

# The Accuracy of 0.3 Tesla MRI for Diagnosing Meniscal Tears in the Knee a Multi-Center Study

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## ABSTRACT

**Objective:** This study aims to compare the accuracy of a 0.3-tesla MRI in diagnosing meniscal injury in the knee to that arthroscopic findings.

**Duration and place of study** Qazi Hussain Ahmad Medical Complex Nowshera, Pakistan, from Jan 2021 to Jan 2022. (departments of Radiology and Orthopedic).

**Methodology:** One hundred patients who satisfied the study's inclusion criteria were sent from the orthopedics. We successfully collected patient data and permission from the Qazi Hussain Ahmed Medical Complex Nowshera. outpatient department and tertiary care hospital kpk between January 2021 and January 2022. All of the 0.3 Tesla scans were completed by a single MRI tech. To confirm the findings of the MRI, an arthroscopy was done by a professor of orthopedics. We tracked everything in a proforma spreadsheet and analyzed the data.

**Results** The result is that 100 patients participated in the trial. There were 96 males (or 95%) and four females (5%). Individuals' ages varied from the low teens to the high fifties. Patients had a mean age of 30.3 +/- 6.82 years. We found that, in contrast to arthroscopy, our method for diagnosing meniscal injuries of the knee joint was susceptible (96%), specific (95%), and accurate (95%).

**Conclusion:** For the evaluation of meniscal injuries, MRI is a reliable, accurate, and noninvasive method.

**Keywords:** Arthroscopy, MRI, and Knee Replacement are Some Key Terms

## INTRODUCTION

Magnetic Resonance Imaging has improved as a diagnostic tool for the musculoskeletal system since its first in 1981<sup>1</sup>. MRI scans are risk-free since they do not use ionizing radiation. As a result of its superior signal-to-noise ratio, excellent resolution, decreased artifacts, shorter imaging periods, and increased accuracy, MRI has now replaced conventional radiography as the principal imaging method in diagnosing knee joint pathology<sup>2</sup>. MRI reveals osseous abnormalities and offers information on the cartilages, menisci, ligaments, and surrounding soft tissues<sup>3</sup>. Magnetic resonance imaging (MRI) may detect meniscal tears as linear, complex, or diffuse regions of increased signal intensity inside the meniscus that are in contact with the articular surface<sup>4</sup>. Because of its great accuracy and possible therapeutic intervention in the same environment, knee arthroscopy has also been increasingly employed for diagnostic reasons. Infection, haemarthrosis, adhesions, and anesthesia complications<sup>4</sup> are some of the problems that might arise. My study aimed to determine whether 0.3-Tesla MRI may serve as a screening tool for identifying meniscal injuries in the knee, hence decreasing the prevalence of unnecessary arthroscopic operations in our community<sup>5</sup>

## METHODS AND MATERIALS

We collected patient data and permission from the Qazi Hussain Ahmad Medical Complex Nowshera outpatient department and tertiary care hospital between January 2021 and January 2022. The investigation comprised 14–56-year-olds who went to the orthopedic outpatient department (OPD) with knee instability and locking and were assigned to us for MRI. The outpatient orthopedics department of Qazi Hussain Ahmad Hospital, Nowshera, sent 100 patients with knee instability and locking with meniscal damage to the Radiology department from January 2021 to January 2022. Knee tumors, knee surgery, and intra-articular fractures were eliminated. After the orthopedic surgeon took a medical history and examined these patients, a technician conducted 0.3-Tesla MRIs. MRIs showed medial and lateral meniscal injury. One orthopedic surgeon compared MRI findings with knee arthroscopy, the gold standard in patient follow-up. Knee tumors, knee surgery, or intra-articular fractures disqualified

patients. MRI scans were unsafe for pregnant women or those with metallic implants. One researcher studied the Toshiba 0.3 Tesla Visart TM series. The imaging approach included sagittal (T1), coronal (T2), and axial (T2\*) T2-weighted images. Knee and extremity imaging coils were employed. Two board-certified radiologists independently assessed the images and reported their results. A modified Lotysch et al. classification system rated meniscal damage on MR images.

