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A Comparative Analysis of Clinical Examination and Magnetic Resonance Imaging for the Accurate Diagnosis of Meniscal Tears.

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Abstract

Background: This study aimed to investigate the correlation between clinical assessments, MRI results, and arthroscopic findings in cases of meniscal injury. We compared various parameters between clinical assessments and MRI findings in suspected meniscal injury cases, with arthroscopy serving as the reference standard.

Method: A total of 60 patients presenting with knee pain were examined by an experienced orthopedic surgeon in our outpatient department. All suspected meniscal tear cases underwent clinical examination, MRI scanning, and arthroscopic evaluation to assess the relationship between clinical findings and MRI results, with arthroscopy findings considered as the gold standard.

Results: Clinical evaluation by an experienced orthopedic surgeon demonstrated higher sensitivity, specificity, accuracy, and negative and positive predictive values for diagnosing medial and lateral meniscus tears compared to MRI.

Conclusion: Clinical evaluation by an experienced orthopedic surgeon outperformed MRI in diagnosing meniscal injuries. MRI remains valuable for assessing complex knee injuries.

Keywords: Meniscus Injury, Clinical Examination, Magnetic Resonance Imaging, Arthroscopy Findings, Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value.

Introduction

Meniscal injuries are prevalent among intra-articular knee injuries, frequently necessitating surgical intervention by orthopedic surgeons. They represent a significant reason for orthopedic procedures. These injuries demonstrate a higher incidence in men compared to women, with a female-to-male incidence ratio ranging

between 4:1 and 2.5:1. The peak age of occurrence for both sexes is typically between 20 and 29 years old [1,2,3]. Meniscal lesions commonly manifest in the right knee [1] and can affect individuals of any age.

The primary pathophysiological and etiological factors vary considerably and are largely contingent upon the patient's age [4, 5]. In young patients, meniscal lesions frequently result from sports-related injuries, notably in individuals participating in soccer, skiing, baseball, basketball, and football. These activities contribute to over one-third of all meniscal injury cases [1, 2]. The majority of these injuries result from actions involving hyperextension, twisting, or cutting movements, as well as significant force. Notably, approximately 80% of meniscal tears during athletic activities coincide with anterior cruciate ligament tears. Additionally, the incidence of meniscal lesions in this age group is heightened by meniscal tears resulting from automotive accidents [1]. In middle-aged and older individuals, the majority of meniscal lesions arise from gradual wear and tear over time.

These lesions often lead to joint swelling, discomfort along the joint line, and mechanical obstruction. Given these symptoms, accurate diagnosis of meniscus injury is crucial to ensure appropriate treatment. Thorough history-taking and physical examination play pivotal roles in distinguishing patients with knee pain attributable to meniscus injury from those with other conditions [6, 7].

Magnetic resonance imaging (MRI) is widely regarded as the gold standard investigation for confirming meniscal tears [8, 9]. It is routinely employed to bolster the diagnosis of meniscus injuries before recommending diagnostic arthroscopy and subsequent surgical interventions. Moreover, relying solely on patient history is insufficient as a diagnostic tool, and the diagnostic accuracy of clinical tests for meniscus injuries has been subject to scrutiny. Existing literature presents conflicting results regarding their utility [10, 11].

Our objective was to assess and compare the sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of clinical examination and MRI in diagnosing meniscal tears, with arthroscopic findings serving as the reference standard.

Methods

Patients presenting to our outpatient department (OPD) with complaints of knee pain, locking, and instability between November 2022 and December 2023 were included in the study. A comprehensive history was obtained from each patient regarding their complaints. Suspected cases underwent clinical examination, radiological assessment, and arthroscopy. Exclusions from the study included patients with a history of previous knee surgery, traumas, fractures, or further knee injuries occurring between the time of MRI or clinical diagnosis and surgery. Each patient underwent a thorough clinical examination conducted by an experienced surgeon, including assessment of the site of tenderness and performance of the McMurray and Apley's tests, among others, to rule out alternative diagnoses.

To evaluate tenderness along the knee joint line on both medial and lateral sides, the patient was positioned supine, with the knee flexed at approximately a 90-degree angle. McMurray's test was conducted by initially flexing the knee beyond 90 degrees, followed by internal rotation of the tibia on the femur to assess the lateral meniscus. Subsequently, full external rotation of the tibia on the femur was performed to examine the medial meniscus. These maneuvers were executed with the knee

flexed to varying degrees to assess different aspects of the meniscus. Palpation was conducted along both the medial and lateral aspects of the joint line. A positive test result was indicated by either a "click" or "pain" experienced at the joint line [12].

