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Correlation between clinical findings and magnetic resonance imaging findings in meniscal and anterior cruciate ligament injuries

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ABSTRACT

Background: This study aims to compare the correlation between clinical findings and magnetic resonance imaging with arthroscopic findings in meniscal and anterior cruciate ligament (ACL) injuries.
Methods: This was a prospective study of 60 patients with ACL and meniscal injuries of the knee who were admitted between October 2020 and October 2021, who underwent clinical examination, MRI, and arthroscopy of the knee.
Results: In our study of 60 cases, there were 44 male and 16 female patients ranging from 18 to 45 years, with the majority of patients between the ages of 25 and 35. The clinical examination had a sensitivity of 88%, specificity of 100%, and accuracy of 90% for ACL, the sensitivity of 80%, specificity of 100%, and accuracy of 90% for medial meniscus, and sensitivity of 50%, specificity of 100%, and accuracy of 83.33% for lateral meniscus. Magnetic resonance imaging (MRI) had a sensitivity of 100%, specificity of 100%, and accuracy of 100% for ACL, the sensitivity of 100%, specificity of 66.67%, and accuracy of 83.33% for medial meniscus, and sensitivity of 100%, specificity of 85%, and accuracy of 90% for lateral meniscus.
Conclusions: In conclusion, the current investigation emphasizes the importance of clinical diagnosis, as the positive predictive value (PPV) for all lesions is high. An MRI provides an additional diagnostic tool for ligament and meniscal injuries of the knee. The diagnostic accuracy of all lesions was in the 90th percentile. Because the negative predictive value (NPV) for all lesions is substantial, MRI is utilized to confirm the diagnosis and rule out pathology.

Keywords: Meniscal injuries, ACL, MRI findings, Clinical examination

INTRODUCTION

The knee joint is the synovial and weight-bearing form of joint. The joint's stability relies upon its supporting ligamentous and tendinous systems.[4,5] Injury to the ligaments and meniscus disrupts the stability and normal mechanics of the knee joint, resulting in an unstable knee that makes it difficult for a person to do their everyday activities. Trauma, degenerative joint disease, infections, inflammatory diseases, and congenital abnormalities are all possible causes. Our objective was to see how accurate clinical and MRI findings were compared to arthroscopic findings in meniscal and ACL injuries.

According to, preoperative diagnosis of ACL rupture was correct in 38 percent of 85 patients.[4,5] However, Torg et al diagnosed 95 percent of 250 cases properly using the Lachman test. Multiple lesions in the same knee are uncommonly reported. In a prospective series, DeHaven and Collins correctly diagnosed 72 percent of patients. Taking a clinical history on the mechanism of the knee and performing a thorough physical examination give a significant clue to the injuries in the knee joint leading us to an accurate diagnosis.[6,7]

The non-invasive alternative to diagnostic arthroscopy has long been thought to be MRI scanning of the knee joint.

An MRI scan is commonly used to support the diagnosis of meniscal or cruciate ligament injuries, providing pictures demonstrating morphological abnormalities. For the diagnosis of traumatic intraarticular knee injuries, arthroscopy is regarded as "the gold standard." Arthroscopy is a highly sensitive and specific procedure used to diagnose and treat various conditions.[1-3] Clinical examination and MRI findings were correlated with arthroscopy findings for ACL and meniscal injury. This study aimed to see how accurate clinical and MRI findings were compared to arthroscopic findings in meniscal and ACL injuries.

METHODS

After taking institutional ethical committee approval, a prospective study was conducted on 60 patients in Yenepoya medical college and hospital, Mangalore, Karnataka, between October 2020 and October 2021.

Inclusion criteria included patients who complained of knee pain following injury and were clinically and radiologically evaluated to have an ACL and meniscal tear.

Exclusion criteria excluded patients with septic arthritis.

Patients diagnosed clinically with multiple ligamentous injuries and osteochondral defects.

