

CORRELATION OF MRI FINDINGS OF KNEE WITH THAT OF ARTHROSCOPY IN PATIENTS OF POST TRAUMATIC INTERNAL DERANGEMENT OF KNEE – A PROSPECTIVE OBSERVATIONAL STUDY

Rayudu Lakshmi Kranthi¹, Akshay Bhanudas², Bharath Kakileti³, Yella Sitara Geetanjali⁴

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Corresponding Author:

Dr. Yella Sitara Geetanjali,

Email: geetanjaliyella@gmail.com

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¹Assistant Professor, Department of Radiodiagnosis, Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India

²Professor, Department of Radiodiagnosis, Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India

³Assistant Professor, Department of Radiodiagnosis, Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India

⁴Senior Resident, Department of Radiodiagnosis, Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, Andhra Pradesh, India

Abstract

Background: Internal derangement of the knee (IDK) is a common condition following trauma, requiring accurate diagnostic methods. Magnetic resonance imaging (MRI) is widely used for non-invasive evaluation, but its reliability compared to arthroscopy remains under study. The aim is to evaluate the correlation between MRI findings and arthroscopic findings in post-traumatic internal derangement of the knee. **Materials and Methods:** This prospective observational study included 41 patients aged 18-60 years who underwent MRI followed by arthroscopy for suspected IDK at Konaseema Institute of Medical Sciences, Amalapuram over six months. MRI findings, including ligamentous and meniscal tears, joint effusion, and osteochondral lesions, were compared with arthroscopic findings. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated. **Result:** The study population included 33 males (80.5%) and 8 females (19.5%). MRI revealed joint effusion in 68.3%, ACL tears in 75.6%, PCL tears in 34.2%, MM tears in 39%, and LM tears in 17.1%. MRI findings correlated significantly with arthroscopic findings: ACL tears: Sensitivity 100%, Specificity 90.9%, PPV 96.77%, NPV 100%. PCL tears: Sensitivity 100%, Specificity 96.42%, PPV 92.85%, NPV 100%. MM tears: Sensitivity 94.1%, Specificity 100%, PPV 100%, NPV 96%. LM tears: Sensitivity 100%, Specificity 97.14%, PPV 85.71%, NPV 100%. **Conclusion:** MRI demonstrates high sensitivity, specificity, and accuracy in diagnosing IDK, making it a reliable non-invasive diagnostic tool, with excellent correlation to arthroscopic findings.

INTRODUCTION

Internal derangement of the knee (IDK) refers to a group of pathologies involving damage to the intra-articular structures of the knee, such as ligaments, menisci, cartilage, and osteochondral surfaces.^[1] These injuries are common in individuals subjected to trauma, particularly among athletes and active young adults.^[2] Accurate diagnosis is essential to ensure appropriate treatment and to prevent long-term complications such as chronic pain, instability, and osteoarthritis.^[3]

Magnetic resonance imaging (MRI) has emerged as a cornerstone in the non-invasive diagnosis of IDK due to its ability to provide high-resolution images of soft tissue structures.^[4] It allows detailed evaluation

of ligamentous injuries, meniscal tears, joint effusions, and osteochondral lesions. However, arthroscopy, considered the gold standard for diagnosing intra-articular knee pathologies, remains indispensable for therapeutic interventions.^[5,6] Although highly accurate, arthroscopy is invasive, expensive, and associated with risks such as infection and bleeding.^[7]

The reliability of MRI in diagnosing IDK has been widely studied, but its diagnostic accuracy compared to arthroscopy varies across populations and settings. Discrepancies between MRI and arthroscopic findings could stem from variations in expertise, equipment, or pathology severity.

This study aims to evaluate the correlation between MRI findings and arthroscopic findings in patients

with post-traumatic IDK. By determining the sensitivity, specificity, and predictive values of MRI, the study seeks to establish its reliability as a diagnostic modality, thereby optimizing the diagnostic workflow for IDK and reducing unnecessary invasive procedures.

MATERIALS AND METHODS

Study Design: This was a prospective observational study conducted over six months, from June to November 2024, at Konaseema Institute of Medical Sciences, Amalapuram, Andhra Pradesh. The study compared MRI findings with arthroscopic findings in patients with post-traumatic internal derangement of the knee (IDK).

Study Population: The study included 41 patients aged 18-60 years who underwent MRI for suspected IDK, followed by arthroscopy as part of their diagnostic and/or therapeutic management.

Inclusion Criteria

1. Patients with knee pain, with or without swelling, where MRI was used for diagnosis.
2. Clinically suspected ligamentous or meniscal tears.
3. Restricted knee joint movement following trauma.
4. Patients aged between 18 and 60 years.