Apley's test was performed with the patient lying prone on an examination table, with their knees flexed to a 90-degree angle. This positioning was chosen to ensure optimal assessment of the patient's posture. The examiner's knee was positioned over the posterior aspect of the patient's thigh, and the tibia was subjected to both external and internal rotation while being compressed against the knee joint. The examiner's knee remained positioned across the patient's thigh throughout the maneuver. A positive test result was indicated if the patient experienced pain during both the external rotation test, suggestive of medial involvement, and the internal rotation test, indicative of lateral involvement. Meniscal involvement was suspected when at least two of the three administered tests yielded positive results.

The grading systems proposed by Crues et al. [13] and Lotysch et al. [14] were utilized to assess meniscal injuries on MRI. Meniscal signal changes graded as 1 and 2, which do not extend to the articular surface, were not considered tears. In contrast, grade 3 signal intensity on MRI indicated abnormal signal extending to the articular surface. However, the diagnosis of a tear was not made until definitive observations of high-signal intensity reaching the articular surface were identified. A single abnormal image was deemed sufficient to identify a torn meniscus using MRI technology. The imaging protocol comprised sagittal T1, T2, GRE sequences; coronal T2, PD sequences; and axial T2 and GRE sequences. Fat suppression was achieved in all cases with T2 and PD sequences. MRI scans were reviewed by an experienced musculoskeletal radiologist who was blinded to the results of the orthopedic clinical evaluation.

The arthroscopic procedure was performed on the knee of each patient by an orthopedic surgeon with over fifteen years of experience in knee arthroscopy. Standard anterolateral and anteromedial portals were utilized. Prior to surgery, patients received spinal anesthesia, and a knee examination was conducted while under anesthesia. Clinical findings, as well as those from MRI and arthroscopy, were documented and compared. Specificity, sensitivity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were assessed, with arthroscopy serving as the gold standard.

Figure 1

Results

There were a total of 60 patients who took part in our study; 39 of them were male, and 21 of them were female. (Figure 2). Age group was between 18 to 50 years. In our study, Males are more in number than females who sustained meniscal injuries. In our study Right side involvement is most commonly seen than the left side (Figure 3).

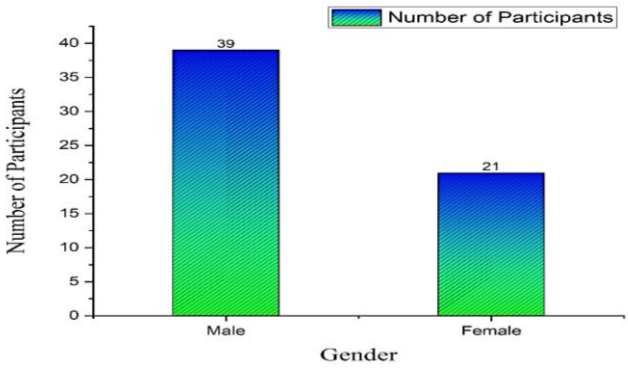

Figure 2: Number of participants in this study

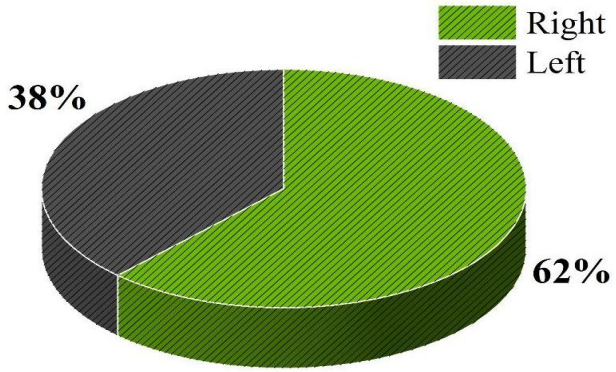

Figure 3

There were a total of 39 individuals who had a possible diagnosis of a tear in the medial meniscus. Among them, there were 25 True Positive cases [clinical diagnoses confirmed with arthroscopy]. 3 cases were False Negative [one positive clinical test with meniscal tear confirmed during Arthroscopy]. 3 were False Positive [positive clinical exam with no meniscal tear at arthroscopy]. 8 were True Negative. The results of the MRI examination showed that there were 7 True Negative patients, 5 False Positive patients, 4 True Positive patients, and 23 True Positive patients.

