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***Original Research Article***

# DIAGNOSTIC ACCURACY OF MAGNETIC RESONANCE IMAGING (MRI) FOR MENISCAL KNEE INJURIES TAKING ARTHROSCOPY AS THE GOLD STANDARD

**SAJID M[*1], UPPAL MSK[1], BAJWA ZU[2], RIAZ T[3]**

[1]*Department of Orthopedics, Unit-2 Jinnah Hospital Lahore, Pakistan*
[2]*Department of Orthopedics, Farooq Hospital DHA Lahore, Pakistan*
[3]*Chairman Dept. of Orthopedics of Lahore, Pakistan*
**Correspondence author email address: sajidsial1691@gmail.com*

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**Abstract:** *The accurate non-invasive diagnosis of meniscal tears is challenging. Magnetic resonance imaging (MRI) is commonly employed, but previous studies have reported inconsistent findings regarding its diagnostic accuracy. This study aimed to determine the diagnostic accuracy of MRI for detecting meniscal injuries in the knee joint using arthroscopy as the gold standard. The cross-sectional study was conducted at the Department of Orthopedics, Jinnah Hospital Lahore, from October 17, 2021, to April 16, 2022. Ethical approval was obtained from the hospital's Ethical Review Board, and all eligible patients were enrolled after providing informed consent. MRI scans were performed on all patients to assess meniscal injuries, followed by arthroscopy performed by a consultant Orthopedic Surgeon in the department. The collected data were analyzed using SPSS version 20. 131 patients were included in the study, with a mean age of 35.06 ± 8.32 years. The majority of the patients were male (79.4%). The mean body mass index (BMI) was 23.37 ± 4.05 kg/m², and the mean duration of illness was 5.20 ± 2.6 months. The sensitivity and specificity of MRI for diagnosing medial meniscal injuries were found to be 77.4% and 44.9%, respectively. For lateral meniscal injuries, the specificity was 66.7%, and the specificity was 65.3%. MRI demonstrated good sensitivity in detecting meniscal injuries when arthroscopy findings were considered the gold standard. However, its specificity was low for detecting these lesions. Therefore, MRI may be used as a screening tool for these patients, but arthroscopy remains the gold standard for definitive diagnosis.*

**Keywords:** MRI, Meniscal Injury, Arthroscopy, Clinical Examination

## Introduction

Meniscal tears (MT) occur due to excessive compression and shear forces acting on normal or degenerated menisci. MT's exact incidence and prevalence are still unknown, and there is no evidence of a correlation with ethnicity. In a study involving 549 patients, the incidence of meniscal tears diagnosed through arthroscopic examination was 79.2% (Martand Badole et al., 2019). These injuries are more commonly observed in young male athletes and show a second peak of incidence in individuals over the age of 55, as degenerated menisci become more susceptible to tears from low-energy trauma (Palisch et al., 2016; Tornbjerg et al., 2017). Meniscal tears are a prevalent cause of knee pain in young and older patients, emphasizing the importance of accurate diagnosis to guide appropriate treatment (Cerciello et al., 2021).

Magnetic resonance imaging (MRI) is widely regarded as the gold standard non-invasive method for diagnosing meniscal tears. It is routinely employed to support the diagnosis of meniscal injuries before recommending arthroscopic examination and surgery (Anwar et al., 2015; Saqib et al., 2015). In a study by Antinolfi et al., MRI demonstrated a sensitivity of 85% and specificity of 75% for diagnosing medial meniscus injuries, with a positive predictive value (PPV) of 88% and a negative predictive value (NPV) of 71%. Similarly, for lateral meniscus injuries, MRI exhibited a sensitivity of 85%, specificity of 91%, PPV of 94%, and NPV of 77% (Antinolfi et al., 2017). The rationale behind this study is that traumatic knee joint injuries, often requiring surgical intervention, are a common occurrence. Therefore, investigating the diagnostic accuracy of MRI for ligamentous injuries is crucial. Additionally, there is a lack of literature on this topic from Pakistan, making this study a valuable source of authentic evidence. If MRI is proven to have similar diagnostic accuracy, it could be regularly utilized as a screening tool, avoiding the need for invasive procedures.

