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Research Article

**DIAGNOSTIC PRECISION OF 1.5 TESLA MAGNETIC  
RESONANCE IMAGING IN THE ANALYSIS OF MENISCAL  
TEARS OF KNEE JOINT**<sup>1</sup>Dr Hassan Shafiq, <sup>2</sup>Dr Maham Zafar, <sup>3</sup>Dr Rooha Siddique<sup>1</sup>Clinical Fellow ST 2, Royal London Hospital Barts Trust NHS<sup>2</sup>Nishtar Medical College, Multan<sup>3</sup>S. Tentishev Asian Medical University Kyrgyzstan

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**Abstract:**

**Aim:** To govern the diagnostic accuracy of MRI 1.5 tesla MRI in the diagnosis of knee joint meniscus tears, taking arthroscopic findings as gold standard.

**Place and duration of the study:** In the Orthopedic Unit II and Radiology department of Mayo Hospital Lahore for one year duration from March 2019 to March 2020.

**Case and method:** 60 patients were identified who met the selection criteria directed to the radiology department from an orthopedic hospital. Patient consent and demographic profile were obtained. MRI 1.5-Tesla was performed by one technician from the MRI department. Arthroscopy was performed by an orthopedic professor to confirm MRI results. All this information was recorded in the proforma and the results were evaluated.

**Results:** The study involved 60 patients. By Gender; 52 (87%) patients were male and 8 (13%) were female and were between 15 and 55 years old.  $30.4 \pm 5.91$  years was the patients mean age. Our study showed high specificity (94%), high sensitivity (97%) and confidence (96%) compared to arthroscopy for knee joint meniscus injuries.

**Conclusion:** Magnetic resonance imaging is a virtuous, non-invasive and precise method for assessing meniscal injuries.

**Key words:** Arthroscopy, magnetic resonance imaging, knee

**Corresponding author:****Dr Hassan Shafiq,**

Clinical Fellow ST 2, Royal London Hospital Barts Trust NHS

[Hassan.shafiq@nhs.net](mailto:Hassan.shafiq@nhs.net)

QR code



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**INTRODUCTION:**

Magnetic resonance imaging has attained acceptance as an analytical tool for the musculoskeletal system since its introduction in the 1980s<sup>1</sup>. Magnetic resonance imaging is not invasive and does not require exposure to ionizing radiation<sup>2-5</sup>. Since then, due to the better signal-to-noise ratio, higher resolution, reduced number of artifacts, shorter imaging time and better accuracy, MRI has clearly become the main imaging tool in knee joint pathology studies.

Magnetic resonance imaging not only represents bone changes, but also provides information on surrounding cartilage, menisci, connective tissue and soft tissue. In MRI, meniscus tears are characterized by increased linear, complex or diffuse signal intensity in the meniscus communicating with the surface of the joint. Diagnostic knee arthroscopy is also increasingly used because it is very accurate and can be therapeutic in the same environment<sup>6</sup>. However, infection can be complicated by anesthesia-related complications, as well as haemarthrosis and adhesions<sup>7</sup>. The reason for my research was to assess the role of 1.5 Tesla MRI as a detection technique to reduce the number of arthroscopic procedures in the diagnosis of meniscus tear in our local population.

**PATIENTS AND METHODS:**

This cross-sectional study was held in the Orthopedic Unit II and Radiology department of Mayo Hospital Lahore for one-year duration from March 2019 to March 2020. The age group was 15-55 years for both sexes. Patients with instability and suspicion of knee locking with suspected meniscal tears referred us to an MRI were selected. While patients having history of previous knee surgery, history of tumor of knee, history of related intra-articular fracture and confirmed on x-ray were omitted.

**Data collection procedure:**

Sixty individuals with a history of instability and knee lock suspicion were referred from the outpatient orthopedic department to the radiology department. Collecting the history and clinical examination of the patients 1.5- Tesla MRI done by single technician prior to surgery and after informing these patients. On magnetic resonance imaging, changes were observed in the middle meniscus or lateral meniscus or both. These

