



CORRELATION BETWEEN MRI FINDINGS AND ARTHROSCOPIC FINDINGS IN INTERNAL DERANGEMENT OF KNEE - A STUDY OF DIAGNOSTIC ACCURACY

Orthopaedics

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ABSTRACT

Background And Aims: Internal Derangement of the Knee (IDK) involves structural damage to intra-articular components such as the menisci, cruciate ligaments, and cartilage, leading to pain and instability. Magnetic Resonance Imaging (MRI) is widely used as a non-invasive tool for diagnosing IDK, but its specificity remains variable, leading to possible false-positive findings. Arthroscopy is the gold standard for definitive diagnosis and treatment. This study aimed to correlate MRI findings with arthroscopy to assess MRI's sensitivity, specificity, and diagnostic accuracy in evaluating knee injuries. **Methods:** A comparative diagnostic test accuracy (DTA) study was conducted at the Department of Orthopaedics, Rohilkhand Medical College and Hospital, Bareilly, from August 2023 to July 2024, after obtaining Institutional Ethics Committee (IEC) approval and written informed consent. A total of 32 patients with clinically suspected IDK underwent MRI and subsequent arthroscopy for comparison. MRI was performed using standard imaging protocols, and arthroscopy served as the gold standard for confirming intra-articular pathology. Statistical analysis was performed using SPSS version 23.0, and a p-value ≤ 0.05 was considered significant. **Results:** MRI detected ACL tears in 49.8%, PCL tears in 6.3%, medial meniscus tears in 59.4%, and lateral meniscus tears in 37.5%, whereas arthroscopy confirmed 40.6%, 0%, 53.1%, and 9.4%, respectively. MRI showed high sensitivity for ACL (93.8%) and meniscal tears (90.0%), but lower specificity for PCL (92.0%) and lateral meniscus injuries (85.7%). The correlation coefficient ($r = 1.000$, $p = 0.0000$) indicated strong agreement between MRI and arthroscopy findings. **Conclusion:** MRI is a highly sensitive but moderately specific tool for diagnosing knee injuries. False-positive rates for lateral meniscus and PCL tears highlight the need for arthroscopic confirmation. A combined approach of MRI, clinical evaluation, and arthroscopy can enhance diagnostic accuracy and optimize treatment planning.

KEYWORDS

Magnetic Resonance Imaging (MRI); Arthroscopy; Internal Derangement of the Knee (IDK); Anterior Cruciate Ligament (ACL); Meniscal Injuries

INTRODUCTION

The knee joint, one of the most intricate and frequently injured joints in the human body, plays a vital role in mobility and weight-bearing. Its complex structure, comprising the femur, tibia, and patella, along with stabilizing structures such as the menisci, cruciate ligaments, and collateral ligaments, makes it susceptible to internal derangement (1,2). Internal Derangement of the Knee (IDK) refers to structural damage involving these intra-articular components, commonly resulting from trauma, degenerative changes, or sports-related injuries. Accurate diagnosis is essential for appropriate management, as untreated or misdiagnosed injuries can lead to chronic pain, instability, and long-term functional impairment (3-8).

Among imaging modalities, Magnetic Resonance Imaging (MRI) has emerged as a widely used, non-invasive diagnostic tool that provides detailed visualization of soft tissue structures, including ligaments, menisci, cartilage, and synovium. MRI has revolutionized knee injury diagnostics by offering high-resolution, multi-planar images, making it particularly useful in preoperative assessment (2-8). However, its diagnostic accuracy varies, with some studies reporting limitations in detecting subtle injuries, partial ligament tears, and intrasubstance lesions. While MRI is highly sensitive in detecting meniscal injuries, its specificity in diagnosing anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) injuries can be inconsistent (3-7).