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## Methodology

The cross-sectional study was conducted at the Orthopedics Department of the Jinnah Hospital Lahore, from October 17, 2021, to April 16, 2022. A sample size of 131 was determined at a 95% confidence interval, considering a prevalence frequency of 79.2%, MRI sensitivity of 85% (with an 11% margin of error), and MRI specificity of 91% (with a 9% margin of error). Non-probability consecutive sampling was employed to collect the data. The study included male and female patients aged 18-45 years with a history of sports or accidental knee injuries within six weeks, experiencing difficulty walking, and a positive McMurray test. Patients with congenital ligament laxity syndrome, previous knee surgery, or previous trauma were excluded. Ethical approval was obtained from the hospital's Ethical Review Board and the College of Physicians and Surgeons Pakistan (CPSP). Informed consent was obtained from all enrolled patients after explaining the study details. All patients underwent an MRI scan, which was reported by a consultant radiologist (operational definition). Patients with positive or negative findings on MRI underwent arthroscopy performed by a consultant Orthopedic Surgeon in the department. All findings and data were recorded using a standardized Performa. The collected data were entered and analyzed using SPSS version 20, employing appropriate statistical methods. Descriptive statistics were used for numerical values such as age, BMI, and duration of illness, calculating mean and standard deviation. Frequencies and percentages were calculated for qualitative variables such as gender and true positive/negative/false positive/false negative. 2x2 contingency tables were generated to determine the sensitivity, specificity, PPV, and NPV of MRI in diagnosing meniscal injuries of the knee joint, using arthroscopy as the gold standard. Statistical significance was considered at a p-value < 0.05.

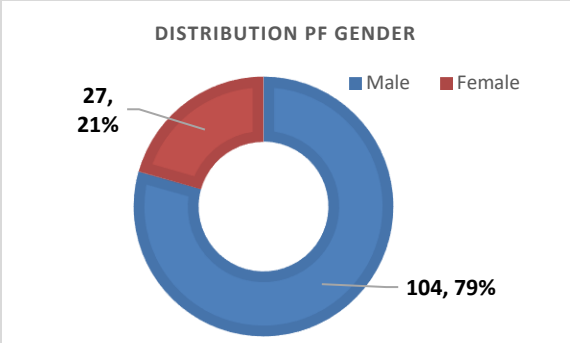


***Figure 1 Gender distribution of patients***

## Results

A total of 131 patients were included in the study. The mean age of the patients was found to be 35.06 ± 8.32 years. The gender distribution showed that most of the patients in this study were male (79.4%) (Figure 1). The mean BMI was found as 23.37 ± 4.05 kg/m2. The mean duration of illness was found as 5.20 ± 2.6 months. The 2 x2 table for MRI for medial and lateral meniscal injuries of knee joint taking arthroscopy as the gold standard is summarized in tables 1 and 2.

These measures indicate that arthroscopy has moderate sensitivity (77.4%), suggesting that it effectively identifies positive cases identified by MRI. However, the specificity (44.9%) is relatively low, indicating a higher rate of false-positive results. The positive predictive value (55.8%) indicates that slightly more than half of the positive arthroscopy results are true positives, while the negative predictive value (68.9%) indicates that a higher proportion of negative arthroscopy results are true negatives. The diagnostic accuracy (65.6%) represents the overall percentage of correct test results.

**Table 1: Table for MRI for Medial Meniscal Injuries**

| | | **Arthroscopy** | | |
|---|---|---|---|---|
| | | **Positive** | **Negative** | Total |
| **MRI** | **Positive** | 48 | 38 | 86 |
| | **Negative** | 14 | 31 | 45 |
| | Total | 62 | 69 | 131 |
| **Sensitivity** | | **77.4%** | | |
| **Specificity** | | **44.9%** | | |
| **Positive Predictive Value** | | **55.8%** | | |
| **Negative Predictive Value** | | **68.9%** | | |
| **Diagnostic Accuracy** | | **65.6%** | | |

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.**Table 2: Table for MRI for Lateral Meniscal Injuries**

| Arthroscopy | | | | |
|---|---|---|---|---|
| | | **Positive** | **Negative** | Total |
| **MRI** | **Positive** | 22 | 34 | 56 |
| | **Negative** | 11 | 64 | 75 |
| | Total | 33 | 98 | 131 |
| **Sensitivity** | | **66.7%** | | |
| **Specificity** | | **65.3%** | | |
| **Positive Predictive Value** | | **39.3%** | | |
| **Negative Predictive Value** | | **85.3%** | | |
| **Diagnostic Accuracy** | | **42.7%** | | |

These measures indicate that arthroscopy has moderate sensitivity (66.7%), which is relatively effective in identifying MRI-positive cases. The specificity (65.3%) is also moderate, indicating a reasonable ability to identify true negative cases. The positive predictive value (39.3%) indicates that less than half of the positive arthroscopy results are truly positive, while the negative predictive value (85.3%) indicates that a high proportion of negative arthroscopy results are true negatives. The diagnostic accuracy (42.7%) represents the overall percentage of correct test results, which in this case, is relatively low.