Exclusion Criteria

1. Acute fractures or osteochondritis diagnosed on X-ray.
2. Postoperative knee cases.
3. Patients with pacemakers or metallic implants incompatible with MRI.
4. Severe motion disorders or claustrophobia.
5. Patients with inflammatory, neoplastic, infective, or degenerative knee conditions.
6. Age <18 or >60 years.
7. Knee pain without trauma history.

Data Collection: Institutional ethical committee approval and informed consent were obtained. A detailed history, clinical examination, and MRI scans were performed for all participants. The MRI protocol included T1-weighted, T2-weighted, and PDFS sequences in sagittal, coronal, and axial planes, using a GE 1.5 Tesla 8-channel whole-body MR scanner. MRI findings were recorded for joint effusion, ligamentous injuries, meniscal tears, and osteochondral lesions.

Arthroscopy Procedure: Arthroscopy was performed by experienced orthopedic surgeons for diagnostic or therapeutic purposes. Findings were documented and compared with MRI results.

Statistical Analysis

MRI findings were compared to arthroscopic findings to calculate sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy. Statistical significance was assessed using the Chi-square test, with a p-value <0.05 considered significant. Data were analyzed using SPSS v19.0 software.

Ethical Approval

Institutional ethical approval was obtained from the ethics committee of Konaseema Institute of Medical Sciences, Amalapuram, Andhra Pradesh. Written informed consent was acquired from all participants prior to their inclusion in the study.

RESULTS

This prospective observational study aimed to evaluate the correlation between MRI findings and arthroscopic findings in patients with post-traumatic internal derangement of the knee (IDK). The results of the study, including demographic distribution, clinical findings, MRI findings, and statistical correlations, are presented below.

Demographic Distribution: The study included 41 patients aged 18-60 years. The majority of patients (46.3%) were in the 21-30 years age group, followed by 24.4% in the 31-40 years age group. Males constituted 80.5% of the study population, while females accounted for 19.5% [Table 1].

Clinical and MRI Findings: Duration of Symptoms: The distribution of symptoms ranged from less than one week to more than six months, with 22% of patients presenting within one week and an equal proportion (22%) reporting symptoms persisting for more than six months [Table 2].

Joint Effusion: MRI revealed joint effusion in 68.3% of patients: Ligament and Meniscal Tears: MRI findings demonstrated anterior cruciate ligament (ACL) tears in 75.6% of cases, posterior cruciate ligament (PCL) tears in 34.2%, medial meniscal (MM) tears in 39%, and lateral meniscal (LM) tears in 17.1%.

Osseous/Osteochondral Lesions: Osseous or osteochondral lesions were observed in 46.3% of patients [Table 2].

Correlation Between MRI and Arthroscopy: The correlation between MRI findings and arthroscopic findings was statistically significant for all evaluated parameters, as detailed below [Table 3]:

ACL Tears: MRI demonstrated excellent sensitivity (100%) and specificity (90.9%) in detecting ACL tears. Positive predictive value (PPV) and negative predictive value (NPV) were 96.77% and 100%, respectively.

PCL Tears: Sensitivity and specificity for detecting PCL tears were 100% and 96.42%, respectively, with a PPV of 92.85% and NPV of 100%.

MM Tears: MRI findings showed a sensitivity of 94.1%, specificity of 100%, PPV of 100%, and NPV of 96% for medial meniscal tears.

LM Tears: The sensitivity and specificity for lateral meniscal tears were 100% and 97.14%, respectively, with a PPV of 85.71% and NPV of 100%.

Statistical Analysis: Chi-square analysis revealed significant correlations between MRI and arthroscopic findings for all evaluated parameters:

- ACL Tears: Chi-square = 31.309, p < 0.001.
- PCL Tears: Chi-square = 32.549, p < 0.001.

- MM Tears: Chi-square = 33.19, $p < 0.001$.
- LM Tears: Chi-square = 27.622, $p < 0.001$ [Table 3].

Statistical Values: The diagnostic accuracy of MRI in evaluating ligamentous and meniscal injuries was consistently high, with accuracy rates exceeding 97% across all parameters [Table 4].

