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A Comparative Study on Correlation between Magnetic Resonance Imaging and Arthroscopic Findings in the Knee Joint Injuries

K V Arun Kumar[1], Krishnavel Thavasianantham[1], Prashanth Pandian[1], Haemanath Pandian[1], E Pradeep[1], Mohideen Sheik[1]

Learning Point of the Article:

To impose that arthroscopy can be performed following a comprehensive clinical assessment in patients with persistent pain or instability of knee where the MRI turned out to be normal.

Abstract

Introduction: The knee joint primarily allows for flexion and extension and is essentially a hinge joint. The knee joint, like all hinge joints, is strengthened by collateral ligaments – one on each side of the joint.

Objective: Our study sought to investigate potential correlations between arthroscopy and magnetic resonance imaging (MRI) examination in the diagnosis of traumatic diseases of the knee.

Methods and Materials: A prospective study was conducted on 30 persons who showed signs of having traumatic knee disease. Following a comprehensive evaluation of the patient's medical history and current state of health, we opted to undergo an arthroscopic evaluation and knee MRI.

Results: The sensitivity of the MRI was 93.87%, the specificity was 91.54%, the accuracy was 92.50%, and the negative predictive value was 95.58% when compared to arthroscopic inspection as the gold standard.

Conclusion: This study demonstrates that MRIs frequently misdiagnose individuals with multiple knee injuries or fail to detect a lesion while doing a diagnostic evaluation. Therefore, if the MRI comes out normal, there is no reason to deny the patient arthroscopy. Due to this MRI flaw, researchers have determined that arthroscopy can be performed following a comprehensive clinical assessment without the need for an MRI.

Keywords: Knee, anterior cruciate ligament injury, posterior cruciate ligament injury, medial meniscal injury, lateral meniscal injury, magnetic resonance imaging, arthroscopy.

Introduction

The medial and lateral condyles of the femur, the tibial plateau, and the patellar surface all serve as articular surfaces that allow for flexion, extension, anterior-posterior sliding, and internal-external rotation of the knee. The knee may bend and straighten because it is a hinge joint. The knee, like all hinge joints, is reinforced by a set of collateral ligaments on either side of the joint. Cruciate ligaments connect the extremities of the femur and tibia, keeping them in their opposite positions. The knee is particularly vulnerable to frontal impacts and rotations due to its thin anterior covering and lack of strong muscle protection. At present, magnetic resonance imaging (MRI) is the best non-invasive diagnostic tool for evaluating internal knee dysfunction [1-5]. Although arthroscopy can be utilized for both diagnosis and treatment, it is intrusive and expensive and provides only a partial picture of the extracapsular soft tissues surrounding the

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Dr. K V Arun Kumar


Dr. Krishnavel Thavasianantham


Dr. Prashanth Pandian


Dr. Haemanath Pandian


Dr. E Pradeep


Dr. Mohideen Sheik

[1]Department of Orthopaedics, Chettinad Hospital and Research Education, Chettinad Academy of Research and Education, Kelambakkam, Tamil Nadu, India.

Address of Correspondence:
Dr. Krishnavel Thavasianantham,
Department of Orthopaedics, Chettinad Hospital and Research Education, Chettinad Academy of Research and Education, Kelambakkam, Tamil Nadu, India.
E-mail: krishna08vel@gmail.com