Regarding sensitivity, arthroscopy has a slightly higher value (66.7%) than MRI (66.1%). This means that arthroscopy correctly identified a slightly higher proportion of true positive cases than MRI.

Regarding specificity, MRI has a higher value (65.3%) than arthroscopy (65.2%). This indicates that MRI is slightly better able to identify true negative cases than arthroscopy.

**Discussion**

Accurate diagnosis of knee injuries relies on a comprehensive clinical history and thorough physical examination. Magnetic resonance imaging (MRI) is commonly used to evaluate meniscal and ligament injuries of the knee by providing detailed images that highlight morphological abnormalities. Radiologists can enhance the sensitivity of MRI through specific methods. While MRI is generally effective for knee assessment and offers excellent diagnostic capabilities for various types of knee injuries, including ligament, meniscal, tendon, bone, and chondral injuries, there is currently no evidence to suggest that MRI reduces the number of negative arthroscopic procedures (Gwinner et al., 2018). Some studies have shown that certain MRI findings, such as lesions of the anterior meniscal cornu, may not correlate with significant clinical symptoms and should be interpreted in conjunction with the physical examination. Inconsistencies in the accuracy of physical examinations for meniscal injuries have been observed due to deficiencies in clinical practice (Kızılgöz et al., 2018; Lecouvet et al., 2018). Qualified orthopedic surgeons can confidently diagnose anterior cruciate ligament and meniscal injuries through physical examination, reserving MRI for complex and ambiguous cases. However, this practice is not initially recommended as it may hinder the surgeon's training (Masuda et al., 2018). The advancements in arthroscopic surgery and clinical and complementary examinations have facilitated the diagnosis, treatment, and prognosis of intra-articular knee injuries. Orthopedic surgeons typically diagnose knee ligament and meniscal injuries through physical examination, with MRI providing supplementary information.

A study comparing arthroscopy and MRI demonstrated a sensitivity of 89% for meniscal injuries when using arthroscopy as the reference standard. Signal abnormalities detected on MRI provided information about the morphological alterations of injuries. In one study, sensitivity and specificity values for MRI and arthroscopy were reported as 70.4% and 50%, respectively, for meniscal injuries (Magee et al., 2002). Another study showed that MRI did not significantly reduce the number of negative arthroscopy procedures, as the physical examination correlated with arthroscopic findings at a similar rate. MRI signal changes indicating meniscal injuries of the anterior cornu often lacked apparent clinical signs. Comparisons between MRI and physical examination in diagnosing meniscal and ligament injuries did not show statistical significance, suggesting that well-trained orthopedic surgeons can confidently diagnose anterior cruciate ligament injuries without relying on MRI as a routine procedure (Brooks and Morgan, 2002; Shepard et al., 2002).

A study investigated the concordance between MRI and arthroscopic findings, concluding that MRI was adjunctive to physical examination in preoperative

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planning for knee operations. MRI showed a sensitivity of 66.7%, specificity of 95.1% for meniscal injuries, and 100% and 96.9% for anterior cruciate ligament (ACL) injuries. According to other research, MRI should be used to diagnose. In acute injuries where the physical examination is inconclusive, MRI aids in diagnosis and may guide surgical decisions (Chang et al., 2004). However, the correlation of MRI with arthroscopy in this population has not yet been documented. Combined approaches utilizing physical examination and MRI have shown potential in reducing the number of negative arthroscopy procedures by 5%, emphasizing the diagnostic value of MRI and its impact on anesthesia type and treatment decisions, potentially decreasing the need for additional arthroscopic interventions (Munk et al., 1998; Munshi et al., 2000).

In a double-masked study, MRI accuracy was higher than arthroscopy when MRI was used as the standard for diagnosis. However, in a few cases, some injuries identified on MRI were not observed during arthroscopy. Based on this finding, it was suggested that MRI should be employed initially for diagnosing knee injuries to reduce the number of negative arthroscopy procedures potentially.

## Conclusion

MRI has good sensitivity for detecting meniscal injuries while considering arthroscopy findings the gold standard. However, its specificity was low for detecting these lesions. So, we may use MRI as a screening tool for these patients, However, arthroscopy remains the gold standard in these patients

## Conflict of interest

The authors declared absence of conflict of interest.

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