

# Diagnostic accuracy of Magnetic Resonance Imaging (MRI) Knee in detecting Anterior Cruciate Ligament (ACL) tear taking arthroscopy as gold standard.

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## Authorship and contribution Declaration:

Each author of this article fulfilled ALL 4 Criteria of Authorship:

1. Conception and design of case report
2. Drafting the manuscript or revising it critically for important intellectual content.
3. Final approval of the version for publication.
4. All authors agree to be responsible for all aspects of their research work.

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## ABSTRACT

**Objective:** To determine the diagnostic accuracy of MRI in detecting ACL tears in patients presenting with knee injury taking arthroscopy as gold standard.

**Methods:** This Cross sectional study was conducted in department of Orthopedic Surgery Khyber Teaching Hospital Peshawar from 2<sup>nd</sup> February 2019 to 28<sup>th</sup> August 2020. All patients with clinical ACL tear fulfilling the inclusion criteria had MRI of the knee joint followed by arthroscopy. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of MRI was calculated with reference to arthroscopy as gold standard.

**Results:** The total number of patients in our study was 106 with mean age 32±9 years. Male patients were 77 (72.64%) and female 29 (27.35%) were female. Left knee was involved in 67 (63.20%) patients and right in 39 (36.79%). ACL tear was noted in 43 (40.56%) patients on MRI while 86 (81.13%) patients had ACL tear diagnosed on arthroscopy. Sensitivity of MRI was 66.67%, specificity 75.90%, PPV 81.13%, NPV 59.43% and diagnostic accuracy 70.28%.

**Conclusion:** MRI is a useful diagnostic modality but we found low diagnostic accuracy of MRI for ACL tear considering arthroscopy as gold standard. Diagnostic arthroscopy is therefore recommended for confirming ACL tear in doubtful cases.

**Keywords:** Anterior cruciate ligament, arthroscopy, Magnetic Resonance imaging

This article may be cited as:

Ullah S, Shah DB, Khan Q, Khan MA<sup>4</sup>, Janan H, Khan A. Diagnostic accuracy of Magnetic Resonance Imaging (MRI) Knee in detecting Anterior Cruciate Ligament (ACL) tear taking arthroscopy as gold standard. *J Pak Orthop Assoc* 2021;33(2):

## INTRODUCTION

Knee joint is one of the most commonly injured joints and injury to the cruciate ligaments, menisci and collateral ligaments can happen depending on amount and direction of forces during trauma.<sup>1,2</sup> Magnetic Resonance Imaging (MRI) and arthroscopy has improved the diagnostic skills of knee pathologies.<sup>3</sup> MRI is preferred as it is noninvasive and highly sensitive for meniscal injuries but less sensitive for anterior cruciate ligament injuries.<sup>4</sup> It has excellent soft tissue contrast and multi-planer slices hence ideal for imaging the complex anatomy of the knee joint.<sup>3,5</sup> The sensitivity of MRI for ACL tear is 87.87%, medial meniscal tear 93.54% and

lateral meniscal tear 77.77%.<sup>6</sup> MRI is noninvasive and can visualize all articular ligaments and some extra articular ligaments which even arthroscopy sometimes fails to visualize.<sup>7,8</sup> Arthroscopy is a keyhole surgery which can even be performed as a day case procedure depending on its indication and no evidence yet supported the statement that MRI decreases the incidence of negative arthroscopies.<sup>5,9</sup> Currently arthroscopy is considered as the gold standard for diagnosing intra-articular ligament tears.<sup>9</sup> It is highly sensitive and specific with 100% accuracy but is invasive and may have post operative complications.<sup>7</sup>

Patient with suspected ligamentous knee injuries are routinely presented to our department. They are

booked for MRI and patients with positive MRI are booked for arthroscopy. We conducted this study to determine the diagnostic accuracy of MRI in detecting ACL tears in patients presenting with knee injury taking arthroscopy as gold standard. If accuracy of MRI was found to be 90% or more with a high positive predictive value we can decrease the burden of diagnostic arthroscopies.

### METHODS

This Cross sectional study was conducted in department of Orthopedic Surgery Khyber Teaching Hospital Peshawar from 02<sup>nd</sup> February 2019 to 28<sup>th</sup> August 2020. All patients of knee trauma of either gender who had suspected anterior cruciate ligament tear with at least 6 weeks duration with positive Lachman test and age range 18 to 55 years were included in this study. Patients with previous knee surgery, associated fracture of the femoral condyle, tibial plateau fractures, dislocated knee and patients who had contraindications for MRI imaging were excluded.

Data was collected after seeking permission from hospital ethical committee. Informed written consent was obtained from all the patients. Patients were booked for MRI and diagnostic arthroscopy.

MRI was done in radiology department of our institution with 1.5 TESLA MRI machine. A 3mm thick sections of the scans were taken in sagittal, coronal, and axial planes of the knee with TI(time of inversion) , T2 , STIR(Short term inversion recovery), PD(Proton density) and PD with fat suppression images. In order to obtain better sections of ACL patients were placed supine in MRI scanner and respective extremity flexed 15 degrees during the sagittal images. All images of the patients were reported by a single senior radiology consultant(with minimum of 5 years post fellow ship experience) who was fellow of College of Physicians and Surgeons Pakistan(CPSP). Patient with complete anterior cruciate ligament injuries were dated for arthroscopy. Patients with injuries other than meniscal or anterior cruciate ligament was excluded from our study.