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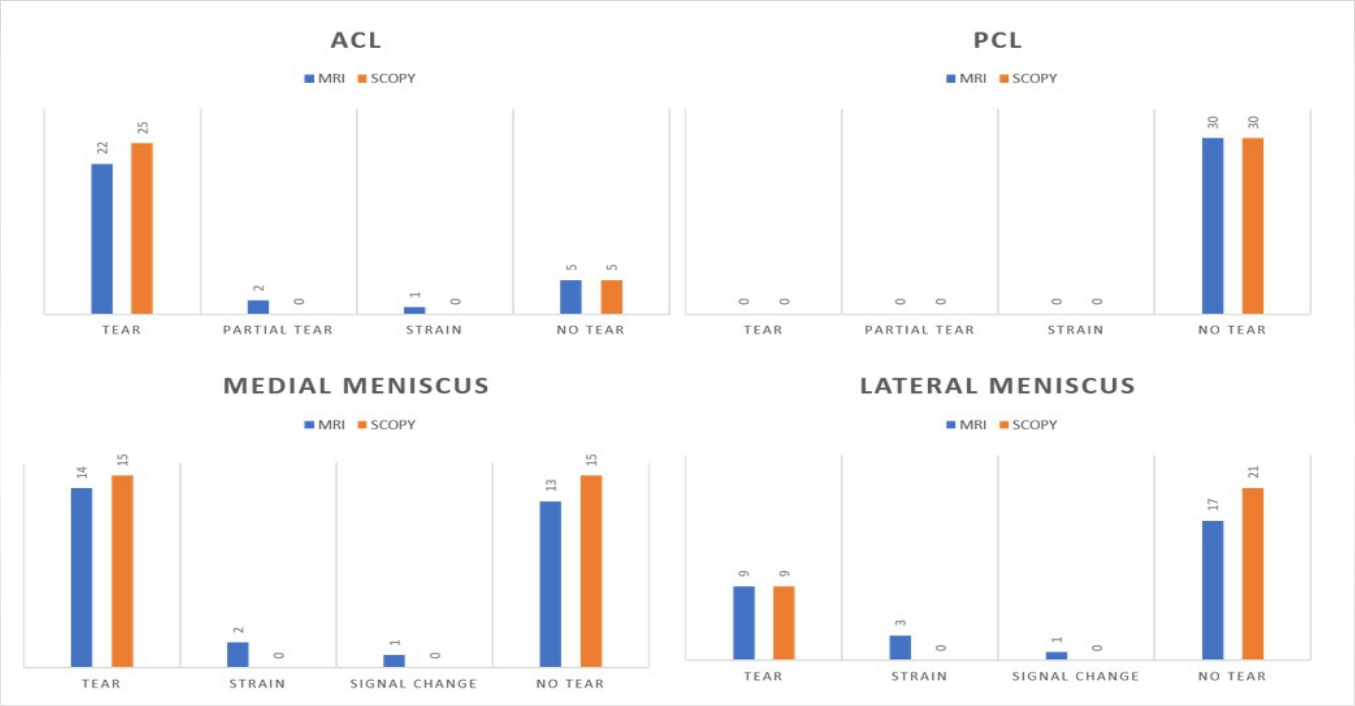

Chart 1: Magnetic resonance imaging findings and their correlation with findings of arthroscopy.

joint. Internal knee derangements and other knee disorders have long been diagnosed with the help of arthroscopy and arthrography. Despite MRI's rising prevalence in the examination of knee lesions, its diagnostic value is limited [6].

Objective

The purpose of this study was to compare the diagnostic accuracy of arthroscopy, MRI, and clinical assessment for traumatic knee diseases (Chart 1).

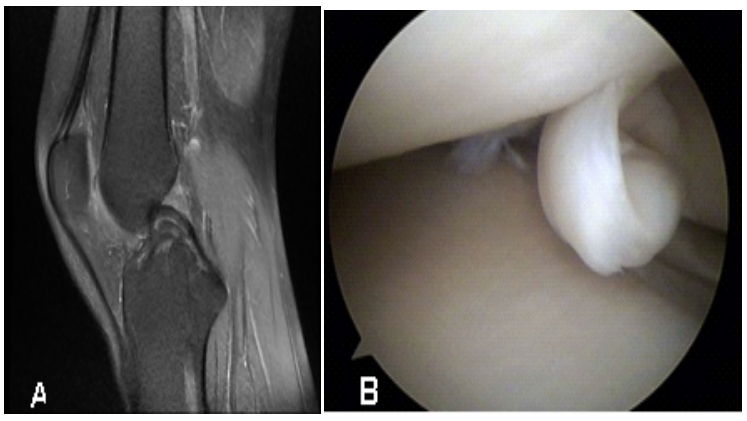

Figure 1: (a) Magnetic resonance imaging showing bucket handle tear and (b) arthroscopy showing bucket handle tear of medial meniscus.

Materials and Methods

A prospective study was conducted in the Orthopaedics Department at Chettinad hospital and research institute between September 2022 and August 2023. There were a total of 30 patients, whom had experienced knee pain, instability, or other symptoms like locking or giving way following an episode of trauma. After gathering the patient history and performing a thorough physical examination, MRI of the knee was performed. Senior radiologist had examined the images thoroughly and reported his results which was confirmed by the senior orthopedic surgeon. Arthroscopy patients were evaluated and prepared for surgery.