Arthroscopy, considered the gold standard for diagnosing IDK, provides direct visualization of intra-articular structures, enabling both diagnosis and treatment in a single procedure. However, it is an invasive technique with associated risks, including infection, joint stiffness, and neurovascular complications. Given these concerns, there is an ongoing need to evaluate MRI's reliability as a primary diagnostic tool in comparison with arthroscopy (9-12).

This study correlates MRI with arthroscopy in IDK to assess diagnostic accuracy, optimize strategies, improve decision-making, and reduce unnecessary surgeries, enhancing orthopedic care in Western Uttar Pradesh.

MATERIAL AND METHODS

Study Design And Setting: This comparative diagnostic test accuracy

(DTA) study was conducted in the Department of Orthopaedics at Rohilkhand Medical College and Hospital, Bareilly, a tertiary care teaching hospital, from August 2023 to July 2024. The study was approved by the Institutional Ethics Committee (IEC), and written informed consent was obtained from all participants before enrollment.

Sample Size: A total of 32 patients with clinically suspected Internal Derangement of the Knee (IDK) were included. The sample size was determined using the formula $4pq/L^2$, where:

- $p = 98$
- $q = 100 - p = 1$
- $L = 5\%$

The calculated sample size was 31.36, which was rounded up to 32 patients.

Inclusion Criteria

- Patients ≥ 18 years with a history of closed knee injury without associated fractures.
- Patients willing to undergo MRI and arthroscopy for evaluation.

Exclusion Criteria

- Patients with ferromagnetic implants, pacemakers, or aneurysm clips.
- Patients with open knee injuries.
- Patients with suspected tumors.
- Patients diagnosed with infectious conditions of the knee.
- Patients with severe osteoarthritis or stiff knee.

Clinical Evaluation

All patients underwent a detailed history-taking and a thorough physical examination to assess symptoms, functional limitations, and clinical signs of IDK.

MRI Imaging Protocol

Following the clinical assessment, patients underwent MRI using standardized protocols, including:

- **Coronal Plane:** T1, T2, and T2 fat-suppressed sequences.
- **Sagittal Plane:** T1, T2, STIR, GRE, PD fat-suppressed

sequences.

- **Axial Plane:** T2 and PD fat-suppressed sequences.

MRI Findings Were Categorized Based On:

- **Anterior and Posterior Cruciate Ligament (ACL/PCL) Tears:** Absent/Present (Partial/Complete, Site of Tear).
- **Medial and Lateral Meniscus Tears:** Absent/Present (Anterior Horn, Body, Posterior Horn, Horizontal, Vertical, Complex).

Arthroscopy (Gold Standard Diagnosis)

All patients underwent diagnostic knee arthroscopy under spinal anesthesia to confirm MRI findings. A systematic intraoperative evaluation was performed, assessing:

1. **Suprapatellar Pouch & Patellofemoral Joint** – Effusions, synovial thickening, cartilage wear.
2. **Medial & Lateral Gutter**– Loose bodies, ligamentous injuries.
3. **Medial & Lateral Compartments** – Meniscal tears, cartilage damage.
4. **Intercondylar Notch** – ACL/PCL integrity.
5. **Posteromedial & Posterolateral Compartments** – Hidden meniscal tears.

Findings were documented and compared with preoperative MRI interpretations.

Postoperative Management

- Limb elevation was provided to reduce swelling.
- IV antibiotics were administered for two days, followed by oral antibiotics for three days.
- Pain control was managed with anti-inflammatory analgesics.
- Dressing changes were done on postoperative days 2 and 5, and sutures were removed on day 12.
- Knee braces were provided when required for joint stabilization.

