ORIGINAL ARTICLE

DIAGNOSTIC ACCURACY OF MAGNETIC RESONANCE IMAGING FOR MENISCAL TEARS, TAKING ARTHROSCOPY AS THE GOLD STANDARD

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ABSTRACT

Objective: To evaluate the accuracy of magnetic resonance imaging (MRI) in detecting meniscal injuries, with arthroscopy as the gold standard.

Materials and Methods: We conducted this prospective observational study at Khyber Teaching Hospital from August 2024 to May 2025. A total of 263 adults, aged between 20 and 60 years, with symptoms suggestive of meniscal pathology, underwent MRI followed by arthroscopic confirmation. Diagnostic accuracy was evaluated using a 2×2 table to calculate diagnostic metrics for the medial and lateral meniscus separately. Statistical significance was assessed, and receiver operating characteristic (ROC) curves were constructed.

Results: Of 263 patients, 76.8% were male; the average age was 30 ± 4.32 years. MRI detected meniscal tears in 65.0% of patients, while arthroscopy confirmed them in 73.4%. For medial meniscal injuries, MRI showed a sensitivity of 60.9%, specificity of 44.9%, PPV of 68.4%, NPV of 37.0%, and diagnostic accuracy of 55.5%. For lateral meniscal injuries, sensitivity was 55.6%, specificity 95.6%, positive predictive value 66.7%, negative predictive value 93.1%, and diagnostic accuracy 90.1%. ROC analysis indicated an area under the curve of 52.9% for medial and 75.6% for lateral meniscus tears.

Conclusion: MRI demonstrates greater diagnostic accuracy and specificity in detecting lateral meniscal tears compared to medial tears. Due to lower sensitivity and specificity for medial meniscal injuries, arthroscopy remains crucial for a definitive diagnosis, especially in symptomatic patients with negative or inconclusive MRI results.

Keywords: Meniscal Injuries; Magnetic Resonance Imaging; Arthroscopy; Knee Joint; Diagnostic Accuracy; Sensitivity and Specificity; Medial Meniscus; Lateral Meniscus

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INTRODUCTION

Meniscal tears are clinically significant because the meniscus plays a crucial role in joint stabilization, shock absorption, and load distribution. A tear at the root of the meniscus or a meniscectomy can increase pressure on the articular cartilage, which may accelerate its wear and degeneration over time. [1] Accurate identification of the tear's location and type is vital for guiding treatment decisions and ensuring proper management. [2] Overall, meniscal tears are found in approximately 14.0% of patients with knee injury. [3]

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Magnetic resonance imaging (MRI) is a common tool for diagnosing meniscal tears. However, despite technological progress, many meniscal injuries remain undetected due to considerable variability in MRI's diagnostic accuracy. [4] The sensitivity of MRI for identifying ramp lesions, peripheral longitudinal tears, or menisco-capsular separations of the medial meniscus is approximately 65.1%. [5] A large percentage of lateral meniscus posterior root tears, ranging from 40% to 67.7%, are missed on MRI. Still, these findings are based on studies with relatively small patient groups undergoing ACL reconstruction. [6] Few studies have also explored MRI accuracy in detecting meniscal tears by their location and type. [7]

Limited regional data exists on the accuracy of MRI for diagnosing knee meniscal injuries. We aimed to assess MRI's accuracy in detecting meniscal tears, using arthroscopy as the gold standard. The results will offer practical insights for regional orthopedic surgeons, aiding in the differential diagnosis of patients with knee-related symptoms.

MATERIAL AND METHODS

We conducted this prospective observational study at Khyber Teaching Hospital, Peshawar, Pakistan, between August 2024 and May 2025. The sample size was calculated using Buderer's formula, incorporating a reported prevalence of meniscal injury at 14.0%, with a sensitivity of 89.3 and a specificity of 91.8%, a 95% confidence level, and a 10% error margin, enrolling 263 patients for the study. [3]

A non-probability, consecutive sampling method was used to enroll patients aged 20 to 60 years, of any gender, who met specific criteria. Patients were included if they were classified as American Society of Anesthesiology (ASA) Grade I or II, had knee pain for more than three weeks, displayed clinical signs of instability, had a pain score above four on the visual analogue scale, or had a persistently swollen, injured knee lasting more than 12 weeks compared to the other side. Exclusion criteria included a body mass index exceeding 30, prior knee surgery, multi-ligamentous injuries, rheumatoid arthritis, osteoarthritis, open or closed knee fractures, or systemic conditions associated with knee pain.