Results

A total of 30 patients (24 men and 6 women) were evaluated. Among the patients were those as young as 18 and as old as 60. The MRI and arthroscopy findings were compared (Table 1) to determine which diagnosis was more likely to be accurate. The diagnostic accuracy of each technique was determined (Tables 2 and 3). Patients between the ages of 25 and 38 made up the largest demographic of those who required treatment for knee injuries. Among the patients analyzed, lower leg

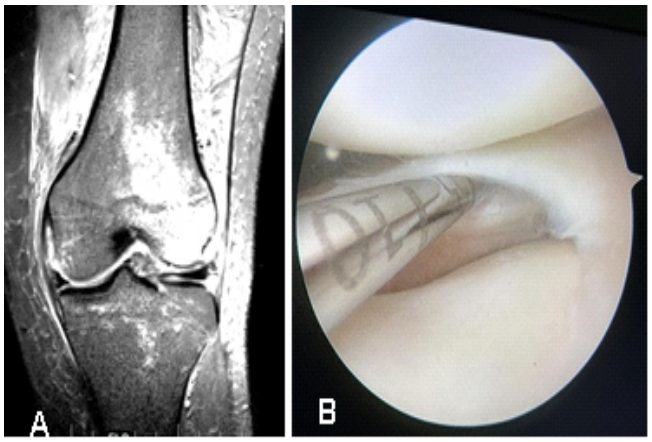

Figure 2: (a) Magnetic resonance imaging showing complete tear and (b) arthroscopy showing stable tear of lateral meniscus.

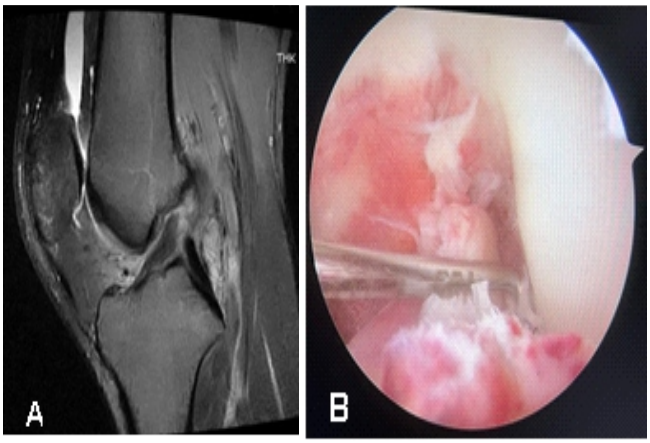

Figure 3: (a) Magnetic resonance imaging showing partial tear and (b) arthroscopy showing complete tear of anterior cruciate ligament.

twisting injuries were prevalent, with the most common causes being car accidents (40%), fall from stairs (26.6%), sports injuries (13.3%), and other causes (20%). When compared to the gold standard of arthroscopic inspection, the MRI showed a sensitivity of 93.87%, a specificity of 91.54%, an accuracy of 92.5%, and a negative predictive value (NPV) of 95.5% (Table 2).

Discussion

Medical records of patients with pre-existing joint problems were used for this study. On MRI, we identified 17 cases of medial meniscus (MM) damage, however, arthroscopy confirmed only 15 (Fig. 1). The diagnostic accuracy of arthroscopy and MRI for medial meniscal tears is very similar; MRI has a sensitivity of 100% and a specificity of 86.6%. The predicted range of values was 88% positivity, 100% negativity, 88% sensitivity, and 88% specificity.

In a study conducted by Elvenes et al., MRI was reported to have a sensitivity of 100%, specificity of 77%, a positive predictive value (PPV) of 71%, and an NPV of 100% for MM [7], while for lateral meniscus (LM), these values were found to be 40%, 89%, 33%, and 91%, respectively. MRI's overall accuracy for both MM and LM was 84%.

The NPV (100%) and PPV (88.2%) of arthroscopy are both excellent, and its sensitivity (100%) and specificity (86.6%) are also excellent. Our results show that arthroscopy outperforms MRI in terms of sensitivity, specificity, and predictiveness, whereas MRI fares worse in terms of its positive and NPVs.

Of the 13 patients in our study with lateral meniscal injuries, 9 underwent successful arthroscopic surgeries (Fig. 2). Comparing arthroscopy with MRI, the former was 100% sensitive and the latter was 80.9% specific. MRI demonstrated a moderate connection with arthroscopy for the diagnosis of lateral meniscal injury. MRI has a 69.2% positive and 100% negative injury detection accuracy for the LM.

Incorrect positive and negative diagnoses were more common when the MM was torn, but not when the LM was injured.

Structures injured	Clinical examination	Arthroscopy	MRI	True positive	False positive	True negative	False negative
ACL	20	25	22	22	0	5	3
PCL	0	0	0	0	0	30	0
Medial meniscus	9	17	15	15	2	13	0
Lateral meniscus	7	9	13	9	4	17	0
MRI: Magnetic resonance imaging, ACL: Anterior cruciate ligament							

Table 1: Comparison of clinical examination, arthroscopy, and magnetic resonance imaging findings.

