International Journal of Research in Orthopaedics
Singh R et al. Int J Res Orthop. 2025 Sep;11(5):1043-1048
http://www.ijoro.org

Original Research Article

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20252513

A comparative study of magnetic resonance imaging and arthroscopic findings in the diagnosis and management of meniscal lesions

Rakesh Singh[1], Rajat Saran[1], Nisha Singh[2]*

[1]Department of Orthopaedics, RKDF Medical College, Sarvepalli Radhakrishnan University, Bhopal, Madhya Pradesh, India
[2]Department of Community Medicine, Index Medical College, Hospital and Research Centre, Malwanchal University, Indore, Madhya Pradesh, India

Received: 20 July 2025
Accepted: 08 August 2025

***Correspondence:**
Dr. Nisha Singh,
E-mail: nisha.singh106@gmail.com

ABSTRACT

Background: Meniscal injuries are the most common types of knee injuries, particularly in athletes and individuals with physically demanding activities. Meniscal lesions can be assessed by either magnetic resonance imaging (MRI) or arthroscopy. There is a pressing need to compare the findings of MRI and arthroscopy to optimize the diagnostic process, which is critical in determining the most appropriate treatment, whether conservative or surgical.
Methods: The aims of this study was to evaluate the MRI and arthroscopy findings in patients with meniscal injuries of knee joint and to compare and assess the clinical significance of MRI and arthroscopic findings in the management of Meniscal Injuries. Hospital based observational study conducted on 50 patients with knee injury ranging from 18 to 60 years after obtaining written informed consent. Participants recruited by non- probability convenience sampling. Those with local infections or neoplasms, those having contraindications to MRI and unfit for anaesthesia were excluded from the study. Data collected using semi- structured questionnaire after pilot testing. Data entered into Microsoft excel and analyzed using Stata 17.0. Diagnostic accuracy analysis viz., sensitivity and specificity assessments for MRI and arthroscopy were conducted.
Results: Mean age of study participants was 34.6 years and 70% were males. Grade III meniscal tears were the most common (42%). The sensitivity and specificity of MRI was 89.6% and 100% respectively indicating that it correctly identified a high proportion of true meniscal tears and ruled out meniscal injury in all patients without tear.
Conclusions: MRI is a highly accurate, non-invasive diagnostic tool for detecting meniscal injuries.

Keywords: Magnetic resonance imaging, Arthroscopy, Meniscal injury, Meniscal tears

INTRODUCTION

The meniscus is a crescent-shaped fibrocartilaginous structure in the knee joint that plays a crucial role in load distribution, shock absorption, and joint stability.[1] Meniscal injuries are among the most common types of knee injuries, particularly in athletes and individuals with physically demanding activities.[2] Meniscal tears can result from traumatic events such as sports injuries such as football, basketball, and rugby, where sudden twisting or pivoting movements of the knee increase the risk of injury or from degenerative changes associated with aging. Clinically, these injuries can lead to pain, swelling, restricted range of motion, and impaired knee function, significantly affecting a patient's quality of life.[3] Risk factors for meniscal injuries include traumatic events, such as sports-related collisions, falls, or sudden changes in direction, and intrinsic factors like age-related degeneration.[4-6] Other factors, such as obesity, joint misalignment, and previous knee injuries, may also predispose individuals to meniscal tears.[4-6] Proper diagnosis is critical for determining the appropriate treatment plan and avoiding long-term complications.

Two primary diagnostic modalities are used to assess meniscal lesions: magnetic resonance imaging (MRI) and arthroscopy. MRI is a non-invasive imaging technique that provides detailed visualization of soft tissues, including the meniscus, ligaments, and cartilage.[7,8] It is widely used as a first-line diagnostic tool due to its high sensitivity and ability to detect not only meniscal tears but also concurrent knee pathologies.[7,8] Arthroscopy, on the other hand, is an invasive procedure considered the gold standard for diagnosing and treating intra-articular knee conditions, including meniscal injuries.[9,10] It allows for direct visualization of the meniscus and if necessary, immediate surgical intervention. Comparing the diagnostic efficacy of MRI and arthroscopy is crucial to improving patient outcomes, as it can guide the choice between conservative management and surgical repair.