Patients who had previously undergone meniscectomies, knee ligament repair or reconstructions, and knee arthroscopies were excluded. Patients with posterior cruciate ligament injuries, intracerebral aneurysmal clips, cardiac pacemakers, metallic foreign bodies in the eye, implants in the middle ear, knee joint neoplasm, and infectious and inflammatory conditions of the knee joint were all excluded.

Patients who had an arthroscopy without an MRI and could not endure anesthesia were also excluded from research.

These patients underwent the following preoperative clinical examination.

Lachman's test

Knee is flexed 20-30 degrees. One hand is placed behind the tibia, while the other is placed on the patient's thigh. An undamaged ACL should inhibit forward translation when pushing the tibia anteriorly. Tibia translation indicates a positive test.[9]

Anterior drawers test

Supine position with 45-degree flexed hips, 90-degree flexed knees, and feet flat. To stabilize, the examiner sits on the toes of the tested leg. Examiner tries to translate the lower leg anteriorly by grasping the proximal lower leg just below the tibial plateau.[9]

Mc Murray test

With one hand, hold the knee and palpate the joint line, thumb on one side, finger on the other. The other hand supports and moves the limb by holding the sole. Extend the knee to its maximum flexion with internal tibial rotation and a varus tension/ external tibial rotation with valgus stress.[9]

All clinical test results were statistically analyzed.

All patients underwent MRI imaging in a 3 Tesla MRI machine, including sagittal, coronal, and axial planes, fat-suppressed T2 axial turbo spin echo, and T1 spin echo sagittal.[10]

A senior radiologist analyzed the MRI report. Complete ACL Tears were interpreted, and Types of meniscal tears were reported accordingly (Figure 5 and 6).

Finally, all the patients underwent therapeutic arthroscopy by a single surgeon. For inclusion in the trial, all patients signed a written consent form. The patients were informed about the treatment process and their rights throughout the trial. Patients with ACL and meniscal injuries (Figure 1) aged >18 met the inclusion criteria. Patients with single and multiple lesions were examined and included in the study six weeks following the injury. The knee was thoroughly examined, with particular attention paid to various tests. Identifying cruciate ligament tears was done using the Lachman anterior drawer and posterior drawer tests. McMurray's test and joint line tenderness were used for meniscal injuries as diagnostic criteria. Two experienced examiners (consultants) from the Department of Orthopaedics conducted a clinical examination to eliminate inter-observer bias. An X-ray of the affected knee was taken in the anteroposterior (AP) and lateral views to rule out any bone injury. Because of acute hemarthrosis or effusion of the knee, an MRI of the joint was performed three weeks after the injury rather than immediately, which led to a misdiagnosis. Radiological evaluation was done by two radiologists (consultants) from the radiology department. After a proper MRI study by the surgeon, an examination under anesthesia was performed to validate the indicators of instability. Arthroscopic surgery was performed (Figure 2). The results of clinical, MRI, and arthroscopic tests were compared. SPSS was used to conduct the statistical analysis. Sensitivity, specificity, positive, and NPV s were all evaluated. The purpose is to examine the accuracy of clinical evaluation by validating it with MRI and arthroscopy findings in the same patient.

Ethics approval

Protocol number: YEC2/691, approved by Yenepoya ethics committee 2, Yenepoya (Deemed to be university), DCGI registration No.: ECR/1337/Inst/KA/2020.

Data analysis was done using SPSS software.

Figure 1: MRI knee joint with bucket handle tear of medial meniscus showing double PCL sign.

Figure 2: Arthroscopic finding of medial meniscal tear.

RESULTS

In our study, we included 44 male and 16 female patients between the ages of 18 and 45 (Figure 3). The right knee joint (40 patients) was shown to be more typically affected than the left knee joint (20 patients). Sports injuries were discovered to be the most common type of injury (Figure 4). Clinical diagnosis was correct in 24 patients (40%) with a medial meniscus injury, ten patients (16.66%) with a lateral meniscus injury, and 44 patients with ACL injury (73.33%). Clinical diagnosis was inaccurate in 36 patients (60%) with a medial meniscus injury, 50 patients (83.33%) with a lateral meniscus injury, and 16 patients with ACL injury (26.66%) (Figure 7-9).