After obtaining ethical approval, patients were recruited from the outpatient department. Written informed consent was obtained before enrollment. Demographic and clinical data, including age, weight, height, BMI, gender, and symptom duration, were recorded. A thorough clinical history was documented, followed by a detailed physical examination conducted by a senior orthopedic surgeon. All patients with suspected meniscal tears underwent MRI, which was interpreted by a radiologist with over five years of experience. MRI was performed on a 1.5 Tesla Magnetom scanner using a dedicated knee coil. The imaging protocols followed departmental guidelines, employing multi-planar, multi-sequential sequences. MRI findings were considered positive if a high-intensity intra-meniscal signal extended to at least one articular surface on a minimum of two consecutive slices, or if there was any distortion in normal meniscal morphology. A sports and arthroscopy surgeon then performed an arthroscopic evaluation. MRI findings were compared with those of arthroscopy, which served as the definitive standard for diagnosing meniscal tears. [8]

Data analysis was conducted using SPSS version 24.0. Continuous variables were presented as means and standard deviations, while categorical variables were shown as frequencies and percentages. A 2×2 contingency table was employed to evaluate diagnostic accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Ninety-five percent confidence intervals (CIs) were calculated for these metrics. The McNemar test for correlated proportions was used to determine statistically significant differences in specificity and sensitivity; all statistical analyses were conducted to assess whether MRI performance differed significantly from that of arthroscopy. To further evaluate MRI's diagnostic accuracy, receiver operating characteristic (ROC) curves were plotted, comparing sensitivity and specificity to those of arthroscopy. Statistical significance was set at $p < 0.05$. The report was prepared in accordance with the 2015 Standards for Reporting of Diagnostic Accuracy Studies (STARD) guidelines. [9]

RESULTS

Overall, 263 patients were included in the study. Baseline demographic and clinical characteristics are summarized in Table 1, while the patient flow during the study is depicted in Figure 1. Radiological assessment via MRI revealed meniscal tears in 65% of patients (n=171), while 35% (n=92) showed no tears. Arthroscopic evaluation identified meniscal tears in 73.4% (n=193) and no tears in 26.6% (n=70). MRI identified 14 lateral meniscal tears, 16 involving both medial and lateral menisci, and 141 medial tears. In comparison, arthroscopy found 17 lateral tears, 19 involving both compartments, and 157 medial tears. Overall, medial meniscal injuries were detected in 58.9% (n=155) and lateral in 11.4% (n=30) on MRI, while arthroscopy confirmed medial injuries in 66.2% (n=174) and lateral in 13.7% (n=36).

The diagnostic accuracy of MRI was determined through a 2×2 contingency table. (Tables 2 and 3). The ROC curve showed an area under the curve (AUC) of 52.9% (95% CI: 45.5%–60.3%) for the medial meniscus and 75.6% (95% CI: 65.2%–85.9%) for the lateral meniscus (Figure 2). Additionally, stratification by age and injury mechanism did not show a statistically significant differ-

Table No 1: Demographic characteristics of participants at baseline

Characteristics		Values
Total cases		263 (100%)
Sex	Male	202 (76.8%)
	Female	61 (23.1%)
Age (years)		30 ± 4.32
Weight (kg)		74 ± 7.66
Height (meters)		1.6 ± 0.19
BMI (kg/m^2)		23.3 ± 4.04
Duration of symptoms (months)		11 ± 3.39
Age groups (years)	20–25	88 (33.5%)
	26-30	79 (30.0%)
	31-35	67 (25.5%)
	36-40	26 (9.9%)
	>40	3 (1.1%)
Injury mechanism	Road Traffic Accident	139 (52.8%)
	Fall form height	80 (30.4%)
	Sports related	44 (16.7%)

Kgs: kilograms; BMI: body mass index

Table No 2: Contingency table for diagnostic accuracy of MRI against arthroscopy

		Meniscal injury on Arthroscopy		χ^2 (P-value)
Medial Meniscal injury on MRI		+	-	3.08 (0.08)
	+	106 (40.3%)	49 (18.6%)	
	-	68 (25.9%)	40 (15.2%)	
Lateral Meniscal injury on MRI	+	20 (7.6%)	10 (3.8%)	1.38 (0.24)
	-	16 (6.1%)	217 (82.5%)	