There is a pressing need to compare the findings of MRI and arthroscopy to optimize the diagnostic process. Accurate diagnosis is critical in determining the most appropriate treatment, whether conservative or surgical. By comparing MRI and arthroscopic findings, this study seeks to evaluate which modality offers superior diagnostic accuracy, thus aiding clinicians in making better-informed decisions. The findings of this study will help bridge the current knowledge gap and provide clinicians with clearer guidelines on when to rely on MRI and when arthroscopy should be prioritized for accurate diagnosis and optimal patient care. The aims and objectives of this study are: to evaluate the MRI findings in patients with meniscal injuries of knee joint, to evaluate the arthroscopic findings in patients with meniscal injuries of the knee joint, and to compare and assess the clinical significance of MRI and arthroscopic findings in the management of meniscal injuries.

METHODS

A hospital based, prospective, observational study was conducted at the Department of Orthopaedics, RKDF Medical College Hospital and Research Centre, Jatkhedi, Bhopal, Madhya Pradesh, India. Prior to conducting the study, ethical approval was obtained from the Institutional Ethical Committee to ensure compliance with ethical standards. The study adhered to the principles outlined in the Declaration of Helsinki, ensuring the protection of participants' rights, safety, and confidentiality. Written informed consent was obtained from all participants before inclusion in the study by the investigator using a detailed bilingual consent form in Hindi and English. The total duration of the present study was 18 months, divided into three phases: planning phase (3 months), participant recruitment and data collection phase (12 months), and data analysis and report writing phase (3 months). The participants for the present study were patients aged 18 to 60 years presenting with clinical signs and symptoms suggestive of meniscal injuries, undergoing diagnostic evaluations such as MRI and arthroscopy and willing to participate in the study. Patients with age below 18 years or above 60 years, those with local infections or neoplasms, those having contraindications to MRI and unfit for anaesthesia were excluded from the study.

Participants were selected based on their availability and willingness to participate during the recruitment period, provided they met the inclusion criteria. Eligible participants were recruited in the study based on their clinical presentation of traumatic knee injuries. The inclusion criteria were assessed systematically, including age, type of injury, and the ability to undergo both MRI and arthroscopy. Non-probability convenience sampling was employed for this study. The minimum required sample size for the study was calculated as follows.

Based on a prevalence of 12-14% for meniscal injuries from previous studies.

$$Sample\ size\ (n) = Z^2PQ/D^2[P = Prevalence, Q = (1 - P)]$$

$$So, (n) = (1.96)^2 \times 0.12 \times 0.88/(0.9)^2 = 0.406/0.0081 = 50$$

Following this approach, a total of 50 participants were included in the study.

The research objectives and variables were identified to create a comprehensive framework for data collection. The data collection form included sections to record demographic details, clinical history, MRI findings, arthroscopy results, treatment plans, and other relevant parameters. The form was pilot-tested on a small group of participants to ensure clarity, completeness, and reliability. Feedback from the pilot test was incorporated to refine the form, ensuring it captured all necessary data accurately and efficiently. Completed forms were verified for completeness and accuracy by the study supervisor. Any inconsistencies or missing information were resolved by consulting the respective data sources or conducting follow-up evaluations with the participants.

The data was initially entered into Microsot Excel and imported into Stata 17.0. All the statistical and graphical analyses for this study were undertaken using Stata software version 17.0. Descriptive statistics summarized participant demographics and clinical characteristics. Diagnostic accuracy analysis viz., sensitivity and specificity assessments for MRI and arthroscopy were conducted.