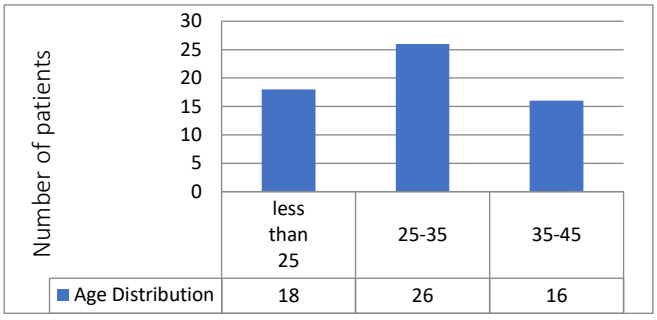

Figure 3: Age distribution of study participants.

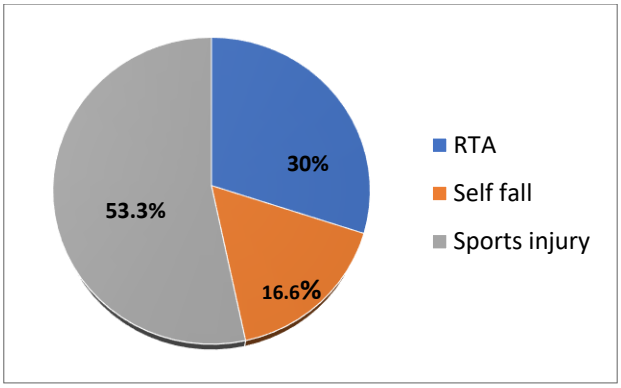

Figure 4: Mode of injury.

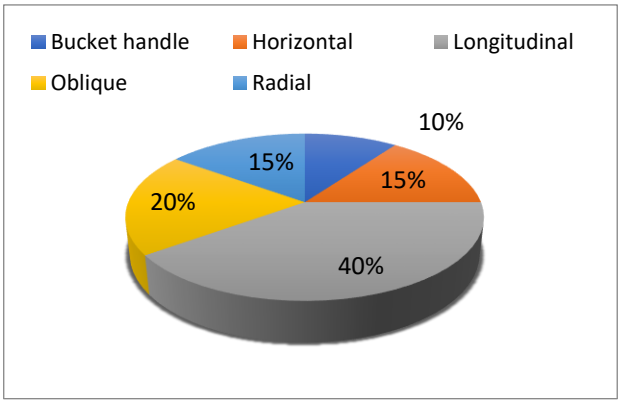

Figure 5: Types of medial meniscal tear.

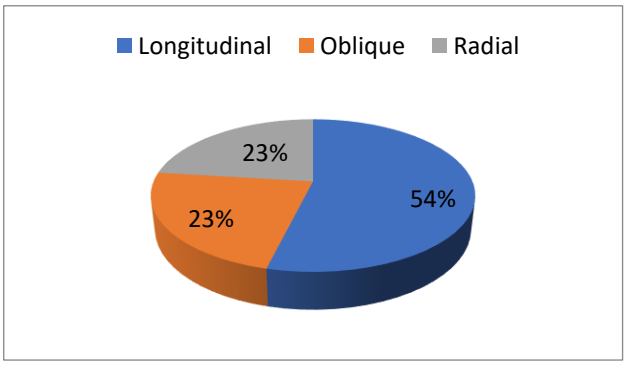

Figure 6: Types of lateral meniscal tear.

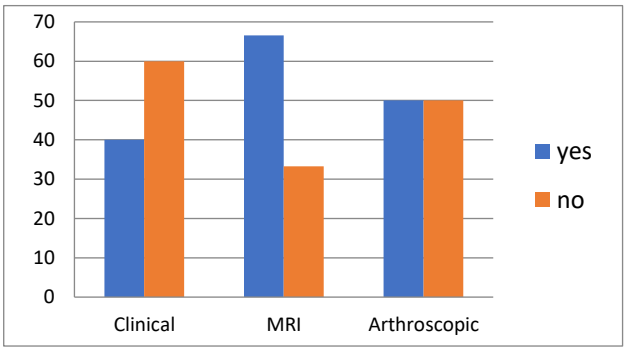

Figure 7: Correlation between clinical, MRI, and arthroscopic findings in medial meniscus tear.

