Original Article

Diagnostic Accuracy of Magnetic Resonance Imaging for Detection of Anterior Cruciate Ligament Tears Taking Arthroscopy as Gold Standard

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ABSTRACT

Objective: To assess the diagnostic accuracy of magnetic resonance imaging for detection of anterior cruciate ligament tears taking arthroscopy as gold standard.

Study Design: Cross sectional study

Place and Duration of Study: This study was conducted at the Department of Radiology, Lahore General Hospital, Lahore from six months 1.7.2019 to 31.12.2019.

Materials and Methods: 100 patients referred to Radiology Department, with knee injury were enrolled in the study. Written informed consent was taken. Demographic detail was also noted. Then all patients underwent MRI by using 1.5 tesla and 3 tesla MRI machines. Then arthroscopy was done and patients were confirmed as positive or negative for ACL tear.

Results: The mean age of patients was 52.31±11.02 years. There were 69 (69%) males and 31 (31%) females. Out of 100 cases, left side was involved in 22 cases, right side in 67 cases while 11 had bilateral injury. There were 51 cases who presented after road accident, 39 fall from height while 10 had fight. The mean duration of injury was 10.87±1.28hours. The sensitivity and specificity of MRI were 93.3% and 96.4% for detection of ACL tear. PPV and NPV were 95.5% and 94.6% while diagnostic accuracy was 95%.

Conclusion: It is concluded that MRI is highly accurate diagnostic modality for detection of ACL tears. Now we can recommend MRI for screening of knee injuries instead of arthroscopy.

Key Words: magnetic resonance imaging, anterior cruciate ligament tears, arthroscopy, knee injury

Citation of article: Ahmed ZT, Khan NH, Bilal S, Ameer S, Tanveer F, Tanveer M. Diagnostic Accuracy of Magnetic Resonance Imaging for Detection of Anterior Cruciate Ligament Tears Taking Arthroscopy as Gold Standard. Med Forum 2020;31(3):31-34.

INTRODUCTION

The anterior cruciate ligament (ACL) extends from the posterior surface of lateral femoral condyle and attaches to the anteriorintercondylar process of the tibia. Its average length is 31–38 mm and its average intersecting surface area is 36 mm^2 in females and 44 mm^2 in males.[1] The ACL stabilizes the joint during hyperextension and prevents anterior translation of tibia over femur.[2] Among all knee injuries, about 50% of injuries were ACL tears, for 30 ACL tears/100,000 persons.[3, 4]

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Received: January, 2020
Accepted: January, 2020
Printed: March, 2020

It can be divided into anteromedial and posterolateral bundles. The main function of the ACL is to limit the forward slip of the tibia on the femur. The anteromedial bundle of the ACL can prevent excessive external rotation of the leg, whereas the posterolateral bundle prevents excessive internal rotation. With the posterior cruciate ligament, the ACL limits excessive flexion, and excessive extension in combination with the posterior cruciate ligament, the medial and lateral collateral ligaments, the articular capsule and the oblique popliteal ligament.[5] It also contributes to restriction of lateral slip and rotation with the articular capsule, the medial and lateral collateral ligaments and the posterior cruciate ligament.[6]

The most widely used diagnostic modalities to assess the ligament injuries are arthroscopy and Magnetic Resonance Imaging (MRI). Arthroscopy is considered gold standard in the diagnosis of knee ligament injuries, with diagnostic accuracy up to 94%; and can be used therapeutically as well.[7] However, arthroscopy is an invasive and relatively high cost procedure requiring anesthesia and hospitalization, and there is a possibility of complications like infection. Thus, surgeons are increasingly turning to MRI as a non-invasive means of

diagnosing ligament injuries.[8]MRI is accurate and non-invasive modality for the assessment of ligamentous injuries. It can be used as a first line investigation to patients with suspicion of ACL injury.[2]

Rationale of this study is to assess the diagnostic accuracy of MRI for detection of ACL tears taking arthroscopy as gold standard. Literature showed that MRI has contradictory accuracy rate for detection of ACL in knee injuries, which create a dispute regarding the reliability of MRI. Moreover, there is only one local study available in literature which showed high reliability of MRI for detection of ACL. So further trials are needed to confirm the evidence. Thus to confirm the evidence we want to conduct this study to find the reliable results regarding the predictive accuracy of MRI in order to avert the unnecessary invasive procedures likes arthroscopy. This will help to improve our practice and we will implement the results in local setting to implement the application of MRI for prediction of ACL tear.

MATERIALS AND METHODS

This cross sectional study was conducted at the Department of Radiology, Lahore General Hospital, Lahore for a period of 6 months from 1.7.2019 to 31.12.2019after the approval of synopsis.

Sample Size: Sample size of 100 cases is calculated with 95% confidence level, and taking expected percentage of ACL tear i.e. 50% and sensitivity 93% with 7.5% margin of error and specificity 89% with 9% margin of error taking arthroscopy as gold standard.

Sampling Technique: Non probability consecutive sampling.

Sample Selection

Inclusion criteria: Patients of age 20-70years, both genders, presenting with knee injury (on clinical examination) due to accident and planned to undergo arthroscopy

Exclusion criteria: Patients with recurrent knee or ligamentous injuries, muscular or skeletal dystrophy, open wound injury, osteomalacia, osteoporosis or osteopenia, rheumatoid arthritis.