Table No 3: Metrics for MRI diagnostic test accuracy

MRI	Medial Meniscus injury (95% CI)	χ^2 (p-value)	Lateral Meniscus injury (95% CI)	χ^2 (p-value)
Sensitivity	60.9% (53.5%, 68.0%)	271.2 (<0.01)	55.6% (39.4%, 71.0%)	45 (<0.01)
Specificity	44.9% (34.9%, 55.3%)	72.6 (<0.01)	95.6% (92.4%, 97.8%)	4925.9 (<0.01)
PPV	68.4% (68.8%, 75.4%)	335.3 (<0.01)	66.7% (48.9%, 81.7%)	60 (<0.01)
NPV	37.0% (28.3%, 46.4%)	63.5 (<0.01)	93.1% (89.4%, 95.9%)	3160.1 (<0.01)

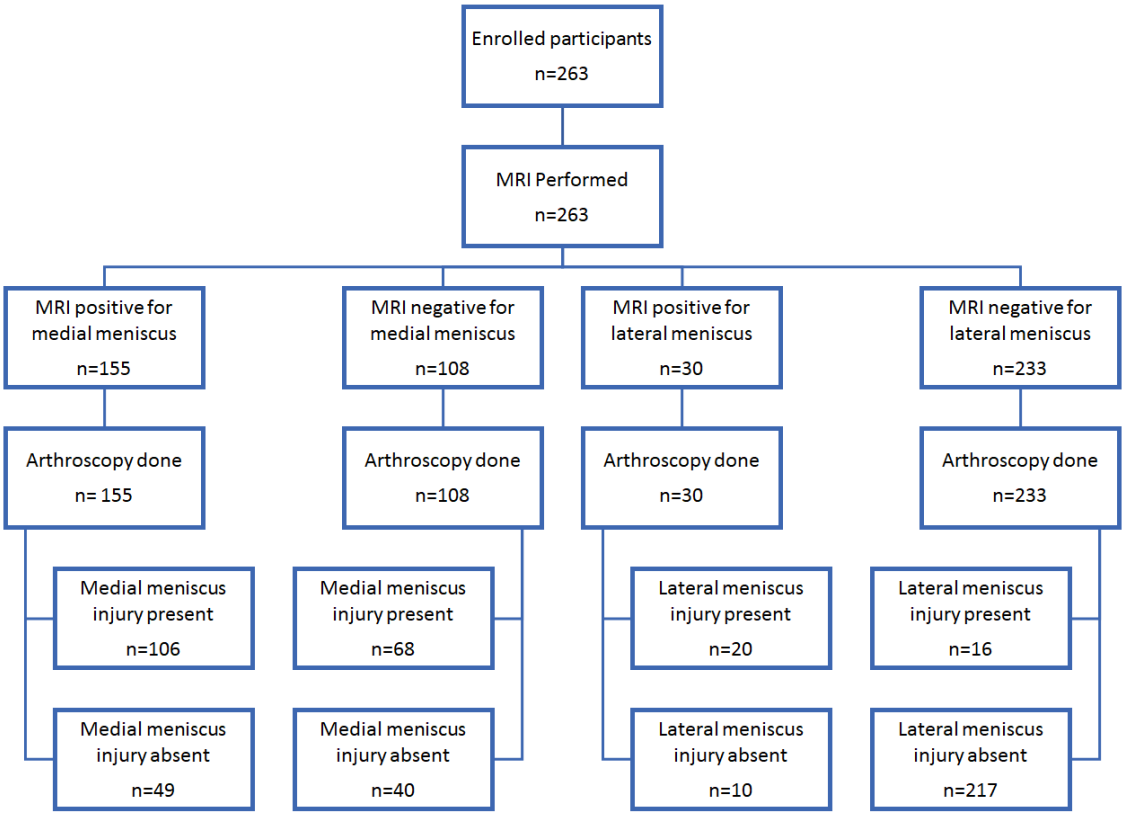

Fig 1: Patient flow chart in the study

ence in diagnostic accuracy between subgroups ($p > 0.05$).