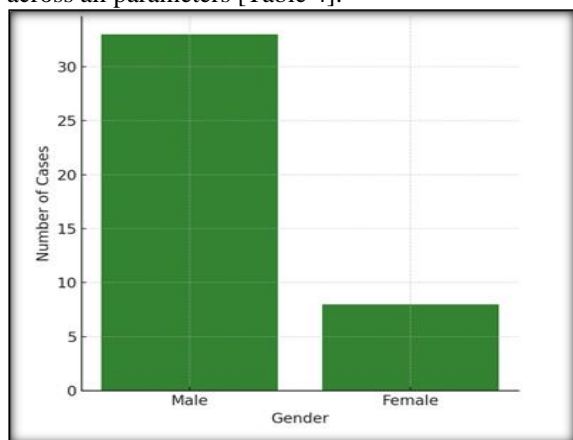


Figure 1: Gender Distribution

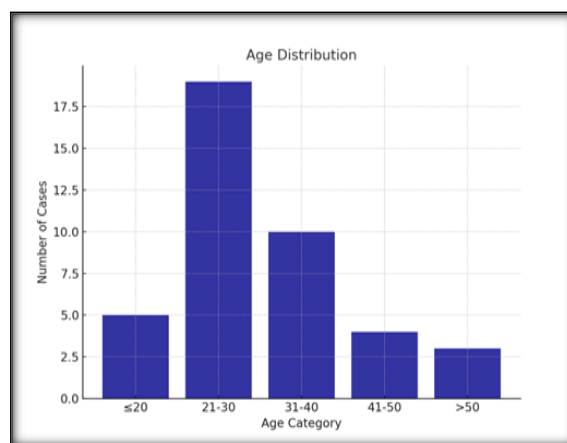


Figure 2: Age Distribution

Table 1: Demographic Distribution of Study Population.

Parameter	Category	Number of Cases	Percentage
Age (years)	≤20	5	12.2%
	21-30	19	46.3%
	31-40	10	24.4%
	41-50	4	9.8%
	>50	3	7.3%
	Total	41	100%
Gender	Male	33	80.5%
	Female	8	19.5%
	Total	41	100%

Table 2: Clinical and MRI Findings

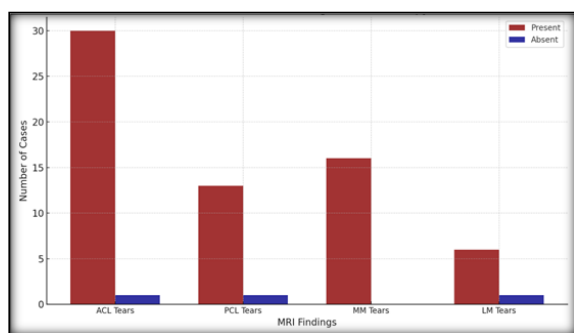
Parameter	Category	Number of Cases	Percentage
Duration of Symptoms	Up to 1 week	9	22%
	1 week – 2 weeks	7	17%
	2 weeks – 3 weeks	3	7.3%
	3 weeks – 4 weeks	4	9.7%
	1 month – 6 months	9	22%
	>6 months	9	22%
	Total	41	100%
Joint Effusion	Present	28	68.3%
	Absent	13	31.7%
	Total	41	100%
ACL Tears	Present	31	75.6%
	Absent	10	24.4%
	Total	41	100%
PCL Tears	Present	14	34.2%
	Absent	27	65.8%
	Total	41	100%
MM Tears	Present	16	39%
	Absent	25	61%
	Total	41	100%
LM Tears	Present	7	17.1%
	Absent	34	82.9%
	Total	41	100%
Osseous/Osteochondral Lesions	Present	19	46.3%
	Absent	22	53.7%
	Total	41	100%

Table 3: Correlation of MRI Findings with Arthroscopy

Parameter	MRI Findings	Arthroscopy Findings (Present)	Arthroscopy Findings (Absent)	Total	Statistical Significance
ACL Tears	Present	30 (96.7%)	1 (3.3%)	31	Chi-square = 31.309, p < 0.001
	Absent	0 (0%)	10 (100%)	10	
	Total	30	11	41	
PCL Tears	Present	13 (92.8%)	1 (7.2%)	14	Chi-square = 32.549, p < 0.001
	Absent	0 (0%)	27 (100%)	27	
	Total	13	28	41	
MM Tears	Present	16 (100%)	0 (0%)	16	Chi-square = 33.19, p < 0.001
	Absent	1 (4%)	24 (96%)	25	
	Total	17	24	41	
LM Tears	Present	6 (85.7%)	1 (14.3%)	7	Chi-square = 27.622, p < 0.001
	Absent	0 (0%)	34 (100%)	34	
	Total	6	34	41	

Table 4: Statistical Values for MRI Diagnosis

Parameter	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
ACL Tears	100	90.9	96.77	100	97.6
PCL Tears	100	96.42	92.85	100	97.6
MM Tears	94.1	100	100	96	97.5
LM Tears	100	97.14	85.71	100	97.5

**Figure 3: Correlation of MRI Findings with Arthroscopy**

DISCUSSION

Internal derangement of the knee (IDK) includes a range of intra-articular pathologies such as ligamentous injuries, meniscal tears, and osteochondral lesions, commonly resulting from trauma. Accurate diagnosis is crucial for effective management, reducing long-term complications such as osteoarthritis and ensuring optimal functional outcomes. Magnetic resonance imaging (MRI) has emerged as a valuable non-invasive tool for assessing IDK due to its ability to provide detailed visualization of soft tissue and osseous structures. However, its diagnostic reliability compared to arthroscopy, the gold standard, is a subject of ongoing research.