Table 1

Factors	Clinical Investigation (%)	MRI (%)
Specificity	73	58
Sensitivity	89	85
Accuracy	85	77
PPV	89	82
NPV	73	64

From Table 1, it is evident that clinical evaluation outperformed MRI in terms of specificity, sensitivity, accuracy, and positive and negative predictive values. This indicates that clinical examination was more reliable in correctly identifying the presence or absence of meniscal tears compared to MRI.

Out of the 21 cases suspected of lateral meniscus tears, clinical examination yielded True Positive results in 15 cases. There was 1 case classified as False Negative and 1 case as False Positive, while 4 cases were correctly identified as True Negatives. MRI, on the other hand, identified 7 True Negatives, 3 False Positives, 1 False Negative, and 10 True Positives among these cases.

Table 2

Factors	Clinical Investigation (%)	MRI (%)
Specificity	80	70
Sensitivity	94	91
Accuracy	90	81
PPV	94	77
NPV	80	87

As depicted in Table 2, MRI exhibited lower specificity, sensitivity, accuracy, as well as positive and negative predictive values compared to clinical evaluation. This suggests that clinical examination was more effective in accurately identifying the presence or absence of lateral meniscus tears than MRI.

Discussion

In our investigation into suspected meniscal tears, the diagnostic accuracy of clinical examination and MRI was assessed and compared, with arthroscopy serving as the gold standard. Sensitivity, specificity, accuracy, positive predictive value (PPV), and negative predictive value (NPV) were evaluated for both MRI and clinical evaluation, focusing on both the medial and lateral meniscus. Consistent with previous studies, our findings indicated a higher prevalence of right-side involvement in meniscal tears, aligning with research by MA Sweigart and KA Athanasiou on knee meniscus tissue engineering. The literature review revealed conflicting results regarding the diagnostic accuracy of clinical examination versus MRI scans. While Rose et al.

observed greater diagnostic accuracy with clinical evaluation, Mohan et al. reported high diagnostic accuracy rates for both medial and lateral meniscus tears with clinical examination. Similarly, our study results demonstrated superior diagnostic accuracy with clinical examination compared to MRI, consistent with prior research. Studies by Abdon et al. and Antinolfi et al. also supported the notion of clinical examination outperforming MRI in diagnosing meniscal tears, highlighting the importance of clinical evaluation in this context.

Table 3

Study	Diagnostic Accuracy of Clinical Investigation (%)
Mohan et al. [30]	88
Antinolfi et al. [41]	90
Abdon et al. [31]	61
Our study	85

Studies conducted by Rangger et al. [19] and Abdon et al. [17] have advocated for the routine use of MRI before knee arthroscopy in cases where a suspected meniscus tear is diagnosed clinically. This approach stems from the observation that various knee pathologies present with similar symptoms, underscoring the utility of MRI in confirming suspected meniscus tears. However, our study results suggest that thorough clinical examination conducted by experienced orthopedic surgeons in cases of suspected meniscal tears may offer superior diagnostic accuracy. Consequently, routine MRI scans for every suspected meniscus tear may not be necessary. Relying solely on MRI findings without clinical evaluation could lead to inappropriate treatment decisions. Moreover, our study found that MRI scans did not prevent unnecessary surgeries in any case, further supporting the importance of clinical evaluation in the diagnostic process.

Our study encountered several limitations, including a small sample size and a relatively short study period. Additionally, the inclusion of only patients who underwent MRI scans introduced a bias into the study. Furthermore, inherent verification bias was present as all patients had undergone an MRI scan before arthroscopy, potentially influencing the decision to proceed with arthroscopy. These limitations should be considered when interpreting the results of our study and may impact the generalizability of our findings. Future research with larger sample sizes and longer study durations, as well as a more balanced inclusion of patients regardless of MRI status, could provide a more comprehensive understanding of the diagnostic accuracy of clinical examination versus MRI in suspected meniscal tears.

Conclusion

In conclusion, our study underscores the effectiveness of clinical examination conducted by experienced orthopedic surgeons in accurately diagnosing meniscal injuries. When clinical examination findings strongly suggest meniscal injuries, routine MRI scans may be unnecessary. Depending solely on MRI without thorough clinical assessment may lead to diagnostic inaccuracies and inappropriate treatment decisions. Therefore, MRI should be reserved for cases of complex, equivocal or challenging knee injuries where clinical assessment alone is insufficient. By judiciously applying this expensive diagnostic tool, clinicians can optimize patient care while minimizing unnecessary healthcare costs and interventions.

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