RESULTS

Table 1 illustrates the distribution of the study participants according to demographic and clinical characteristics. This study was conducted on patients with age ranging from 18 to 60 years with a mean age of 34.6 years at the time of admission. Out of the total 50 individuals, the majority (34%) were in the 41–50 years age group, followed by 28% in the 21–30 years group. Participants aged 31–40 years comprised 18% of the sample, while those aged 51–

60 years accounted for 12%. The least represented age group was 11–20 years, comprising only 8% of the participants. This indicates that meniscal injuries were more frequently observed in middle-aged adults within the study population. As far as gender is concerned, out of the 50 patients included in the study, 35 (70%) were male and 15 (30%) were female. This finding shows a higher occurrence of meniscal injuries among males compared to females in this study. The table also shows the distribution of the injured knee side among the study participants, wherein, 28 (56%) had injuries to the right knee, while 22 (44%) had left knee involvement. This indicates a slightly higher occurrence of right-sided meniscal injuries in the study population. Table 1 also illustrates the mechanism of knee injury. Road traffic accidents (RTA) and falls were the most common causes, each accounting for 28% of the cases. Twisting injuries were observed in 24% of participants, while sports-related injuries were reported in 20%. These findings suggest that both high-impact trauma and indirect mechanisms such as twisting contribute significantly to the development of meniscal injuries.

Table 1: Table illustrating the distribution of the study participants according to demographic and clinical characteristics (n=50).

Variables	N (%)
Age (in completed years)	
11-20	4 (8)
21-30	14 (28)
31-40	9 (18)
41-50	17 (34)
51-60	6 (12)
Gender	
Male	35 (70)
Female	15 (30)
Side of injured knee	
Left	22 (44)
Right	28 (56)
Mechanism of inury	
Sports	10 (20)
RTA	14 (28)
Fall	14 (28)
Twisting	12 (24)

Figure 1 depicts the MRI-based characteristics of meniscal tears in the study population. Horizontal tears were identified in 36% of participants, vertical tears in 38%, and complex tears in 26%. Regarding the location, lateral meniscal tears were more common (56%) than medial tears (36%), while both menisci were involved in 8% of cases. On arthroscopic evaluation, longitudinal and flap tears were each observed in 28% of participants, bucket handle tears in 26%, and radial tears in 18%. These findings reflect a varied pattern in the type and site of meniscal tears, with lateral meniscus involvement being more frequent. Figure 2 highlights the arthroscopic findings related to meniscal tears. Vertical tears were the most commonly observed type, seen in 38% of participants, followed by complex tears in 30% and horizontal tears in 28%. In only 4% of cases, no meniscal tear was detected during arthroscopy. These results reinforce the role of arthroscopy as a sensitive modality in detecting various patterns of meniscal injury, with vertical tears being the most prevalent in this study population.

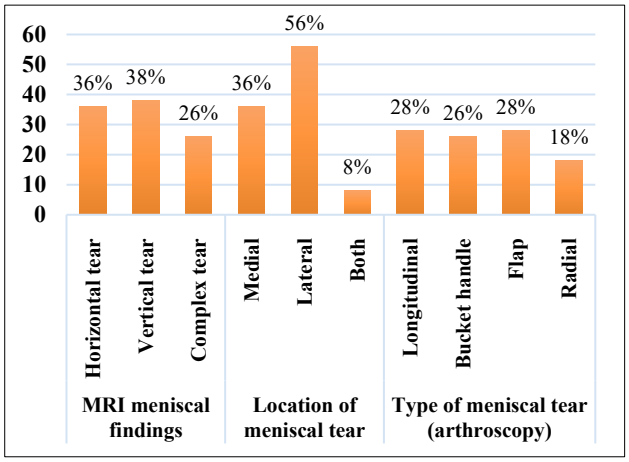

Figure 1: Figure depicting MRI based characteristics of meniscal tears in study participants (n=50).

Table 2 illustrates the comparison between MRI and arthroscopy findings in diagnosing meniscal tears. In 90% of the cases, MRI findings matched with arthroscopic findings, while a mismatch was observed in only 10% of cases. This high level of agreement indicates that MRI is a reliable diagnostic tool for detecting meniscal injuries when compared to the gold standard of arthroscopy. Table 2 also illustrates the grading of meniscal tear observed on MRI. Grade III tears were the most common, seen in 42% of participants, followed by grade I and grade II with 32% and 26%, respectively.