Only 40% of medial meniscus tears could be diagnosed clinically, with the remaining 60% undiagnosed. On the other hand, 66.6 percent of the cases were discovered using MRI, whereas 33.3 percent were not. Arthroscopy may be beneficial in only half of the cases.

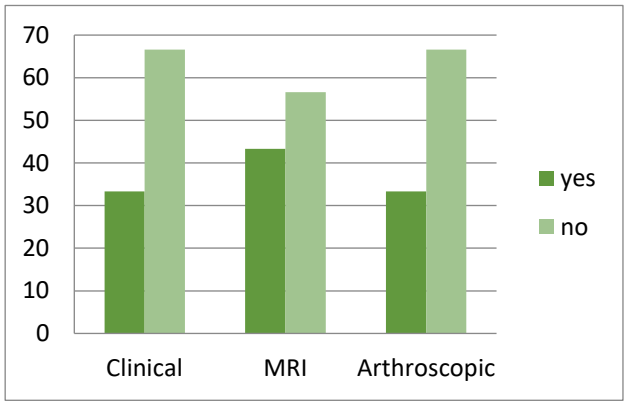

Figure 8: Correlation between clinical, MRI, and arthroscopic findings in lateral meniscus tear.

Only 33.3 percent of lateral meniscus injuries could be diagnosed clinically. MRI revealed 43.3 percent of the cases, while arthroscopy revealed 33.3 percent. This indicates that MRI has a PPV in detecting lateral meniscus tears.

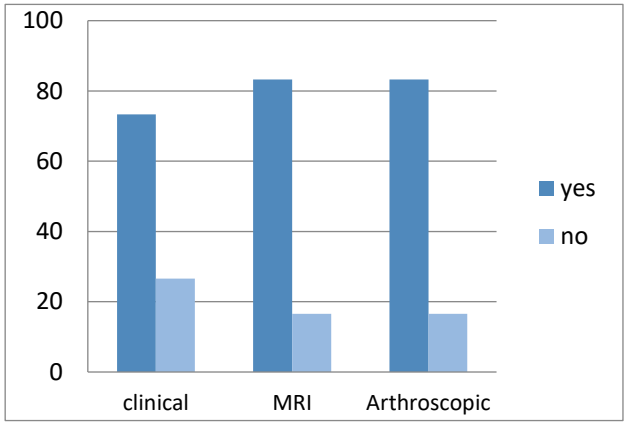

Figure 9: Correlation between clinical, MRI, and arthroscopic findings in ACL tear.

The 73.3 percent of ACL tears were identified clinically, while 83.3 percent were diagnosed with MRI and arthroscopy (Figure 7-9).

Table 1: Results for clinical examination in diagnosing ACL and meniscal tears.

Variables	ACL (%)	MM (%)	LM (%)
Sensitivity	88	80	50
Specificity	100	100	100
PPV	100	100	100
NPV	62.5	83.33	80
Accuracy	90	90	83.33

Table 2: Results for MRI in diagnosing ACL and meniscal tears

Variables	ACL (%)	MM (%)	LM (%)
Sensitivity	100	100	100
Specificity	100	66.67	85
PPV	100	75	76.9
NPV	100	100	100
Accuracy	100	100	100

In our current analysis of 60 patients, the p value between clinical diagnosis and MRI is 0.034, between clinical diagnosis and rthroscopy is 0.065, and between MRI and arthroscopy is 0.077 (Table 1 and 2). Because all values are less than 0.05, the p value is significant, indicating that the study is significant.