Tests	Between MRI and arthroscopy (%)
Sensitivity	93.87
Specificity	91.54
PPV	88.46
NPV	95.58
Accuracy	92.5
MRI: Magnetic resonance imaging, PPV: Positive predictive value, NPV: Negative predictive value	

Table 2: Overall sensitivity, specificity, and accuracy between magnetic resonance imaging and arthroscopy.

Tests	ACL (%)	PCL (%)	Medial meniscus (%)	Lateral meniscus (%)
Sensitivity	88	100	100	100
Specificity	100	100	86.6	80.9
PPV	100	100	88.2	69.2
NPV	62.5	100	100	100
Accuracy	90	100	93.3	86.6
PPV: Positive predictive value, NPV: Negative predictive value, ACL: Anterior cruciate ligament				

Table 3: Sensitivity, specificity, and accuracy between magnetic resonance imaging and arthroscopy of various structures in knee.

There could be a number of factors for the unexpected MRI menisci findings. Meniscal rips and degenerative changes first seem identical on MRI due to the abundance of strong signals within the meniscus. The articular surface tear of the meniscus is diagnosed by the stretched high signal line. The signal from the inferior genicular artery might also be misinterpreted, leading to erroneous MRI results for the LM. Misdiagnosis as popliteal bursitis or Humphreys' ligament damage is a common occurrence when a posterior LM injury is present[3].

The anterior cruciate ligament was the site of injury in 22 of 30 MRI of patients with knee injuries (Fig. 3). MRI has a sensitivity of 88%, a specificity of 100%, and a 100% significant association with arthroscopy for detecting ACL injuries. MRI has a perfect PPV of 100%. Value in predicting failure is 62.5% negative. MRI provides a 93–97% detection rate for ACL injuries. MRI was found to have a 100% PPV and a 62.5% NPV in our study.

Estimates of accuracy, sensitivity, and specificity for knee lesions have a wide range across the literature. A single ACL tear was detected with a sensitivity of 93%, as described by Rubin et al. [8]. Several prospective studies have demonstrated that MRI has a high potential for accurately diagnosing a torn ACL, with a sensitivity of 92–100% and a specificity of 93–100%. Rose and Gold. [9] observed that clinical evaluation was just as reliable as MRI in identifying meniscal tears and ACL ruptures; hence, they concluded that MRIs were unnecessary in patients with a clinical suspicion of these injuries due to their high cost. According to Boden et al. [2], if meniscus injury has already been diagnosed clinically, an MRI will not alter therapeutic options.

Since the posterior cruciate ligament (PCL) was not damaged in any of the cases, imaging techniques (MRI and arthroscopy) show that it functions normally. The diagnosis of PCL rips with MRI has been shown to be accurate. This may be predicted because the PCL is typically thought of as a continuous, low-signal, homogeneous structure. Many studies have demonstrated a PPV of 99–100% and a NPV of 0%. Our study likewise had a 100% PPV, 100% NPV, 100% sensitivity, and 100% specificity [10, 11].

The severity of cartilage abnormalities cannot be disguised by arthroscopy as a standalone diagnostic method [12]. This shows that arthroscopic examination is more accurate than radiography or MRI at grading osteoarthritis and detecting anomalies in the surface cartilage. Retrospectively collecting MRI data, after noting arthroscopy results, enhanced the test's sensitivity (from 40% to 71%), as discovered by Ochi et al. [13]. The computed sensitivity of MRI in cases of full-thickness cartilage loss and severe deep erosions in chondral lesions was 100% and 75%, respectively. However, arthroscopic imaging was unable to detect fibrilization or tiny lesions on the skin's surface. Mori et al. stated that newer, more precise methods can help distinguish between partial and full-depth chondral damages in addition to displaying the degree of chondral lesions [14].

Conclusion

This study demonstrates that MRIs frequently misdiagnose individuals with multiple knee injuries or fail to detect a lesion while doing a diagnostic evaluation. Therefore, if the MRI comes out normal, there's no reason to deny arthroscopic evaluation to the patient. Due to this MRI flaw, researchers have determined that arthroscopy can be performed following a comprehensive clinical assessment without the need for an MRI.

Clinical Message

This study provides valuable insights for clinicians, enhancing diagnostic accuracy, preoperative planning precision, informed decision-making, resource optimization, and the continual improvement of diagnostic modalities in orthopedic practice

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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