Data Collection Procedure: 100 patients referred to Radiology Department, fulfilled selection criteria were enrolled in the study. Written informed consent was taken. Demographic detail was also noted. Then all patients underwent MRI by using 1.5 tesla and 3 tesla MRI machines by a single senior radiologist with assistance of researcher. Findings were recorded and patients were labeled as positive or negative (as per operational definition). Then patients underwent arthroscopy by a single surgical team under spinal anesthesia. Patients were confirmed as positive or negative for ACL tear. On MRI**,** it was labeled as positive if there was a tear present in ACL and was labeled as negative if ACL is in its normal position. On arthroscopy, it was labeled as positive if there was a tear of ACL and if not present then labeled as negative.

Data Analysis: The collected data was entered and analyzed in SPSS 21. Age and duration of injury were presented as mean and standard deviation. Gender, laterality, mode of injury and ACL tear (on MRI & arthroscopy) were presented as frequency and percentage. 2x2 table was generated to calculate the sensitivity, specificity, PPV, NPV and accuracy of MRI taking arthroscopy as gold standard.

RESULTS

The mean age of patients was 52.31±11.02years. There were 69 (69%) males and 31 (31%) females. Out of 100 cases, left side was involved in 22 cases, right side in 67 cases while 11 had bilateral injury. There were 51 cases who presented after road accident, 39 fall from height while 10 had fight. The mean duration of injury was 10.87±1.28hours. Table 1

The sensitivity and specificity of MRI were 93.3% and 96.4% for detection of ACL tear. PPV and NPV were 95.5% and 94.6% while diagnostic accuracy was 95%. Table 2.

Table No.1: Characteristics of patients

N	100
Age (years)	52.31±11.02
Male	69
Female	31
Left side	22
Right side	67
Bilateral	11
Mode of injury	
Road accident	51
Fall	39
Fight	10
Duration of injury (hours)	10.87±1.28

Table No.2: Accuracy of MRI against arthroscopy for detection of ACL injury

		Arthroscopy		Total
		Positive	Negative	
MRI	Positive	42	2	44
	Negative	3	53	56
Total		45	55	100

Sensitivity: 93.3%, Specificity: 96.4%, PPV: 95.5%, NPV: 94.6%, Accuracy: 95%

DISCUSSION

ACL reconstructions are among the most common sports medicine procedures performed in the United States, numbering about 100,000 each year. Currently there is no evidence that ACL reconstructions prevent the development of arthritis.[9] Therefore it is not enough to just diagnose and treat ACL tears. The focus of many orthopedic surgeons and of ACL-related research is on

the prevention of ACL tears and the development of prevention programs.[10, 11]

In our study, the mean age of patients was 52.31±11.02years. There were 69 (69%) males and 31 (31%) females. The sensitivity and specificity of MRI were 93.3% and 96.4% for detection of ACL tear. PPV and NPV were 95.5% and 94.6% while diagnostic accuracy was 95%, which were corresponding to Fisher et al., study.[12] The sensitivity and specificity of MRI in various studies have been shown to range between 61% and 100%, and 82% and 97%, respectively.[13]

In a comparative diagnostic accuracy study by Amin et al., in post double bundle ACL reconstruction cases, MRI had sensitivity of 82.3% and specificity of 100% for complete tears.[14] MRI is accurate in identification of ACL tears, ranging from 93% to 97%.[13] Li et al., found that the pooled sensitivity and specificity were 87% (84–90%) and 90% (88–92%), respectively.[1]

Diagnostic sensitivity of MRI for ACL tear is reported to be 93% while specificity was 89%.[15] One study showed that MRI has 77.8% sensitivity and 100% specificity in diagnosing ACL tear.[16] One more study showed that MRI had 91.6% sensitivity, 95.2% specificity for detection of ACL.[17] In another Pakistani study, the accuracy of MRI in diagnosing the ACLwas 91.89%, with sensitivity of 93.33%, specificity of 85.71%, positive predictive value of 96.55% and the negative predictive value of 75%.[2]

Rose et al., reported that the accuracy of MRI was 98% for ACL tears. This they found that MRI is an expensive and unnecessary diagnostic test in patients with suspected meniscal pathology.[18] Khandelwal et al., found that the sensitivity, specificity and accuracy of MRI in reference to arthroscopy for ACL tear was 97.46%, 90.38% and 95.71%, respectively.[8]

The results of two large studiesshowed that MRI has relatively low sensitivity (40–75%), butmoderate to high specificity (62–94%) in diagnosis of partial tears.[19, 20]

CONCLUSION

It is concluded that MRI is highly accurate diagnostic modality for detection of ACL tears. Now we can recommend MRI for screening of knee injuries instead of going for interventional method like arthroscopy.

Author's Contribution:

Concept & Design of Study:	Zafar Tanveer Ahmed
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Data Analysis:	Saima Ameer, Fareeha Tanveer, Madeeha Tanveer
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Final Approval of version:	Zafar Tanveer Ahmed

Conflict of Interest: The study has no conflict of interest to declare by any author.

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