Table 2: Table illustrating MRI based grade of meniscal tear and MRI match with arthroscopy (n=50).

Variables	N (%)
MRI match with arthroscopy	
Mismatch	5 (10)
Match	45 (90)
MRI based grade of meniscal tear	
Grade I	16 (32)
Grade II	13 (26)
Grade III	21 (42)

Table 3 presents the diagnostic accuracy of MRI in detecting meniscal injuries, with arthroscopy used as the gold standard. The sensitivity of MRI was 89.6%, indicating that it correctly identified a high proportion of true meniscal tears. The specificity was 100%, reflecting that MRI accurately ruled out meniscal injury in all patients without a tear. The positive predictive value (PPV) was also 100%, suggesting that all patients diagnosed with a tear on MRI were confirmed to have a

tear on arthroscopy. However, the negative predictive value (NPV) was comparatively low at 28.6%, implying that a negative MRI result did not consistently exclude the presence of a tear. The overall diagnostic accuracy of MRI in this study was 90%, supporting its reliability as a non-invasive diagnostic tool for meniscal injuries.

Table 3: Table illustrating diagnostic accuracy of MRI (n=50).

Diagnostic parameter	Value
Sensitivity	89.6
Specificity	100
Positive predictive value (PPV)	100
Negative predictive value (NPV)	28.6
Overall diagnostic accuracy	90

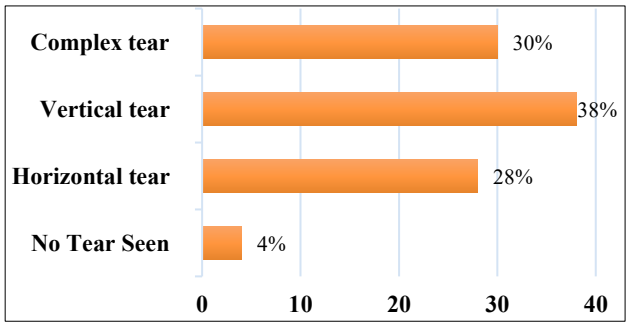

Figure 2: Figure depicting arthroscopic findings related to meniscal tears (n=50).

DISCUSSION

This study holds clinical significance as it not only quantifies the diagnostic performance of MRI but also sheds light on the patterns, types, and associated features of meniscal injuries in a regional Indian population. Understanding the level of agreement between MRI and arthroscopy helps in reducing unnecessary surgical procedures, optimising patient selection for arthroscopy, and enhancing diagnostic protocols.

MRI findings

In the present study, MRI detected vertical tears in 38% of cases, horizontal tears in 36%, and complex tears in 26% of patients. Among the locations identified, 56% of tears were found in the lateral meniscus, 36% in the medial meniscus, and 8% involved both menisci. The predominance of vertical and horizontal tears observed on MRI is consistent with the findings of Sarath et al, who reported that the posterior horn of the medial meniscus was the most frequently affected site, and bucket handle tears were found in 5 cases.[11] Their study similarly noted that both medial and lateral menisci were commonly involved, with a significant number of complex tear patterns, underscoring MRI's strength in identifying the orientation and complexity of meniscal injuries. Comparable results were noted by Kulkarni et al, who documented various tear types, with the medial meniscus being more frequently affected than the lateral.[12] However, in contrast to our findings, their study found slightly higher involvement of medial meniscus tears (60%) than lateral ones (30%). This discrepancy may be attributed to population-specific activity patterns or sample variation. Additionally, the findings are aligned with the study conducted by Tegginamath et al, which reported that the meniscal tear patterns identified through MRI and confirmed via arthroscopy included horizontal, vertical, and complex configurations.[13] Their study also demonstrated that tears involving the lateral meniscus were nearly as common as medial tears, supporting the anatomical distribution observed in the present analysis. Together, these observations reaffirm the diagnostic value of MRI not only in detecting meniscal tears but also in characterising the tear morphology and anatomical location, which is essential for surgical planning.