DISCUSSION

This study assessed the accuracy of MRI in detecting meniscal tears, using arthroscopic findings as the gold standard. The results showed significantly higher diagnostic accuracy for lateral meniscal injuries (90.1%) compared to medial injuries (55.5%). While MRI demonstrated moderate sensitivity and low specificity for medial tears (60.9% and 44.9%, respectively), its performance was considerably better for lateral tears, with a specificity of 95.6% and sensitivity of 55.6%. These findings follow a consistent trend seen in previous research, suggest-

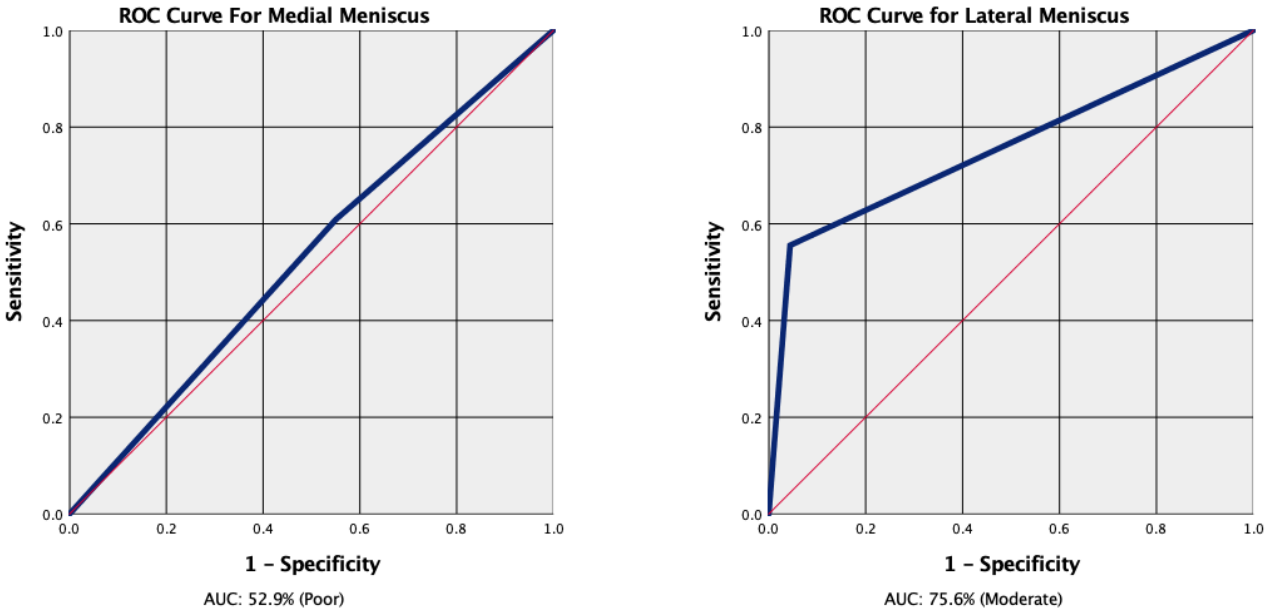

Fig 2: ROC analysis of MRI findings benchmarked against arthroscopic diagnosis

ing that MRI may be more reliable for identifying lateral meniscal injuries than medial ones, especially in our regional setting. [10] The relatively low NPV for medial injuries (37.0%) raises concerns about missed diagnoses if MRI is used alone for medial meniscus evaluation.

Our findings align with previous studies that investigated the same research question. For example, a survey by Sajid et al. [11] reported a sensitivity of 77.4% and a specificity of 44.9% for medial meniscal injuries, and a sensitivity of 66.7% and a specificity of 65.3% for lateral meniscal injuries on MRI. These results demonstrate MRI's usefulness as a screening tool, although arthroscopy remains the definitive diagnostic method. Similarly, Porter and Shadbolt [12] found moderate agreement between MRI and arthroscopy, with Kappa scores of 0.41 for medial and 0.44 for lateral meniscal tears, indicating that clinical assessment may be more accurate for lateral meniscal tears. Additionally, studies by Hatayama et al. [13] have highlighted the recurring issue of missed posterior horn or ramp lesions, emphasizing MRI's limitations in detecting specific meniscal pathologies. Klein and Solomon also noted that while arthroscopy is the gold standard for diagnosing meniscal ramp lesions, high-quality MRI can still be helpful, especially when associated injuries are highly suspected. [14]