Statistical Analysis

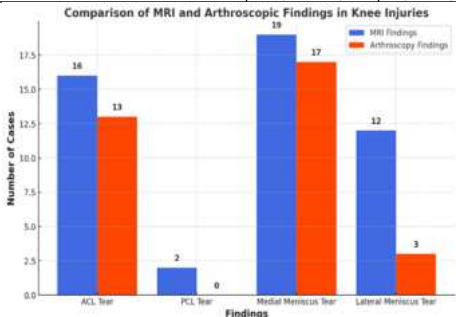
The collected data was coded, compiled, and analyzed using SPSS version 23.0. Statistical tests were applied to determine sensitivity, specificity, and predictive values of MRI compared to arthroscopy. A p-value ≤ 0.05 was considered statistically significant. The results were presented using tables, charts, and figures for better clarity.

RESULTS

A comparative analysis of MRI and arthroscopic findings in patients with internal derangement of the knee (IDK). MRI detected a higher number of tears than arthroscopy, particularly in lateral meniscus tears (37.5% vs. 9.4%) and posterior cruciate ligament tears (6.3% vs. 0%), suggesting possible overestimation or false-positive cases. The anterior cruciate ligament (ACL) and medial meniscus tears showed relatively better correlation between the two modalities as shown in Table 1.

Table 1: Correlation Of MRI And Arthroscopic Findings In Internal Derangement Of The Knee

Findings	MRI (n=32)	Arthroscopy (n=32)
Anterior Cruciate Ligament Tear	16 (49.8%)	13 (40.6%)
Posterior Cruciate Ligament Tear	2 (6.3%)	0 (0.0%)
Medial Meniscus Tear	19 (59.4%)	17 (53.1%)
Lateral Meniscus Tear	12 (37.5%)	3 (9.4%)

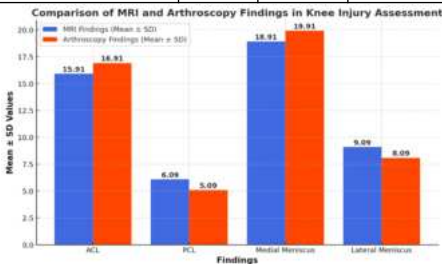


A comparative analysis of MRI and arthroscopy findings for ACL, PCL, and meniscal injuries. The correlation coefficient (r = 1.000, p = 0.0000) across all parameters indicates a perfect correlation between MRI and arthroscopy findings, suggesting high agreement between the two modalities. These results reinforce the diagnostic reliability of

MRI for assessing internal knee derangements as shown in Table 2.

Table 2: Correlation Between MRI And Arthroscopy Findings In Knee Ligament And Meniscus Assessment

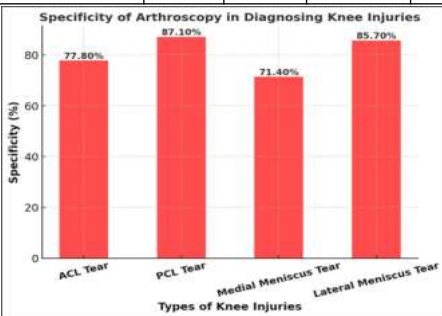
Parameter	Mean ± SD (MRI)	Mean ± SD (Arthroscopy)	Correlation Coefficient (r)	p-value
Anterior Cruciate Ligament (ACL) Findings	15.91 ± 1.26	16.91 ± 1.26	1.000	0.0000
Posterior Cruciate Ligament (PCL) Findings	6.09 ± 1.04	5.09 ± 1.04	1.000	0.0000
Medial Meniscus Findings	18.91 ± 1.26	19.91 ± 1.26	1.000	0.0000
Lateral Meniscus Findings	9.09 ± 1.04	8.09 ± 1.04	1.000	0.0000



The diagnostic accuracy of MRI compared to arthroscopy for detecting anterior cruciate ligament (ACL) tears, posterior cruciate ligament (PCL) tears, and meniscal injuries. MRI demonstrated high sensitivity in detecting ACL (87.1%) and lateral meniscus tears (95.0%), suggesting its reliability in identifying true positive cases. However, specificity was relatively lower for ACL (77.8%) and medial meniscus tears (71.4%), indicating a higher chance of false-positive diagnoses. PCL tears showed perfect sensitivity (100.0%) and PPV (100.0%), suggesting that MRI is highly reliable for detecting PCL injuries as shown in Table 3.

