

Sensitivity and Specificity of Magnetic Resonance Imaging (MRI) in Diagnosing Meniscal Tears of the Knee.

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ABSTRACT

Objective: To determine the sensitivity and specificity of Magnetic Resonance imaging (MRI) in diagnosing meniscal tears of the knee considering arthroscopy as gold standard.

Methods: This cross sectional study was conducted in Orthopaedic Department Aga Khan University Hospital Karachi from 17th August 2019 to 23rd February 2022. All adults patients with clinical diagnosis of medial or meniscal tears undergone MRI followed by arthroscopy. The Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Values (NPV) and accuracy of MRI was calculated using arthroscopic findings as gold standard.

Results: In this study 82 patients were included. Unilateral meniscal tears were present in 71(86.58%) and bilateral in 11(13.41%). The mean age 33.0 ± 11.4 years. Male patients were 61(74.39%) and females were 21(25.60%). The sensitivity and specificity of MRI for diagnosing medial meniscus tear was 96.2% and 80.5% respectively. MRI had accuracy of 89.8% in diagnosing medial meniscus tears with 86.2% PPV and 94.3% NPV respectively. The sensitivity and specificity of MRI for diagnosing lateral meniscus tear was 91.7% and 95.7% respectively. MRI had accuracy of 94.6% in diagnosing lateral meniscus tears with 88.0% PPV and 97.1% NPV respectively.

Conclusion: MRI was more sensitive but less specific for diagnosing medial meniscus tears. It had greater accuracy and greater PPV and NPV for diagnosing lateral meniscal tears than medial meniscal tears.

Keywords: Magnetic Resonance Imaging, Meniscal tear, Sensitivity, Specificity

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INTRODUCTION

Traumatic knee pain is a common presentations in Orthopedics and is usually due to sports injuries, falls and motor vehicle accidents.¹ Due to frequent sports activities and accidents in younger population the frequency of knee injuries including meniscal tears is on the rise.² Accurate diagnosis of meniscal and ligamentous injury is mandatory for optimum management because these injuries can result in knee instability and impairment of routine daily life activities.³ Currently arthroscopy is considered as the gold standard for diagnosis meniscal tears and has the advantage both a diagnostic as well as a therapeutic modality.^{4,5} However arthroscopy is invasive in nature and can have complications

including complications due to anaesthesia.⁶ Magnetic Resonance Imaging (MRI) for diagnosis of traumatic intra-articular knee injuries is continued to gain in popularity in recent times.^{7,8} MRI is non-invasive and has the capacity to diagnose a variety of knee injuries.⁹ The accuracy and reliability of MRI is however variable.⁵

The objective of our study was to determine the sensitivity and specificity of Magnetic Resonance Imaging (MRI) in diagnosing meniscal tears of the knee considering arthroscopy as gold standard.

METHODS

We conducted this cross sectional study in Orthopaedic Department Aga Khan University

Hospital Karachi from 17th August 2019 to 23rd February 2022. All adults of both gender 18 to 60 years of age with clinical diagnosis of medial or lateral meniscal tears of more than 3 weeks old were included. Patients with Anterior Cruciate Ligament (ACL), Posterior Cruciate Ligament (PCL) and collateral ligaments tears, infections, tumors and previous knee surgery were excluded. The study protocols were approved by the Ethical Review Committee of our hospital. Informed consent was obtained from all study participants. Complete history and clinical examination was done in all patients. McMurray's test¹⁰ was utilized to diagnose meniscal tear. All patients with positive McMurray's test had MRI (1.5 Tesla® Siemens - Munich, Germany) with contrast. All MRIs were reported by a qualified radiologists with at least 5 years of experience in reporting of musculoskeletal imaging. Following MRI the patients were booked for diagnostic arthroscopy on our elective operative list. The Arthroscopy was performed under general or spinal anaesthesia by an experienced arthroscopic and sports surgeon. Keeping the arthroscopy as gold standard for diagnosing meniscal tears the following definitions were adopted for calculations:

- True Positive (TP) = The investigation correctly identified Meniscal tear
- False Positive (FP) = The investigation incorrectly identified Meniscal tear although it was absent.
- True Negative (TN) = The investigation correctly identified the absence of meniscal tear.
- False Negative (FN) = The investigation incorrectly identified the absence of Meniscal tear although it was present.
- Sensitivity = $TP \times 100 / TP + FN$
- Specificity = $TN \times 100 / TN + FP$
- PPV = $TP \times 100 / TP + FP$
- NPV = $TN \times 100 / TN + FN$
- Accuracy = $TP + TN / TP + TN + FP + FN$

We analyzed our data with SPSS version 27. All qualitative variables were expressed as percentages while quantitative variables were represented as mean \pm standard deviation. The data was presented in tables where necessary.