For sports surgeons, MRI is a valuable non-invasive tool for detecting meniscal injuries. However, its limitations, particularly in identifying medial meniscal tears and specific lesion types like ramp lesions, require careful interpretation. [13] There are many clinical situations where patients experience persistent knee symptoms—such as joint line tenderness, mechanical locking, or swelling—despite negative MRI results. In these cases, clinical suspicion should outweigh imaging findings, leading to consideration of diagnostic arthroscopy. [12, 15] Arthroscopy remains the most reliable method for diagnosis, especially when MRI results are inconclusive or do not align with clinical signs. Delaying arthroscopic evaluation in symptomatic patients can lead to missed diagnoses of treatable meniscal injuries, which may cause ongoing discomfort and joint deterioration. [12] Therefore, combining clinical assessment with imaging is crucial, and when uncertainty remains, proceeding with arthroscopy ensures accurate diagnosis and appropriate treatment.

Advancements in MRI field strength and imaging techniques continue to transform how we diagnose meniscal tears. A direct comparison study found that the sensitivity and specificity for medial and lateral meniscal tears were nearly identical between 1.5 T and 3 T MRI; for example, medial tears had approximately 92.7% sensitivity at 1.5 T and 92.6% at 3 T. Lateral tear specificity was also similar (~95.2% vs ~91.8%), with the nature of diagnostic errors (false positives/negatives) resembling each other across field strengths. [16] Meta-analyses further confirm that

the overall diagnostic performance for meniscal lesions (e.g., AUC ~0.97) does not significantly differ between 1.5 T and 3 T MRI. [17] This suggests that MRI protocol quality and reader expertise often influence the results more than magnetic field strength alone. [17, 18] However, enhanced 3D isotropic imaging and high-resolution sequences provide practical benefits, such as multi-planar reformats, better control of partial-volume effects, and improved detection of complex tear types, like root or radial lesions, even if routine diagnostic accuracy isn't significantly increased. [16, 18] Given resource differences across regions, the most practical approach is to optimize existing 1.5 T protocols and, when possible, incorporate advanced sequences rather than assuming 3 T systems are inherently superior.

Alongside advances in hardware, artificial intelligence (AI) is quickly becoming an important tool for interpreting meniscal MRI. A recently developed knowledge-distillation deep learning framework, trained on paired MRI and arthroscopy data, showed notable performance improvements: the distilled "student" model achieved higher accuracy (~0.764 vs 0.734), sensitivity (~0.838 vs ~0.733), and F1-score for detecting medial and lateral tears compared to its undistilled version. [19] Another crossover study found that physicians assisted by a DL algorithm (Keros®) significantly increased sensitivity for medial meniscus tears (91% vs 83%, p = 0.04) without sacrificing specificity, and also improved ACL tear specificity with AI assistance. [20] Additionally, broader deep learning-based diagnostic models using MRNet and other datasets are showing around 93–94% AUC in meniscus injury detection, matching or even surpassing general radiologist performance. [21, 22]

Together, these developments show promise for enhancing diagnostic consistency and efficiency. The integration of AI and DL tools could help reduce inter-observer variability, especially in settings where sub-specialty musculoskeletal radiology is limited. [21] From a health economics perspective, more reliable MRI-based diagnostics may lower unnecessary diagnostic arthroscopies and associated morbidity, but the cost–benefit balance must be assessed carefully. Some pathways (e.g., primary care to arthroscopy mapping) suggest MRI might decrease procedural rates and costs, while others (e.g., direct-to-arthroscopy via needle scopes) could be more effective. [23] Clinically, the best practice remains combining clinical history, focused physical examination, and enhanced MRI, potentially supported by AI, to guide decision-making, with arthroscopy reserved for cases with conflicting or unclear findings. This integrated approach maximizes both accuracy and resource efficiency.

Our findings also have important implications for patient outcomes and rehabilitation. Missing medial meniscal tears on MRI can delay timely treatment, potentially leading to faster cartilage breakdown, ongoing pain, and early osteoarthritis. An accurate diagnosis is essential not only for surgical planning but also for designing rehabilitation strategies to preserve the joint. In symptomatic patients, early arthroscopic confirmation of inconclusive MRI results could prevent chronic disability. These points emphasize that imaging accuracy directly impacts both short-term recovery and long-term joint health, highlighting the broader clinical significance of our study's results.