Arthroscopy was performed by single consultant who was CPSP fellow and had specialized training in knee arthroscopy. Arthroscopies were performed

under general or spinal anesthesia. A thorough examination of the knee was performed and structures were identified. Further surgical intervention was carried out according to the pathologies. For ACL tears reconstruction was offered to the patient while for meniscal tears repair/ meniscectomy was advised.

The diagnosis of ACL tear on MRI was divided into four categories:

1. True Positive(TP): If ACL tear shown on MRI was confirmed on arthroscopy.
2. True negative(TN): If ACL tear not shown on MRI and on arthroscopy.
3. False positive(FP): If ACL tear noted on MRI but not on arthroscopy.
4. False negative(FN): If ACL tear not shown by MRI but detected on arthroscopy.

Following equations were used for calculating PPV, NPV, sensitivity, specificity and accuracy:

Positive Predictive Value(PPV)=TP/TP+FP

Negative Predictive Value(NPV)=TN/TN+FN

Sensitivity=TP/(TP+FN)

Specificity=TN(FP+TN)

Accuracy= (TP+TN)/(TP+TN+FP+FN)

Data analysis was performed using statistical software SPSS 22. For continuous variables like age mean and standard deviation was calculated while frequency and percentages were calculated for gender, affected side, mechanism of injury and findings on MRI and arthroscopy. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV)and diagnostic accuracy of MRI was calculated with reference to arthroscopy as gold standard. Data presented in table where necessary.

### RESULTS

We included 106 patients in our study. Male patients were 77 (72.64%) and female 29 (27.35%).The mean age was 32±9 years. Majority(52.83%,n=56) were in age range of 31 to 55 years while 50(47.83%) were in age range of 18 to 30 years. Road traffic accidents were responsible for knee injury in 65 (61.32%) patients whereas 41 (38.67%) had sports injuries.

**Table I:** Diagnostic accuracy of MRI taking arthroscopy as gold standard.

Findings on Arthroscopy	Positive	Negative	Total	Statistics
Findings on MRI	86	20	106	Sensitivity=66.67% Specificity=75.90% PPV=81.13% NPV=59.43% <b>Accuracy=70.28%</b>
Total	43	63	106	
	89	83	--	

Left knee was involved in 67 (63.20%) patients and right in 39 (36.79%). ACL tear was noted in 43 (40.56%) patients on MRI while 86 (81.13%) patients had ACL tear diagnosed on arthroscopy. Sensitivity of MRI was 66.67%, specificity 75.90%, PPV 81.13%, NPV 59.43% and diagnostic accuracy 70.28% as shown in table I.

## DISCUSSION

We included 106 patients in this study with mean age was  $32 \pm 9.48$ . Majority of our patient were male (72.64%, n=77) and in the age range 31-55 years. Similar demographics were reported by other studies.<sup>10,5</sup> Majority (63.20%, n=67). of our patients had left knee injury with road traffic accidents responsible for 65 (61.32%) patients and 41 (38.67%) due to sports injuries. In another study number of non-contact ACL injuries was higher than the number of contact ACL injuries.<sup>11</sup> Anterior Cruciate Ligament (ACL) and menisci are the

commonly injured intra-articular structure.<sup>12-14</sup> Clinical examination is of utmost importance in diagnosing these injuries but MRI and arthroscopy are confirmatory.<sup>14,15</sup> All patients with knee injuries who are preoperative cases of arthroscopy can be benefited from MRI if cost is not a limiting factor.<sup>9,16</sup> Literature has reported the accuracy of arthroscopy up to 100% but the limiting factors are its invasive nature, cost and possible post operative complications.<sup>9,16-18</sup>

In our study the diagnostic accuracy of MRI for ACL tear was 70.28% taking arthroscopy as gold standard. When we searched the literature we found variable accuracy of MRI for ACL tear (table II). The possible reasons for these variations were differences in study designs, MRI intensities, reference points and skills of radiologists and arthroscopic surgeons. We therefore recommend further well designed large sample size studies to confirm our results.

**Table II:** Literature review of diagnostic accuracy of MRI assuming arthroscopy as gold standard.

S. No	Authors of study	Year of publication	Diagnostic accuracy of MRI
1	Sharma <i>et al</i> <sup>19</sup>	2020	97.4%
2	Ahmad ZT <sup>20</sup>	2020	95%
3.	Khan I <sup>21</sup>	2019	94.5%
4	Sarath V <sup>22</sup>	2018	94.6%
5	Khandelwal K <sup>5</sup>	2018	95.7%
6	Ahmed A <sup>23</sup>	2017	91.8%
7	Sheriff S <sup>24</sup>	2017	93%
8	Yaqoob J <sup>25</sup>	2015	94.4%
9	Behairy NH <sup>26</sup>	2009	94%
10	Crawford R <sup>27</sup>	2007	93.4%
11	Jah AK <sup>28</sup>	2005	88.5%
12	<b>Our study</b>	<b>2020</b>	<b>70.28%</b>

## CONCLUSION

MRI is a useful diagnostic modality but we found low diagnostic accuracy of MRI for ACL tear considering arthroscopy as gold standard. Diagnostic arthroscopy is therefore recommended for confirming ACL tear in doubtful cases.

**Conflict of Interest:** None

**Grants/Funding:** None

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