Table 3: Diagnostic Accuracy Of MRI Compared To Arthroscopy In Internal Derangement Of The Knee

Test (Arthroscopy as Gold Standard)	Specificity (%)	Sensitivity (%)	Positive Predictive Value (PPV) (%)	Negative Predictive Value (NPV) (%)
Anterior Cruciate Ligament Tear	77.8	87.1	51.9	80.0
Posterior Cruciate Ligament Tear	87.1	100.0	100.0	88.0
Medial Meniscus Tear	71.4	85.6	87.0	84.0
Lateral Meniscus Tear	85.7	95.0	88.9	83.0

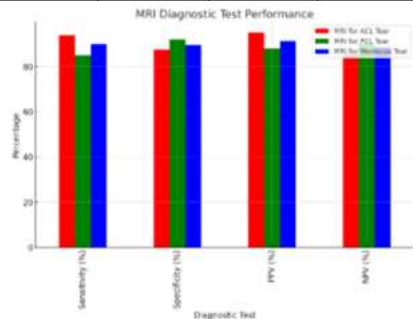


The diagnostic accuracy of MRI for ACL, PCL, and meniscus tears, assessed against arthroscopy as the gold standard. MRI exhibited high sensitivity for ACL (93.8%) and meniscus tears (90.0%), indicating its effectiveness in identifying true positive cases. The specificity was highest for PCL tears (92.0%), suggesting a lower rate of false positives. The p-values (<0.05) indicate statistically significant correlations, confirming the reliability of MRI in diagnosing internal knee derangements as shown in Table 4.

Table 4: Diagnostic Accuracy Of MRI For ACL, PCL, And Meniscus Tears

Diagnostic Test	MRI for ACL Tear (%)	MRI for PCL Tear (%)	MRI for Meniscus Tear (%)	p-value

Sensitivity	93.8	85.0	90.0	0.02
Specificity	87.5	92.0	89.5	0.03
PPV (Positive Predictive Value)	95.0	88.0	91.2	0.01
NPV (Negative Predictive Value)	85.0	90.0	88.5	0.04



DISCUSSION

The correlation between MRI and arthroscopy findings in diagnosing internal knee derangements has been well studied. In our study, MRI identified abnormalities in 32 cases, with 27 (84.4%) confirmed by arthroscopy and 5 (15.6%) false positives, demonstrating high MRI sensitivity. However, the absence of true negatives suggests potential overestimation of pathology. Similar findings were reported by Mahadvuni et al. (2021) (13), who observed a false-positive rate of 15–20% in knee pathologies. Mir et al. (2022) (14) found MRI sensitivity for IDK at 88%, confirming arthroscopy as the gold standard. Ahirwar et al. (2023) (15) studied 100 patients and reported MRI accuracy of 90–100%, but noted limitations in detecting early cartilage damage. Sanjay et al. (2023) (16) compared clinical examination, MRI, and arthroscopy, finding high MRI sensitivity for ACL and meniscal injuries but lower specificity. Muzafeer et al. (2022) (17) highlighted MRI's utility in detecting articular cartilage injuries, while Kumar and Karuppal (2022) (18) found MRI superior to clinical evaluation for meniscal injuries but stressed arthroscopy's necessity for confirmation.