patients were observed using gold standard knee arthroscopy performed by one orthopedic surgeon to compare MRI findings. Exclusion criteria were patients with a history of knee tumor, prior knee surgery, X-ray history, normal history of intra-articular fractures, and contraindications for MRI during pregnancy and metal implants. Magnetic resonance imaging tests were performed by one technician on the Visart TM series (Toshiba 1.5 Tesla unit). Sagittal T2 \*, T2 and T1 imaging protocol; T2 weighted coronal and axial images. Using a devoted extremity knee coil; images were made. The photos were reviewed and testified by minimum two qualified and trained radiologists who had attained consensus analysis. An adapted Lotysch et al classification system version was used to assess meniscus changes on MRI images. Meniscus tears on magnetic resonance imaging were definite as the intensity of the grade III signals (i.e. intra meniscal signal intensity unambiguously outspreading to an articular surface). An experienced orthopedic surgeon has performed all the arthroscopic examinations. The arthroscopy with an angle of view at 30 ° was placed in the knee through the anterolateral or trans patellar portal. All structures are visualized and tested. After the analytic measure of the inspection, the arthroscopic specialist documented the arthroscopic judgment and possible therapeutic interference was performed as required. Then, contingent on the diagnostic findings, arthroscopy ended the procedure or continued the therapeutic part of the procedure. The MRI and arthroscopy findings were noted in the data collection form.

**Data analysis:**

All collected information was analyzed using SPSS computer software version 19, presented as qualitative variables, namely percentage, frequency and gender. Quantitative variables, namely age, are presented as standard deviation and mean. Specificity, sensitivity, negative predictive value, positive predictive value and MRI sensitivity were premeditated using arthroscopy as the gold standard.

**RESULTS:**

Their age ranged from 15 to 55 years (average 30 years). These 10 (17%) patients were 16-25 years old, 35 (58%) patients were 26-35 years old, 36-45 in the 10 (17%) and 5 (8%) age groups age group 46-55 years (Table 1).

**Table 1: Distribution of cases according to age group (n=60)**

Age (years)	=n	%age
15	0	0%
16-25	10	17%
26-35	35	58%
36-45	10	17%
46-55	5	8%

Mean  $\pm$  SD=30.42 $\pm$ 5.91

By gender, 52 (87%) patients were male and 8 (13%) were female (Table 2).

**Table 2: Distribution of cases according to sex group (n=60)**

Gender	=n	%age
Male	52	87%
Female	8	13%

Male: Female ratio 24:1

Seventy percent of patients were thirty to fifty years of age; and only 4% of this group were women. In 40 (67%) patients; left side of the knee was affected and the right side of the knee in 20 (33%) patients (Table 3).

**Table 3: Distribution of cases according to side involved (n=60)**

Knee side	=n	%age
Left	40	67%
Right	20	33%

**Meniscus medius:** 45 tears of medial meniscus were detected in arthroscopy (45/60 patients, 75%) and 39 were also detected by MRI (Table 4).

**Table 4: Findings of arthroscopy and MRI (n=60)**

Modality	Medial Meniscus	Lateral Meniscus
Arthroscopy	45	27
MRI	39	26

MRI did not interpret one tear which was noted during surgery and on MRI; one tear which was confirmed not observed during surgery. 43 true positive results, 4 false positive, 9 true negative and 4 false negatives were obtained (Table 5).

**Table 5: Reliability of magnetic resonance imaging as determined at arthroscopy**

Result	Medial Meniscus	Lateral Meniscus
True +ve	43	26
True -ve	9	26
False +ve	4	4
False -ve	4	4

Therefore, the sensitivity of tear detection of the medial meniscus was 98%, sensitivity 99%, specificity 89%, PPV 99% and NPV 89% (Table 6).

**Table 6: Percentage validity of the diagnoses from MRI**

Validity	Medial Meniscus	Lateral Meniscus
Accuracy	98	98
Sensitivity	99	98
Specificity	89	98
Negative predictive value	89	98
Positive predictive value	99	98

By gender, 52 (87%) patients were male and 8 (13%) were female (Table 2). Seventy percent of patients were three and four years old; and only 4% of this group were women. The left side of the knee was involved in 40 (67%) patients, and the right side of the knee in 20 (33%) patients (Table 3).

Lateral menisci: 27 lateral meniscus tears were identified in the operation (27/50 patients, 54%). Magnetic resonance imaging detected 26 of 27 tears (Table 4). In MRI interpretation, tears were not observed during surgery and tears were not seen in MRI. The results were 26 true positive, 4

false positive, 26 true negative and 4 false negative (Table 5). Therefore, the sensitivity was 98%, specificity 89%, PPV 98% and NPV 98% for detection of lateral meniscus tears (Table 6).

