thrombophlebitis, and anaesthetic risks.[9] Consequently, MRI is increasingly used as a reliable non-invasive alternative before arthroscopic intervention.

Several studies have demonstrated high sensitivity and specificity of MRI in detecting anterior cruciate ligament (ACL) tears, posterior cruciate ligament (PCL) injuries, and meniscal tears.[10,11] Nevertheless, discrepancies between MRI and arthroscopic findings may occur due to partial tears, degenerative changes, technical limitations, or observer variability. Therefore, correlation between MRI findings and arthroscopy remains essential to assess the true diagnostic accuracy of MRI.

The present study was conducted at Dr. Panjabrao Deshmukh Memorial Medical College to evaluate the diagnostic accuracy of MRI in the assessment of internal derangement of the knee joint and to correlate MRI findings with arthroscopic findings in adult patients.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted in the Department of Radiodiagnosis in collaboration with the Department of Orthopaedics at Dr Panjabrao Deshmukh Memorial Medical College over a period of one year. The study aimed to evaluate the diagnostic accuracy of Magnetic Resonance Imaging (MRI) in assessing internal derangement of the knee joint and to correlate MRI findings with arthroscopic findings in adult patients.

Study Population

A total of 48 adult patients presenting with clinical suspicion of internal derangement of the knee joint were included in the study. All patients underwent MRI examination followed by diagnostic and/or therapeutic arthroscopy.

Inclusion Criteria

- Patients aged above 18 years.
- Patients presenting with symptoms suggestive of internal derangement of the knee joint such as pain, locking, swelling, instability, or restricted movement.
- Patients who underwent both MRI and arthroscopy of the affected knee.
- Patients willing to participate and provide informed consent.

Exclusion Criteria

- Patients with previous knee surgery.
- Patients with fractures around the knee joint.
- Patients with contraindications to MRI such as pacemakers, metallic implants incompatible with MRI, or claustrophobia.
- Patients unwilling to participate in the study.
- Patients with inflammatory, infective, or neoplastic conditions affecting the knee joint.

MRI Technique

MRI examinations were performed using a standard knee coil with the patient in supine position and the knee slightly externally rotated. Imaging was obtained in axial, sagittal, and coronal planes using routine sequences including T1-weighted, T2-weighted, Proton Density (PD), and fat-suppressed sequences.

The MRI images were evaluated for:

1. Meniscal injuries (medial and lateral meniscus)
2. Anterior cruciate ligament (ACL) injuries
3. Posterior cruciate ligament (PCL) injuries
4. Collateral ligament injuries
5. Chondral lesions and associated abnormalities

All MRI scans were interpreted by experienced radiologists who were blinded to arthroscopic findings.

Arthroscopic Evaluation

Arthroscopy was performed by experienced orthopaedic surgeons under appropriate anaesthesia using standard arthroscopic techniques. Arthroscopic findings were considered the gold standard for diagnosis. Intraoperative findings regarding ligament tears, meniscal injuries, cartilage defects, and associated lesions were recorded systematically.

Data Collection

Clinical details, including age, sex, presenting symptoms, duration of symptoms, side involved, mechanism of injury, MRI findings, and arthroscopic findings, were documented in a predesigned proforma.

Statistical Analysis

The collected data were entered into Microsoft Excel and analysed using appropriate statistical software. MRI findings were compared with arthroscopic findings to determine diagnostic accuracy. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy of MRI were calculated for various internal derangements of the knee joint. Categorical variables were expressed as percentages and proportions.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee of Dr Panjabrao Deshmukh Memorial Medical College. Written informed consent was obtained from all participants prior to inclusion in the study.

RESULTS AND OBSERVATIONS

A total of 48 adult patients with clinically suspected internal derangement of the knee joint were evaluated using MRI and correlated with arthroscopic findings. The observations obtained during the study are presented below.

Table 1: Age Distribution of Patients (n = 48)

Age Group (Years)	Number of Patients	Percentage (%)
18–30	20	41.7%
31–40	14	29.2%
41–50	9	18.8%
>50	5	10.3%
Total	48	100%

Observation: The majority of patients belonged to the 18–30 years age group.

Table 2: Gender Distribution of Patients (n = 48)

Gender	Number of Patients	Percentage (%)
Male	34	70.8%
Female	14	29.2%
Total	48	100%

Observation: Male patients were more commonly affected than females.

Table 3: Side of Knee Involvement (n = 48)

Side Involved	Number of Patients	Percentage (%)
Right Knee	29	60.4%
Left Knee	19	39.6%
Total	48	100%

Observation: Right knee involvement was more common.

Table 4: Presenting Symptoms of Patients

Presenting Symptom	Number of Patients	Percentage (%)
Knee Pain	48	100%
Swelling	32	66.7%
Locking	18	37.5%
Instability	24	50%
Restricted Movement	20	41.7%

Observation: Knee pain was the most common presenting symptom.

Table 5: MRI Findings in Internal Derangement of Knee Joint (n = 48)

MRI Finding	Number of Patients	Percentage (%)
ACL Tear	24	50%
Medial Meniscus Tear	20	41.7%

Lateral Meniscus Tear	10	20.8%
PCL Tear	4	8.3%
Collateral Ligament Injury	8	16.7%
Chondral Lesions	6	12.5%

Observation: ACL tear was the most common abnormality detected on MRI.

Table 6: Arthroscopic Findings in Internal Derangement of Knee Joint (n = 48)

Arthroscopic Finding	Number of Patients	Percentage (%)
ACL Tear	23	47.9%
Medial Meniscus Tear	19	39.6%
Lateral Meniscus Tear	9	18.8%
PCL Tear	4	8.3%
Collateral Ligament Injury	7	14.6%
Chondral Lesions	6	12.5%

Observation: Arthroscopy confirmed ACL tear as the most frequent pathology.