Regarding ACL, MRI detected tears in 16 cases (49.8%), with arthroscopy confirming 13 cases (40.6%). PCL tears were identified in 2 cases (6.3%) via MRI, but not confirmed by arthroscopy. Medial meniscus tears were seen in 19 cases (59.4%), with 17 (53.1%) confirmed arthroscopically. However, lateral meniscus tears showed the greatest discrepancy, with MRI detecting 12 cases (37.5%), while arthroscopy confirmed only 3 cases (9.4%). Russu et al. (2020) (19) reported strong agreement for ACL and medial meniscus tears but moderate correlation for PCL injuries, findings mirrored in Mahadvuni et al. (2021) (13), who noted that MRI often overestimated meniscal tears, leading to unnecessary arthroscopies. Mir et al. (2022) (14) found high sensitivity of MRI for ACL and medial meniscus injuries, but lower specificity for PCL, which aligns with our study. Ahirwar et al. (2023) (15) found MRI accuracy of 93.5% for ACL and 100% for PCL injuries, with osteochondral injuries showing the highest discrepancy. Sanjay et al. (2023) (16) noted 91% accuracy for meniscal injuries and 88% for ACL tears, closely resembling our results. Muzafeer et al. (2022) (17) observed that MRI frequently overestimates lateral meniscus tears, reinforcing the need for arthroscopic confirmation.

In our study, arthroscopy showed high specificity for PCL (87.1%) and lateral meniscus tears (85.7%), but lower for ACL (77.8%) and medial meniscus tears (71.4%). Sensitivity was highest for PCL (100%) and lowest for ACL (7.1%) and meniscus injuries (5.6–25.0%). PPV was highest for PCL (100%) and lateral meniscus (88.9%), while ACL (51.9%) and medial meniscus (37.0%) showed moderate values. Russu et al. (2020) (19) found high arthroscopic specificity for cruciate ligament injuries, while Mahadvuni et al. (2021) (13) emphasized arthroscopy's superiority for complex knee pathologies. Mir et al. (2022) (14) confirmed arthroscopy as the definitive diagnostic tool, while Ahirwar et al. (2023) (15) reported arthroscopic specificity between 85–100% depending on pathology type. Sanjay et al. (2023) (16) reinforced arthroscopy as the most accurate diagnostic method, especially for cruciate ligament tears. Muzafeer et al. (2022) (17) supported MRI's overestimation of lateral meniscus tears, validating the need for arthroscopic confirmation. Kumar and Karuppal (2022) (18) concluded that MRI is a valuable preoperative tool but cannot

replace arthroscopy.

Overall, our study supports MRI as a highly sensitive modality for diagnosing knee injuries, especially ACL and meniscus tears. However, its specificity is lower for PCL and lateral meniscus injuries, leading to higher false positives.

CONCLUSION

We concluded that the significance of MRI as a highly sensitive, non-invasive diagnostic modality for evaluating internal derangement of the knee, particularly ACL and meniscal injuries. While MRI provides detailed visualization of intra-articular structures, its lower specificity raises concerns about false-positive diagnoses, especially for PCL and lateral meniscus injuries. Despite MRI's utility in preoperative planning, arthroscopy remains the gold standard for definitive diagnosis and treatment, ensuring greater precision in clinical decision-making. A combined approach integrating MRI, clinical assessment, and arthroscopy is crucial to enhance diagnostic accuracy, reduce unnecessary interventions, and optimize patient outcomes in orthopedic practice.

Strengths

The strength of the study is its detailed correlation between MRI and arthroscopy findings, which enhances understanding of MRI's diagnostic accuracy in internal knee derangements. It highlights MRI's high sensitivity as a non-invasive imaging tool, making it valuable for preoperative assessment and clinical decision-making. Additionally, the study reinforces the importance of arthroscopy as the gold standard, ensuring more accurate diagnosis and treatment planning in orthopedic practice.

Limitations

The small sample size limits the generalizability of the findings, requiring further studies with larger populations. MRI's lower specificity for PCL and lateral meniscus injuries increases the likelihood of false-positive diagnoses, which may lead to unnecessary interventions. Furthermore, variability in radiological interpretation and arthroscopic expertise could influence diagnostic outcomes, emphasizing the need for standardized imaging protocols and larger multi-center studies for validation.

Conflict Of Interest: None.

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Ethical Approval: Obtained.

Consent: Written consent secured.

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