Meniscal tears had grade three signal intensity on MRI (i.e., intra meniscal signal intensity unequivocally extending to an articular surface). A skilled orthopedic surgeon performed each arthroscopic assessment. Anterolateral or trans patellar portals were used to implant the 30-degree arthroscope into the knee. Each structure was examined and explored. After diagnosing, the arthroscopist recorded the arthroscopic diagnosis and any subsequent treatment. The arthroscopist either paused the operation to fix it or continued.

Data collection comprised of arthroscopy and MRI findings.

**Analyzing The Data:** SPSS version 22 analyzed all data. Gender was qualitative, given in frequency and percentage. Age average and standard deviation were given. We examined MRI's sensitivity, specificity, positive and negative predictive values, and accuracy against arthroscopy. Accuracy is the percentage of accurate diagnoses (true positives + false negatives) (FN). TP/(TP+FN), TN/(FP+TN), PPV, and NPV are defined as follows.

## RESULTS

Participants' ages varied from 14 to 56. (average 31 years). Of them, 16 (15%) were between the ages of 15 and 26, 67% were between the ages of 27 and 36, 14% were between the ages of 37 and 46, and 3% were between the ages of 47 and 56. (Table 1). Cases by age group (n =100) are broken down in Table 1.

Table 1: Frequency of cases by age group (n=100)

Age (years)	n	%age
14-26	16	15
27-36	66	65
37-46	14	15
47-56	4	5

Table 2: Samples are distributed based on gender (n=100).

Gender	=n	%age
1. Male	96	96%
2. Female	4	4%

Table 3: Cases are divided according to the side involved (n=100).

Knee side	=n	%age
1. Left	72	72%
2. Right	28	28%

Table 4: Results of MRI and arthroscopy (n=100)

Modality	Medial Meniscus	Lateral Meniscus
1. Arthroscopy	84	26
2. MRI	82	23

Table 5: reliability of arthroscopy-based magnetic resonance imaging

Result	Medial Meniscus	Lateral Meniscus
1. True +ve	82	48
2. True -ve	14	48
3. False +ve	2	2
4. False -ve	2	2

Table 6: The percentage of MRI diagnoses that are correct.

Validity	Medial Meniscus	Lateral Meniscus
1. Accuracy	95	95
2. Sensitivity	96	95
3. Specificity	86	95
4. Negative predictive value	86	97
5. Positive predictive value	96	96

There were a total of 96 (96%) male patients and 4 (4%) female patients (Table 2). A large proportion (73%) of the patients were in their 30s and 40s, with just 4% of this group being female. Seventy-two (71% of patients) had problems with their left knees, whereas only 29 (29% of patients) had issues with their right knees (Table 3). Twenty-five lateral meniscal tears (51%, or 25/100) were reported at the surgery. The majority of the 26 tears (23 out of the total) were discovered by MRI (Table 4). Both the tear found after surgery, and the tear detected during the MRI were absent throughout the procedure. Forty-eight true positives, one false positive, and 48 false negatives were recorded (Table 5). All four measures of diagnostic efficacy (PPV, NPV, sensitivity, and specificity) for lateral meniscal tears were perfect (Table 6).

## DISCUSSION

Occasionally, edema and muscle spasms caused by acute knee damage might inhibit full knee extension<sup>6</sup>. MRI is currently the gold standard for detecting internal derangements of the knee<sup>6</sup>, thanks to its accuracy, safety, and additional advantages compared to diagnostic arthroscopy. Arthroscopy is the "gold standard" for identifying meniscal and cruciate ligament tears but requires surgical incisions and extra recovery time. Patients may have an infection, pain, DVT (deep vein thrombosis), blood loss, anesthetic issues, and discomfort<sup>7</sup>. As noninvasive

Diagnostic techniques improve, such as MRI, it is preferable to undertake this procedure exclusively for therapeutic reasons. A regular MR examination may rule out any internal abnormality of the knee. It reveals issues with the meniscus, ligaments, and cartilage. Most orthopedic doctors now favor this kind of exam<sup>8</sup>. Using arthroscopic results as the gold standard, this study examined the diagnostic accuracy of 0.3 Tesla MRI for identifying meniscal injuries in the knee. A total of 100 cases were analyzed, with 82 of them involving medial meniscal tears and 48 involving lateral tears<sup>9</sup>.