### DISCUSSION:

Knee injuries as a result of acute trauma can sometimes limit knee extension due to edema, and MRI has proven safe and offers an advantage over currently accepted diagnostic arthroscopy as reference standard for diagnosing internal disorders Knee<sup>8</sup>. Arthroscopy is considered the "gold standard" and can achieve 69 to 98% diagnostic accuracy in experienced hands with a high level of specificity and sensitivity in detecting meniscus and cruciate ligament injuries<sup>9</sup>. Though, arthroscopy have the complications risk such as pain, infection, blood loss, anesthetic problems, deep vein thrombosis, and discomfort to the patient and is invasive procedure. Preferably it is produced for therapeutic purposes only; however, alternative non-invasive diagnostic methods such as MRI may be used<sup>10</sup>. Normal MR Knee inspection is quite precise in ruling out any inner abnormalities. It shows irregularities of the meniscus, ligaments and cartilage. This is currently the preferred test for most orthopedic surgeons<sup>11</sup>.

In this study, the diagnostic accuracy of 1.5 Tesla MRI was examined in the diagnosis of knee meniscus tears, using arthroscopic results as the gold standard. 60 cases were examined, most cases (45 out of 60) are medial meniscus tears, and 27 are lateral meniscus tears. In his study, the average age of patients during the procedure was 37 years. Therefore, the majority of patients in our study had MRI, and arthroscopy was relatively younger ( $30.42 \pm 5.91$  years). This age difference compared to other studies is that our young population is more likely to have accidents because they are key figures in the development of a developing nation<sup>14</sup>. In this study, 52 patients were male and 8 patients were female. In the study, Gul-ekhanda et al. 32 patients (64%) were male and 18 patients (36%) were female. In the study by Winters K et al. 37 patients (56%) were male and 30 patients (44%) were female. Although women make up about 55% of the total population of our society, male dominance in our study may be the result of our social structure, which provides livelihoods for male families and is more likely to have accidents. In a study by Noble, he highlighted the need to avoid unnecessary arthroscopy, which in some patients has shown that magnetic resonance imaging results increase clinical judgment and leaves arthroscopy to provide a practical solution to a verifiable and confirmed problem of patients<sup>15</sup>. In one study, arthroscopic correlation of MRI results

by Mackenzie R et al revealed overall meniscus sensitivity at 88% and overall specificity at 94%.

Winters K et al. Sensitivity, specificity and sensitivity in meniscus magnetic resonance imaging are as follows: middle meniscus gave 87% sensitivity, 92% specificity, 90% PPV, 89% NPV and 92% sensitivity. 46% lateral sensitivity, 91% specificity, 55% PPV, 88% NPV and 82% precision. In our study there were 60 patients who were subjected to magnetic resonance imaging and arthroscopy and exhibited an outstanding association between these two methods, and the results can be compared with the above-mentioned studies. Our study showed the specificity, sensitivity and magnetic resonance sensitivity of the meniscus: the medial meniscus gave 97% sensitivity, 87% specificity, 97% PPV, 87% NPV and 96% sensitivity; the lateral menisci showed 96% specificity, 96% sensitivity, 96% NPV, 96% PPV and 96% sensitivity.

A meta-analysis by Oei and colleagues combined 29 studies assessing the importance of MRI for meniscus and ligaments in the knee in 1991–2000. The combined sensitivity of the middle and lateral menisci was 93% and 79%, while the specificity collected was 88% and 95%, respectively. When most of the meniscus tears are affected, the middle meniscus is more often affected than the lateral meniscus, and most often this applies to the posterior horn of the medial meniscus and the anterior horn of the lateral meniscus. Sensitivity, specificity and precision of magnetic resonance imaging for meniscus changes were found in the range of 80-95%. The results were the same in our study. Quinn and Brown performed a retrospective analysis of arthroscopic video tapes of false positive MRI imaging and found that in these cases the suspected meniscus area was never visualized. Therefore, false negative arthroscopic results can explain many false positive MRI results. Our study confirmed the MRI's ability to reliably identify an internal knee disorder. MRI capabilities, cost advantage and non-invasiveness make MRI an important diagnostic method.

### CONCLUSION:

Magnetic resonance imaging is a virtuous, non-invasive and very sensitive method of assessing meniscus tears and can be used as a first-line study in patients with soft tissue trauma of the knee.

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