Table III: Comparison of sensitivity, specificity, PPV, NPV and accuracy of medial and lateral meniscal tears.

S. No	Parameter (%)	Medial Meniscus	Lateral Meniscus
1	Sensitivity	96.2	91.7
2	Specificity	80.5	95.7
3	Positive Predictive Value (PPV)	86.2	88.0
4	Negative Predictive Value (NPV)	94.3	97.1
5	Accuracy	89.8	94.6

RESULTS

We included 82 patients in this study. Unilateral knee injuries were present in 71 (86.58%) and bilateral in 11 (13.41%). The mean age 33.0 ± 11.4 years. male patients were 61 (74.39%) and females were 21 (25.60%). The aetiology of meniscal tears were Sports injuries in 34 (41.46%) patients, road traffic accidents in 28 (34.14%) and falls in 20 (24.39%) patients.

Out of the 93 knees, medial meniscus tear was reported in 58 (62.36%) knees on MRI while 35 (37.63%) knees had normal MRI. (table I) Arthroscopy revealed 8 (8.60%) false positive and 2 (2.15%) false negative medial meniscus tears. The Sensitivity and Specificity of MRI for diagnosis of medial meniscus tears was 96.2% and 80.5% respectively with overall accuracy of 89.8%.

Table I: Comparison of medial meniscus tear on MRI and arthroscopy

MRI	Arthroscopy	
	Tear	Normal
Tear	50	8
Normal	2	33

Lateral meniscus tears were reported in 25 (26.88%) knees on MRI while in 68 (73.11%) knees had no tears on MRI (Table II). Arthroscopy revealed 3 (3.22%) false positive and 2 (2.15%) false negative lateral meniscus tears. The Sensitivity and Specificity of MRI for diagnosis of lateral meniscus tears was 91.7% and 95.7% respectively with overall accuracy of 94.6%. A comparison of all variables is shown in table III.

Table II: Comparison of lateral meniscus tear on MRI and arthroscopy.

MRI	Arthroscopy	
	Tear	Normal
Tear	22	3
Normal	2	66

DISCUSSION

In our study we documented that MRI was more sensitive but less specific for diagnosing medial meniscus tears. MRI had greater accuracy and greater PPV and NPV for diagnosing lateral meniscal tears than medial meniscal tears. We found variable results in literature. Anwar¹¹ reviewed the record of 258 patients and noted that MRI was 92% sensitive and 75% specific with 99% PPV, 23% NPV and 91.47% accuracy keeping arthroscopy as gold standard. Rahman and Nafees¹² reported the sensitivity and specificity of MRI for medial meniscus tears 89.4% and 62% respectively while for lateral meniscus the sensitivity was 87% and specificity 88%. They noted that the diagnostic accuracy was 76.4% for medial meniscus tear and 88.2% for lateral meniscus tear. Navali and colleagues¹³ evaluated the record of 120 patients and documented that MRI could detect medial meniscus tear with 84.2% sensitivity, 71.4% specificity and 77.5% accuracy. The sensitivity of MRI for detecting lateral meniscus tears had sensitivity of 56.5%, specificity of 92.8% and accuracy of 85.8%. Laorugthana⁵ did MRI of 50 patients followed by arthroscopy and noted that MRI had 100% sensitivity 52.6% specificity, 64% accuracy and 100% NPV for medial meniscus tear. For lateral meniscus tear they noted that MRI was 55.6% sensitive, 83.35% specific, 75.8% accurate and 83.3% NPV. In a systematic review by Crawford¹⁴ it was concluded that MRI was very accurate in diagnosing medial meniscus tear and should be the screening tool before arthroscopy. However the results of MRI in detecting medial meniscus tears, lateral meniscus tears and ACL tears were different with accuracy of 85%. Orlando¹⁵ did MRI and arthroscopy of 72 patients and noted sensitivity, specificity and accuracy of MRI for medial meniscus tears were 92.50%, 62.50% and 69.44% respectively. For lateral meniscus tear MRI had sensitivity of 65.00%, specificity 88.46% and accuracy 81.94%. These authors concluded that meniscus tears can be diagnosed accurately with physical examination and MRI should be advised in doubtful or complex knee injuries. Babalola¹⁶ compared MRI and arthroscopy in 77 patients and noted that sensitivity, specificity, PPV and NPV of MRI for medial meniscus tear was 87%, 79%, 70% and 82%. For lateral meniscus tears the values were 70%, 76%, 73% and 72% respectively.

Our study had small sample size. Further large sample size studies are therefore recommended to verify our results.

CONCLUSION

MRI was more sensitive but less specific for diagnosing medial meniscus tears. It had greater accuracy and greater PPV and NPV for diagnosing lateral meniscal tears than medial meniscal tears.

Conflict of Interest: None

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