This study is limited by its conduction at a single center, potential inter-observer variability in MRI interpretation, and reliance on non-probability sampling, which may introduce bias. Future research should focus on multi-center trials, utilizing higher-field MRI machines, exploring advanced imaging sequences, or incorporating radiomics and artificial intelligence to improve the detection and characterization of meniscal injuries. Given the limited regional data on MRI accuracy for meniscal injuries in Pakistan, especially in Khyber Pakhtunkhwa, this study provides valuable insights to help orthopedic surgeons improve triage and resource management. Establishing standardized MRI protocols across centers is essential for enhancing diagnostic confidence and consistency.

CONCLUSION

MRI remains a valuable, non-invasive diagnostic tool for assessing suspected meniscal injuries; however, its moderate diagnostic accuracy, especially for medial meniscal tears, requires careful interpretation. Our findings highlight the importance of not relying solely on MRI results in clinical decision-making, particularly when patient symptoms and examination findings strongly suggest intra-articular pathology. Arthroscopy continues to be the definitive diagnostic standard and should be considered promptly in cases of suspected meniscal injury, even if the MRI is inconclusive or negative.

REFERENCES

1. Kim DH, Lee GC, Kim HH, Cha DH. Correlation between meniscal extrusion and symptom duration, alignment, and arthritic changes in medial meniscus posterior root

tear: research article. Knee Surg Relat Res. 2020;32(1):2-9.

2. Luvsannyam E, Jain MS, Leitao AR, Maikawa N, Leitao AE. Meniscus Tear: Pathology, Incidence, and Management. Cureus. 2022;14(5):e25121-7.

3. Kim SH, Lee HJ, Jang YH, Chun KJ, Park YB. Diagnostic Accuracy of Magnetic Resonance Imaging in the Detection of Type and Location of Meniscus Tears: Comparison with Arthroscopic Findings. J Clin Med. 2021;10(4):606-11

4. Bumberger A, Koller U, Hofbauer M, Tiefenboeck TM, Hajdu S, Windhager R, et al. Ramp lesions are frequently missed in ACL-deficient knees and should be repaired in case of instability. Knee Surg Sports Traumatol Arthrosc. 2020 Mar;28(3):840-54.

5. Moreira J, Almeida M, Lunet N, Gutierres M. Ramp lesions: a systematic review of MRI diagnostic accuracy and treatment efficacy. J Exp Orthop. 2020;7(1):71-89.

6. Wong KP, Han AX, Wong JL, Lee DY. Reliability of magnetic resonance imaging in evaluating meniscal and cartilage injuries in anterior cruciate ligament-deficient knees. Knee Surg Sports Traumatol Arthrosc. 2017;25(2):411-7.

7. Felli L, Garlaschi G, Muda A, Tagliafico A, Formica M, Zanirato A, et al. Comparison of clinical, MRI and arthroscopic assessments of chronic ACL injuries, meniscal tears and cartilage defects. Musculoskelet Surg. 2016;100(3):231-8.

8. Speziali A, Placella G, Tei MM, Georgoulis A, Cerulli G: Diagnostic value of the clinical investigation in acute meniscal tears combined with anterior cruciate ligament injury using arthroscopic findings as golden standard. Musculoskelet Surg. 2016, 100:31-5.

9. Cohen JF, Korevaar DA, Altman DG, Bruns DE, Gatsonis CA, Hooft L, Irwig L, Levine D, Reitsma JB, de Vet HC, Bossuyt PM. STARD 2015 guidelines for reporting diagnostic accuracy studies: explanation and elaboration. BMJ Open. 2016 Nov 14;6(11):e012799.

10. Shahrukh Q, Sherjeel Khan O, Azim Q, Jawad Mufti A, Askar Z. Diagnostic Accuracy of Plain Magnetic Resonance Imaging of Cruciate Ligaments and Meniscal Injuries keeping Arthroscopy as Gold Standard. Khyber Med Univ J [Internet]. 2023 Mar. 31 [cited 2025 May 28];15(1):44-8.

11. Sajid M, Uppal M, Bajwa Z, Tahseen R. Diagnostic accuracy of magnetic resonance imaging (MRI) for meniscal knee injuries taking arthroscopy as the gold standard. Biol Clin Sci Res J. 2023;325.