In the present study, MRI grading of meniscal tears revealed that 42% were grade III, 32% were grade I, and 26% were grade II. This predominance of grade III lesions underscores MRI's critical role in identifying clinically relevant meniscal pathology warranting arthroscopic intervention. Our findings are consistent with the study by Kulkarni et al, who also classified meniscal tears using the MAYO system and reported a high frequency of grade III lesions in their MRI-based assessment.[12] Their study, which reported MRI sensitivity and accuracy of 86% for medial meniscus and 83% for lateral meniscus, corroborates the diagnostic reliability of MRI in identifying advanced-grade meniscal pathology. Sarath et al also reported a high diagnostic performance of MRI in detecting grade III tears, particularly in the posterior horn of the medial meniscus, and excluded grade I and II tears from arthroscopic evaluation due to their lack of surface communication.[11] This aligns with our grading distribution and highlights the diagnostic limitations of arthroscopy in visualising lower-grade tears. In the study by Tegginamath et al although tear grading was not explicitly categorised, the authors emphasised that MRI is especially useful for detecting complex or high-grade tears, and should be reserved for ambiguous or clinically challenging cases to avoid unnecessary arthroscopy.[13]

Diagnostic accuracy of MRI

In the present study, MRI demonstrated a high overall diagnostic accuracy of 90% in detecting meniscal injuries of the knee joint, when compared with arthroscopy as the reference standard. The sensitivity and specificity of MRI were found to be 89.6% and 100%, respectively, while the PPV was 100% and the NPV was comparatively lower at 28.6%. These findings reinforce the utility of MRI as a highly accurate non-invasive diagnostic modality for confirming meniscal tears, especially in positive cases, and emphasise its role in preoperative planning and decision-making in orthopaedic practice. The diagnostic accuracy observed in our study is in close agreement with the results reported by Sarath et al who evaluated 56 patients with

suspected internal derangement of the knee and found MRI to have an overall accuracy of 98.21% for medial meniscus and 92.85% for lateral meniscus, with a sensitivity of 100% and specificity of 93.33% for medial meniscal tears.[11] Similarly, Kulkarni et al in a study involving 100 patients, reported an overall diagnostic accuracy of 86% for medial meniscus and 83% for lateral meniscus, with respective sensitivities of 86% and 73.3%, and specificities of 85% and 87.1%.[12] These findings are largely consistent with our results and suggest that MRI maintains high diagnostic accuracy across various patient populations and clinical settings in India. Tegginamath et al also conducted a prospective study involving 90 patients and reported slightly lower diagnostic accuracies of 80% for medial and 83% for lateral meniscal tears, with sensitivity and specificity values for the medial meniscus at 83% and 72%, respectively.[13] In contrast, the present study demonstrated higher specificity (100%) and comparable sensitivity (89.6%), underscoring the superior ability of MRI in ruling out false positives in our cohort. The notably low NPV (28.6%) observed in our study, however, draws attention to the limitations of MRI in ruling out meniscal injuries when the findings are negative. This indicates a potential risk of false negatives, warranting cautious interpretation of negative MRI results and consideration of arthroscopy in persistently symptomatic cases despite inconclusive MRI findings.

In contrast to the present study, Murmu et al concluded that arthroscopy still remains the gold standard in diagnosing the internal knee lesions.[14] The routine use of MRI scan to confirm diagnosis is not indicated, as the positive predictive value of the scan is low for all lesions. The negative predictive value of a scan was found to be high for all structures of the knee joint and hence a 'normal' scan can be used to exclude pathology, thus sparing patients from expensive and unnecessary surgery. However, MRI still remains the first choice for diagnosing the meniscal injuries and a routine pre-operative measure by many surgeons. But in a developing country like India, where people are unable to meet the medical expenditure, it is ideal not to use MRI in all the cases of meniscal injuries. And also relying only on MRI without clinical assessment have led to inappropriate treatment. In any case, MRI did not prevent "unnecessary surgery".[15,16]

Collectively, the findings of this study and corroborating evidence from multiple other Indian and international studies affirm that MRI offers high sensitivity, excellent specificity, and diagnostic accuracy in detecting meniscal injuries, particularly in positively identified cases, and remains an indispensable imaging tool in orthopaedic diagnostics.