This study demonstrates excellent diagnostic performance of MRI for IDK, consistent with findings from prior studies. For anterior cruciate ligament (ACL) tears, MRI exhibited a sensitivity of 100% and specificity of 90.9%, with a positive predictive value (PPV) of 96.77% and negative predictive value (NPV) of 100%. Sharma et al,^[8] (2011) and Khan et al,^[9] (2015) similarly reported high diagnostic accuracy for ACL injuries, emphasizing MRI's ability to identify fiber disruptions and signal changes in ligamentous structures.^[10] Posterior cruciate ligament (PCL)

injuries, although less common, were also well-detected in this study, with 100% sensitivity and 96.42% specificity, comparable to findings by Gupta et al,^[11] (2014), who highlighted MRI's utility in accurately diagnosing partial and complete tears.

Meniscal injuries, particularly medial meniscal (MM) tears, were reliably detected, with a sensitivity of 94.1% and specificity of 100%. These results align with the work of Gyawali et al,^[12] (2020) and Nikolaou et al (2008),^[13] who reported similar diagnostic accuracy for meniscal tears, underscoring MRI's ability to classify tears and provide precise localization. For lateral meniscal (LM) tears, MRI demonstrated 100% sensitivity and 97.14% specificity, consistent with the findings of Sanjay et al (2023),^[10] though the PPV was slightly lower (85.71%), likely due to challenges in detecting subtle or partial LM injuries. This observation highlights the anatomical and biomechanical differences of the lateral meniscus, which can complicate interpretation.

Joint effusion, detected in 68.3% of patients in this study, serves as an important indirect marker of intra-articular pathology. Osseous or osteochondral lesions were identified in 46.3% of cases, further demonstrating MRI's value in providing a comprehensive evaluation of knee injuries. These results align with Nikolaou et al,^[13] (2008) and Khan et al (2015),^[9] who emphasized MRI's role in identifying both primary and secondary indicators of knee pathology.

Statistical analysis in this study revealed a strong correlation between MRI and arthroscopic findings for ACL, PCL, MM, and LM tears, with significant chi-square values (p < 0.001). This supports the conclusions of Sharma et al,^[8] (2011) and Gupta et al (2014),^[11] who also reported excellent concordance between these modalities. The overall diagnostic accuracy of MRI exceeded 97% across all parameters, reinforcing its reliability as a first-line diagnostic tool for IDK.

Despite these strengths, limitations of MRI must be considered. Operator dependency and variability in interpreting subtle findings can affect diagnostic accuracy, as noted by Sanjay et al,^[10] (2023) and Vervaeke et al (2022).^[14] Degenerative changes, particularly in older patients, may mimic traumatic injuries and lead to false positives. Conversely, early cartilage degeneration and micro-injuries may escape detection. These factors underscore the complementary role of arthroscopy in confirming diagnoses and addressing therapeutic needs.

Arthroscopy, while the gold standard, is invasive and associated with risks such as infection and postoperative complications. By reliably identifying IDK, MRI can reduce the need for diagnostic arthroscopy, as demonstrated by Gyawali et al,^[12] (2020) and Nikolaou et al (2008).^[13] This ensures that arthroscopy is reserved for therapeutic interventions or complex cases, improving patient outcomes and resource utilization.

CONCLUSION

This study highlights MRI as a highly reliable diagnostic tool for internal derangement of the knee (IDK), showing excellent correlation with arthroscopic findings. MRI demonstrated a sensitivity of 100% and specificity of 90.9% for ACL tears, and 100% sensitivity and 96.42% specificity for PCL tears. For medial meniscal (MM) tears, sensitivity was 94.1% and specificity was 100%, while lateral meniscal (LM) tears exhibited 100% sensitivity and 97.14% specificity. The diagnostic accuracy for ligamentous and meniscal injuries exceeded 97%, with significant correlations ($p < 0.001$) between MRI and arthroscopy for all evaluated parameters.

These findings validate MRI as a robust, non-invasive diagnostic modality for IDK, capable of minimizing the need for diagnostic arthroscopy. MRI's ability to accurately identify ligament and meniscal injuries ensures that arthroscopy can be reserved for therapeutic purposes or complex cases, optimizing patient management and healthcare resource utilization.

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