DISCUSSION

This study aimed to see how clinical and MRI data correlated in detecting meniscal and ligamentous lesions in the knee joint. We compared the MRI and clinical examination findings with the arthroscopic findings in this study of 60 patients. Using arthroscopy as the gold standard, we computed the sensitivity, specificity, PPV, NPV, and accuracy of clinical and MR examinations in identifying ligament and meniscus injuries. Clinical examination can be challenging in cases of acute injury and inconclusive in multiple ligament/meniscal injuries. However, there are benefits to adopting the Lachman test, which is recognized to have higher validity than other ACL physical examination assessments. ACL rupture is improbable when adequately executed test results are negative. Clinical examination cannot be performed in acute injury since it produces pain, which is one of the downsides.

Furthermore, because it is a subjective examination, at least two doctors must examine the patient to avoid subjective bias. Although a clinical examination is essential in determining the severity of ligament damage, painful stress testing is not always reliable in the early stages of the injury. Clinical tests can be perplexing, resulting in a delay in diagnosis. As a result, supplementary diagnostic methods are frequently required, especially when several lesions are suspected.[11-13]

The most common indication for a knee MRI is to diagnose internal derangements in an injured knee. MRI is a non-invasive and extremely sensitive investigational tool. MRI has revolutionized. It has become the optimum modality for imaging the complicated anatomy of the knee joint because it has better soft tissue contrast and multiplanar slice capacity. MRI is a non-invasive diagnostic tool that does not use ionizing radiation.

Furthermore, the knee has two types of ligaments: intraarticular and extraarticular. The importance of MRI in their evaluation cannot be overstated. The extraarticular ligaments are not visible during typical arthroscopic

surgeries. Therefore, this division is crucial. On the other hand, meniscal tear identification can be challenging to interpret and depends on both the observer's and the scanner's sensitivity.[12,13]

Arthroscopy is a diagnostic and therapeutic treatment due to its excellent sensitivity and specificity. For the diagnosis of traumatic intraarticular injuries, arthroscopy is regarded as "the gold standard." Arthroscopy is a highly sensitive and specific diagnostic and therapeutic procedure; however, it is invasive and can lead to complications such as infection, hemarthrosis, adhesions, and reflex sympathetic dystrophy.[14] The most typical reason for a knee MRI is to diagnose internal derangements in an injured knee. Clinical examination can be challenging in cases of acute damage and inconclusive in numerous ligament/meniscal injuries. Because MRI is a non-invasive and extremely sensitive tool for research, it frequently detects early and subtle alterations in the soft tissues. Arthroscopy is a diagnostic and therapeutic treatment due to its excellent sensitivity and specificity. However, because it is intrusive and has risks, its usage as a diagnostic tool is limited.[15]In our study clinical examination showed sensitivity, specificity, PPV, NPV, accuracy of 80%,100%, 100%, 83.33%, 90% respectively for medial meniscus tear, 50%, 100%, 100%, 80%, 83.33% respectively for lateral meniscus tear and 88%, 100%, 100%, 62.5%,90% respectively for ACL tear. MRI findings showed sensitivity, specificity PPV, NPV, accuracy of 100%, 66.67%, 75%, 100%, 83.33% respectively for medial meniscus, 100%, 85%, 76.9%, 100%, 90% respectively for lateral meniscus tear,100%, 100%, 100%, 100%,100% respectively for ACL tear.

The diagnosis accuracy of clinical and MRI examinations in the case of ACL rupture was 90% and 100%, respectively, indicating that MRI was more sensitive than clinical evaluation. The sensitivity of MRI for identifying an ACL injury was 100 percent, while clinical testing had an 88 percent sensitivity. The NPV of the MRI examination was 100%, making it an excellent screening test. As a result, when the ACL was evaluated as normal on the MRI scan, it was always normal on arthroscopy. The PPV of the MRI examination was also 100%. The clinical examination had a high level of specificity, almost exceeding 100%. There was not a single clinical evaluation that resulted in a false positive. There was a comparable tear on arthroscopy whenever there was a clinical suspicion of ACL tear based on several clinical tests such as the Lachmann test or the anterior drawer test.