CONCLUSION

The present study concludes that 90% MRI findings matched those observed during arthroscopy, demonstrating strong agreement between the two diagnostic methods. The calculated diagnostic parameters showed MRI had high sensitivity (89.6%), specificity (100%), and positive predictive value (100%), although the negative predictive value was relatively low (28.6%). These findings support the use of MRI as a highly accurate, non-invasive diagnostic tool for detecting meniscal injuries. However, the low negative predictive value suggests that in cases of high clinical suspicion, negative MRI results should be interpreted cautiously, and further evaluation through arthroscopy may still be warranted.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the study participants for their wholehearted co-operation towards successful completion of this study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Lento PH, Akuthota V. Meniscal injuries: A critical review. J Back Musculoskelet Rehabil. 2000;15(2):55-62.
2. Fox AJS, Wanivenhaus F, Burge AJ, Warren RF, Rodeo SA. The human meniscus: a review of anatomy, function, injury, and advances in treatment. Clin Anat. 2015;28(2):269-87.
3. van Minnen BS, van Tienen TG. The Current State of Meniscus Replacements. Curr Rev Musculoskelet Med. 2024;17(8):293-302.
4. Papadakis MA, McPhee SJ. Meniscus Injuries. In: Quick Medical Diagnosis and Treatment. New York, NY: McGraw-Hill Education. 2024.
5. Snoeker BAM, Bakker EWP, Kegel CAT, Lucas C. Risk Factors for Meniscal Tears: A Systematic Review Including Meta-analysis. J Orthop Sport Phys Ther. 2013;43(6):352-67.
6. Bhan K. Meniscal Tears: Current Understanding, Diagnosis, and Management. Cureus. 2020;12(6):e8590.
7. Tomsan H, Gorbachova T, Fritz RC, Abrams GD, Sherman SL, Shea KG, et al. Knee MRI: Meniscus Roots, Ramps, Repairs, and Repercussions. RadioGraphics. 2023;43(7):e220208.
8. Li J, Qian K, Liu J, Huang Z, Zhang Y, Zhao G, et al. Identification and diagnosis of meniscus tear by magnetic resonance imaging using a deep learning model. J Orthop Transl. 2022;34:91-101.
9. Khan M, Evaniew N, Bedi A, Ayeni OR, Bhandari M. Arthroscopic surgery for degenerative tears of the meniscus: A systematic review and meta-analysis. CMAJ. 2014;186(14):1057-64.
10. Rodeo SA. Arthroscopic meniscal repair with use of the outside-in technique. Instr Course Lect. 2000;49:195-206.
11. Sarath V, Rao AS, Vibhari KJ. A comparative study of magnetic resonance imaging and arthroscopy in

internal derangement of knee. Indian J Orthop Surg. 2020;4(2):147-54.
12. Kulkarni OP, Pundkar GN, Sonar SB. A comparative study of MRI versus arthroscopic findings in ACL and meniscal injuries of the knee. Int J Res Orthop. 2018;4(2):198.
13. Tegginamath A, Patil C. Clinical, magnetic resonance imaging and arthroscopic findings in diagnosis of meniscal tears: a prospective study. Int J Res Orthop. 2019;5(5):792.
14. Murmu C, Tiwari P, Agrawal VK. Evaluation of medial meniscal injury and anterior cruciate ligament tear by MRI with arthroscopic correlation. Int Surg J. 2017;4:589-92.
15. Gupta K, Kulkarni PN, Patil N. Comparison of MRI Findings with Arthroscopy Findings in Internal Derangement of Knee. Int J Recent Trends Sci Technol. 2013;9(2):159-63.
16. Miller GK. A prospective study comparing the accuracy of the clinical diagnosis of meniscus tear with magnetic resonance imaging and its effect on clinical outcome. Arthroscopy. 1996;12(4):406-13.

Cite this article as: Singh R, Saran R, Singh N. A comparative study of magnetic resonance imaging and arthroscopic findings in the diagnosis and management of meniscal lesions. Int J Res Orthop 2025;11:1043-8.