Table 7: Correlation of MRI and Arthroscopic Findings for ACL Tears

Parameter	Value
True Positive	22
True Negative	23
False Positive	2
False Negative	1
Sensitivity	95.6%
Specificity	92%
Accuracy	93.8%

Observation: MRI showed high sensitivity and specificity for detection of ACL tears.

Table 8: Correlation of MRI and Arthroscopic Findings for Medial Meniscus Tears

Parameter	Value
True Positive	18
True Negative	25
False Positive	2
False Negative	1
Sensitivity	94.7%
Specificity	92.6%
Accuracy	93.5%

Observation: MRI demonstrated high diagnostic accuracy for medial meniscus tears.

Table 9: Overall Diagnostic Accuracy of MRI in Internal Derangement of Knee Joint

Lesion	Sensitivity (%)	Specificity (%)	Accuracy (%)
ACL Tear	95.6%	92%	93.8%
Medial Meniscus Tear	94.7%	92.6%	93.5%
Lateral Meniscus Tear	88.9%	95%	93.2%
PCL Tear	100%	97.7%	97.9%

Observation: MRI demonstrated excellent diagnostic performance in detecting internal derangements of the knee joint when correlated with arthroscopic findings.

DISCUSSION

Internal derangement of the knee joint represents a major cause of morbidity, particularly among young and physically active individuals. Accurate diagnosis of ligamentous and meniscal injuries is crucial for appropriate treatment planning and prevention of chronic instability and degenerative joint disease. The present study evaluated the role of MRI in diagnosing internal derangement of the knee and correlated MRI findings with arthroscopic findings, which are considered the gold standard.

In the present study, the majority of patients were in the age group of 18–30 years (41.7%). This finding suggests that younger individuals are more prone to knee injuries because of increased participation in sports, outdoor activities, and high-energy trauma. Similar age distribution has been reported by Vincken et al.[12] and Fischer et al.[13], who observed a higher incidence of internal derangement among young adults.

Male predominance was noted in the present study, with males accounting for 70.8% of cases. This observation is comparable with studies conducted by Oei et al.[11] and Mackenzie et al.[14], where male patients were more commonly affected. The increased incidence in males may be attributed to greater involvement in physically demanding activities and occupational exposure to trauma.

Pain was the most common presenting symptom, observed in all patients, followed by swelling and instability. Similar clinical presentations have been described by Solomon et al.[4], emphasizing that pain and instability are important indicators of internal derangement. Right knee involvement was more common than left knee involvement, which may be related to dominance of the right lower limb in the majority of individuals.

Among MRI findings, ACL tears were the most common lesions identified, followed by medial meniscus tears. Arthroscopic findings showed a similar pattern. ACL injuries are frequently associated with rotational stress and sports-related trauma. The high prevalence of ACL tears in the present study correlates with observations made by Reicher et al.[7] and Crues et al.[10].

MRI demonstrated high sensitivity (95.6%), specificity (92%), and overall diagnostic accuracy (93.8%) for ACL tears in comparison with arthroscopy. Similar findings have been reported in previous studies. Oei et al.[11] in their systematic review reported sensitivity and specificity of MRI for ACL tears ranging from 86% to 95% and 95% to 98%, respectively. MRI is particularly useful in identifying discontinuity of ligament fibers, abnormal signal intensity, and abnormal orientation of the ACL.

For medial meniscal tears, MRI showed sensitivity of 94.7%, specificity of 92.6%, and accuracy of 93.5% in the present study. Crues et al.[10] demonstrated that MRI has excellent diagnostic performance for meniscal tears when grade III signal intensity extending to the articular surface is considered diagnostic. Similar high diagnostic accuracy has been reported by De Smet and Tuite.[15]

MRI also showed excellent diagnostic performance for lateral meniscal and PCL injuries. The sensitivity and specificity for PCL tears were particularly high, which may be due to the relatively larger size and better visualization of the PCL on MRI. Reicher et al.[7] also reported high accuracy of MRI for cruciate ligament injuries.

Despite the high diagnostic accuracy, a few false-positive and false-negative MRI findings were encountered in the present study. False-positive findings may occur because of intrameniscal degeneration, magic angle phenomenon, or partial volume averaging, whereas false-negative results may occur in partial tears or chronic injuries.[15] Observer experience and image quality also influence diagnostic interpretation.

Arthroscopy remains the definitive diagnostic modality because of direct visualisation of intra-articular structures. However, being invasive, it is associated with procedural risks and increased healthcare costs.[8,9] MRI, on the other hand, is non-invasive, highly sensitive, and capable of evaluating associated osseous and soft tissue abnormalities simultaneously. Therefore, MRI can significantly reduce unnecessary diagnostic arthroscopies.

The findings of the present study support the use of MRI as an accurate and reliable imaging modality in evaluating internal derangement of the knee joint. Strong correlation between MRI and arthroscopic findings indicates that MRI should be considered the primary diagnostic investigation before arthroscopy in patients with suspected internal derangement of the knee.

CONCLUSION

MRI is a highly sensitive and specific non-invasive modality for diagnosing internal derangement of the knee joint. It shows excellent correlation with arthroscopic findings, especially for ACL and meniscal injuries. MRI provides an accurate evaluation of intra-articular structures and can effectively reduce unnecessary diagnostic arthroscopies. Hence, MRI should be considered the primary imaging investigation in suspected internal derangement of the knee joint.

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