Overall, in the case of ACL tears, we believe MRI provides an advantage in cases where clinical tests are ambiguous, and we do not want to submit the patient to an invasive diagnostic arthroscopic surgery. MRI confirms the clinical diagnosis, and the patient can be scheduled for therapeutic arthroscopy.[16] In our study, the diagnostic accuracy of MRI for menisci was 88 percent (83.33 percent for MM and 90 percent for LM). In our investigation, the diagnostic accuracy of clinical examination (83 percent) was lower than that of MRI examination (88 percent). Previous investigations have revealed similar outcomes in terms of diagnostic accuracy. Clinical diagnosis of meniscus tears is typically 75-80% accurate, compared to MRI's 88-90 percent accuracy. Meniscal rips in the posterior horn are more likely to be missed during arthroscopy, mainly if the anterior route is employed and the menisci are not probed.

The inferior surface of the meniscus is especially sensitive to this arthroscopic defect. As a result, accepting MRI data as false positives is debatable. The cause of erroneous positive and false negative meniscal lesion diagnoses has been linked to MRI diagnostic errors and arthroscopic evaluation flaws.[13-15] Based on the correlation between clinical examination, MRI scan, and arthroscopy for meniscal and ACL injuries, we conclude that a comprehensive clinical examination can offer an equal or better diagnosis of meniscal and ACL injuries than an MRI scan. An MRI scan can rule out rather than diagnose such injuries. In both meniscal and ACL damage diagnoses, an MRI scan has a substantially more substantial NPV than a positive predictive value. When clinical indications and symptoms are ambiguous, an MRI scan is more likely to help you avoid unnecessary arthroscopic surgery. MRI scanning should not be used as a primary diagnostic tool for meniscal and ACL injuries. MRI has high sensitivity and a low false-negative rate, so it can be used to avoid diagnostic arthroscopy.[16] As a result, we conclude that MRI is a helpful non-invasive technique with excellent diagnostic accuracy, sensitivity, and NPV, making it a very reliable screening test for internal derangements at the knee joint. In cases where arthroscopy isn't an option, such as peripheral meniscus tears and inferior surface rips, MRI can help.[11] Multiple lesions are prevalent after an injury, but the difficulty in detecting them, aside from meniscal and ACL tears, has not been well discussed. Our findings show that when multiple lesions are present, the likelihood of correctly diagnosing all of them is extremely low (28 percent). Meniscal tears and osteoarthritis might have symptoms and indications that are similar to other conditions, but non-meniscal injuries are the most difficult to identify. Because articular cartilage lacks nerve fibers, chondral fractures are frequently misdiagnosed as meniscal tears.[11]

Limitations

Our study has some weaknesses; the duration of chronicity of the knee injuries is not considered in this study. Hence, this may contribute to a confounding error of Osteoarthritis knee associated with Degenerative Meniscal tear. As the skills of the surgeon and radiologists have a say in the numbers reported, the use of one surgeon in our study may potentially introduce a bias.

CONCLUSION

Appropriately evaluating knee injuries is critical for proper management and result; otherwise, the patient would suffer from persistent debility. Compared to arthroscopy

and MRI, clinical diagnostics for detecting ACL and meniscus problems have a high correlation. When clinical indications and symptoms are ambiguous, an MRI scan is more likely to be beneficial in avoiding unnecessary arthroscopic surgery. Using an MRI scan can significantly benefit the diagnosis of knee lesions. Most diagnostic studies comparing MRI and arthroscopy have found that MRI and arthroscopy have similar diagnostic performance in detecting meniscus and cruciate ligament lesions. When providing the best therapy for the patient, the surgeon's clinical expertise and competence are always the most important factors. Our research indicated that while an MRI scan can be used to confirm a diagnosis, a thorough and precise clinical examination is still the most crucial factor in detecting ligament and meniscal injuries. The sensitivity was much lower than the accuracy of diagnosing all lesions, which was in the 90th percentile. As a result, the capacity to interpret all of the information provided at arthroscopy, which must be thorough, and the findings must be compared to those of physical examination, is the most significant aspect to consider so that surgeons can improve their clinical expertise.

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