12. Porter M, Shadbolt B. Accuracy of standard magnetic resonance imaging sequences for meniscal and chondral lesions versus knee arthroscopy. A prospective case-controlled study of 719 cases. ANZ Journal of Surgery. 2021 Jun;91(6):1284-9.

13. Hatayama K, Terauchi M, Saito K, Aoki J, Nonaka S, Higuchi H. Magnetic resonance imaging diagnosis of medial meniscal ramp lesions in patients with anterior cruciate ligament injuries. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2018 May 1;34(5):1631-7.

14. Klein E, Solomon D. Editorial commentary: Arthroscopy is the gold standard for diagnosis of meniscal ramp lesions: Magnetic resonance imaging also may be helpful. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2023 Mar 1;39(3):600-1.

15. Khan L, Shahrukh Q, Roghani AS, Ghaffar S, Hassan RE, Shah SS, Khan H, Tarangi IS, Ali A, Shahrukh III Q, Ali Sr A. Diagnostic Accuracy of McMurray's Test for Meniscal Injury of the Knee Joint, Taking Arthroscopy as the Gold Standard. Cureus. 2025 May 12;17(5).

16. Grossman JW, De Smet AA, Shinki K. Comparison of the accuracy rates of 3-T and 1.5-T MRI of the knee in the diagnosis of meniscal tear. American Journal of Roentgenology. 2009 Aug;193(2):509-14.

17. Juratović B, Dolić K. Comparison 1.5 T and 3T Magnetic Resonance in the Diagnostics of Knee. Radiološki vjesnik: radiologija, radioterapija, nuklearna medicina. 2021 Nov 29;45(2):2-10.

18. Nouri N, Bouaziz MC, Riahi H, Mechri M, Kherfani A, Ouertatani M, Ladeb MF. Traumatic meniscus and cruciate ligament tears in young patients: A comparison of 3T versus 1.5 T MRI. Journal of the Belgian Society of Radiology. 2017 Mar 29;101(1):14.

19. Ying M, Wang Y, Yang K, Wang H, Liu X. A deep learning knowledge distillation framework using knee MRI and arthroscopy data for meniscus tear detection. Frontiers in Bioengineering and Biotechnology. 2024 Jan 15;11:1326706.

20. Behr J, Nich C, D'Assignies G, Zavastin C, Zille P, Herpe G, Triki R, Grob C, Pujol N. Deep learning-assisted detection of meniscus and anterior cruciate ligament combined tears in adult knee magnetic resonance imaging: a crossover study with arthroscopy correlation. International Orthopaedics. 2025 Jul;49(7):1689-97.

21. Kostadinov M, Lameski P, Kulakov A, Pires IM, Coelho PJ, Zdravevski E. Enhancing Knee Meniscus Damage Prediction from MRI Images with Machine Learning and Deep Learning Techniques. InInternational Conference on ICT Innovations 2023 Sep 24 (pp. 141-155). Cham:

Springer Nature Switzerland.

22. Botnari A, Kadar M, Patrascu JM. A comprehensive evaluation of deep learning models on knee MRIs for the diagnosis and classification of meniscal tears: a systematic review and meta-analysis. Diagnostics. 2024 May 24;14(11):1090.

23. Chou YT, Lin CT, Chang TA, Wu YL, Yu CE, Ho TY, Chen HY, Hsu KC, Lee OK. Development of artificial intelligence-based clinical decision support system for diagnosis of meniscal injury using magnetic resonance images. Biomedical Signal Processing and Control. 2023 Apr 1;82:104523.

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Authors Contribution:

Following authors have made substantial contributions to the manuscript as under

Authors	Conceived & designed the analysis	Collected the data	Contributed data or analysis tools	Performed the analysis	Wrote the paper	Other contribution
Ali A	✓	✓	×	×	✓	×
Ali A	✓	×	✓	✓	✓	×
Hassan RE	✓	✓	×	×	×	✓
Khan NA	✓	×	✓	✓	✓	×
Ali W	✓	✓	×	×	×	✓
Ali W	✓	×	✓	✓	✓	×

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethical Approval:

This Manuscript was approved by the Ethical Review Board of Khyber Medical College, Peshawar. Vide No. 599/DME/KMC. Dated: 01 08 2024

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