Gul-e-khana et al. examined the medial meniscus in only 6 of 100 patients but found that 82 of those patients (82% of the total) had abnormalities. A lateral meniscal tear was detected in 35 cases (35%)<sup>10</sup>. Most meniscal tears (62 of 66) were classified as medial in research involving 66 patients conducted by Winters K et al. Twenty-six of the 66 meniscal tears were on the side. In our

study, patients' mean ages were 31.456.90 (average 31 years)<sup>11</sup>. Winters K et al.<sup>16</sup> found that, on average, their patients were 35 years old at the time of the treatment. Patients in our research who received both MRI and arthroscopy tended to be younger (31.456.90 years old, to be exact) than those in the general population<sup>12</sup>. In the current research, 100 patients (96% were male, and only three patients (3%) were female, an age disparity compared to previous studies caused by the fact that our younger population meets with accidents more often since they are the leading figures in the growth of a growing country. Gul-e-khanda et al. found that of the 100 patients studied, 63 (or 63%) were male, and 37 (or 37%) were female. There were 55 male patients (55%) and 45 female patients (45%) in the research by Winters K et al.

14. Although females make up roughly 55% of the population in our society, our data suggest

that men are more likely to be injured in accidents due to factors such as being the primary breadwinners in their families and the age group most likely to be involved in such incidents (those aged 19–34)<sup>13</sup>.

In contrast to the 2-year research by Gul-e-khanda et al. four and the 5-year study by Winters

K. et al.<sup>14</sup>, our study lasted for just six months. Noble<sup>16</sup> did research in which he argued that doctors should refrain from doing arthroscopies until essential, noting that MR imaging findings may sometimes supplement doctors' clinical judgment. The overall sensitivity of MRI for menisci was found to be 85% in a study by Mackenzie R et al., and its specificity was found to be 96% in a survey by Gul-e-khanda et al.<sup>14</sup>, with the following breakdowns for the medial and lateral menisci: 99% sensitivity, 67% specificity, 91% PPV, 99% NPV, and 91% accuracy for the medial, and 85%

Medial meniscus MRI had a sensitivity of 87%, specificity of 92%, PPV of 90%, NPV of 89%, and accuracy of 92% in another study by Winters K et al.<sup>22</sup>; lateral meniscus MRI had a sensitivity of 46%, specificity of 91%, PPV of 55%, NPV of 88%, and accuracy of 82% in our study of 100 cases with MRI and arthroscopy. According to our research, an MRI of the menisci has the following sensitivity (97%), specificity (85%), and accuracy (96%) for the medial meniscus and the lateral meniscus, respectively<sup>15</sup>.

90% PPV, 85% NPV, and 96% accuracies; lateral meniscus led to 97% sensitivity, 97% specificity, and 97%

The pooled sensitivity of medial and lateral menisci was 92% and 80%, respectively, and the pooled specificity was 87% and 97%, according to a meta-analysis by Oei and colleagues<sup>18</sup> that included 29 studies from 1992 to 2015 that evaluated the validity of MRI concerning meniscal and ligamentous disorders of the knee. The posterior horn of the medial meniscus and the anterior horn of the lateral meniscus are the most often affected regions in meniscal tears, respectively<sup>16</sup>. MRI has been found to have a sensitivity, specificity, and accuracy of 81-97% for meniscal injuries<sup>17</sup>. We found similar outcomes in our research. Retrospective analysis of arthroscopy videotapes of instances with false-positive MR imaging findings by Quinn and Brown revealed that the suspicious region of the meniscus was never visible in any of the cases<sup>18</sup>. Therefore, many false-positive MR imaging results<sup>26</sup> may be attributable to

Arthroscopic false-negative findings<sup>19</sup>. However, our research confirms that MRI can accurately diagnose knee internal derangement. Due to its low cost, high value, and lack of invasiveness, MRI has emerged as a crucial diagnostic tool in recent years<sup>20</sup>.

## CONCLUSION

Tears of the menisci may be evaluated using a noninvasive and highly accurate imaging technique called magnetic resonance

imaging (MRI). It may be an initial diagnostic tool for individuals with knee soft tissue injuries.

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