

A prospective study of role of MRI evaluation in knee injuries in a tertiary care hospital**Lokesh.T^{1*}, Indira Durai²**¹*Assistant Professor, Department of Radiology and Imaging Sciences, Tagore Medical College and Hospital, Rathinamangalam, Melakottaiyur, Chennai, Tamil Nadu, India*²*Associate Professor, Department of Radiology and Imaging Sciences, Tagore Medical College and Hospital, Rathinamangalam, Melakottaiyur, Chennai, Tamil Nadu, India*

Received: 06-11-2020 / Revised: 31-12-2020 / Accepted: 21-01-2021

Abstract

Introduction: Knee is one of the largest and most complex joints in the body. Disease processes and injuries that disrupt ligaments, menisci, articular cartilage and other structures of the knee cause painful knee resulting in significant morbidity and disability. Number of imaging modalities are currently used to evaluate knee abnormalities including standard radiography, scintigraphy, Computed Tomography (CT), planar tomography and arthrography. **Materials and Methods:** This study was a prospective, diagnostic descriptive study conducted in the Department of Radiology and Imaging Sciences, Tagore Medical College and Hospital, Rathinamangalam, Melakottaiyur, Chennai, Tamil Nadu. This study was conducted between January 2019 to December 2019. 100 patients presenting with knee injury referred from OPD (outpatient Department) & IPD (inpatient Department) of Department of Radiology and Imaging Sciences for MR imaging were included in the study. Arthroscopy was done in 39 patients and findings of arthroscopy were correlated with MRI findings. Sensitivity, specificity NPV, PPV and accuracy of MRI were calculated. **Results:** MR diagnosis of 100 cases was as follows: in ACL tear 50%; PCL tear 19%; MCL tear 17%; LCL tear 16%; MM tear 49%; LM tear 31%; Sensitivity, specificity, NPV, PPV and accuracy of MRI in detecting the knee injuries taking arthroscopy as gold standard are as follows ACL- 100%, 90.9%, 100%, 96.5% and 97.4 %; lateral meniscus-100%, 94.5%, 100%, 50% and 94.8%; medial meniscus 90.4%, 66.7%, 85.7%, 76% and 79.5% respectively. Correlation between MRI and arthroscopic findings regarding presence and absence of posterior cruciate ligament tear was highest with sensitivity -100%, specificity- 94.5%, NPV- 100% and accuracy-94.8%. There were 6 false positives for meniscus tear on MR examinations accounting for low positive predictive value (72%) of MR examination. Posterior horn tears of menisci are likely to be missed on arthroscopy. Out of 6 false positive cases of meniscus tear, 4 were located predominately in the posterior horn and 2 in the anterior horn. Thus, acceptance of MRI findings as false positive is controversial. **Conclusion:** MRI is a useful non-invasive modality having high diagnostic accuracy, sensitivity and negative predictive value making it a very reliable screening test for diagnosis of internal derangements of knee joint. Thus, MRI saves many knees from unnecessary arthroscopies.

Key Words: MRI, NPV, PPV, CT.

This is an Open Access article that uses a fund-ing model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Knee is one of the largest and most complex joints in the body. Disease processes and injuries that disrupt ligaments, menisci, articular cartilage and other structures of the knee cause painful knee resulting in significant morbidity and disability. Number of imaging modalities is currently used to evaluate knee abnormalities including standard radiography, scintigraphy, Computed Tomography (CT), planar tomography and arthrography[1].

Magnetic Resonance (MR) has revolutionized the knee imaging. Substantial evidence exists in the literature comparing MRI with arthroscopic findings which has helped in validating the role of MRI for the evaluation of meniscal and ligamentous injuries[2]. A superior soft tissue detail with multiplanar imaging capability provides a distant advantage for MRI over other imaging modalities in addition to its non-invasive, non-operator dependent and cost effective nature. MRI remains the modality of choice for imaging knee joint pathology[3]. It is a non-invasive investigation of knee and provides complete information that cannot be obtained by physical examination. MRI demonstrates the sensitivity and specificity of 90% for detecting meniscal tear and its sensitivity and specificity approaches 100% in cruciate ligaments injury[4,5].

*Correspondence

Dr. Lokesh.T

Assistant Professor, Department of Radiology and Imaging Sciences, Tagore Medical College and Hospital, Rathinamangalam, Melakottaiyur, Chennai, Tamil Nadu, India.

E-mail: driokesh.t@gmail.com

Present study aimed to identify common lesions seen in the knee joint and describe the MRI features in various types of traumatic and non-traumatic lesions causing painful knee joint.

Materials and Methods

This study was a prospective, diagnostic descriptive study conducted in the Department of Radiology and Imaging Sciences, Tagore Medical College and Hospital, Rathinamangalam, Melakottaiyur, Chennai, Tamil Nadu. This study was conducted between January 2017 to December 2017.

100 patients presenting with knee injury referred from OPD (outpatient Department) & IPD (inpatient Department) of Department of Radiology and Imaging Sciences for MR imaging were included in the study. Arthroscopy was done in 39 patients and findings of arthroscopy were correlated with MRI findings. Sensitivity, specificity NPV, PPV and accuracy of MRI were calculated.

Inclusion Criteria

All patients of knee injury to either one or both knees were undergone MR Imaging.

Exclusion Criteria

1. Patient with contraindications to MRI.
2. Patient with prior arthroscopy or surgical intervention.
3. Patient with known joint disease e.g.: Neoplasm, inflammatory or infectious disorder.
4. Patient with history of old significant trauma to the currently injured Knee.

Once the patient satisfied the criteria for this study, a written informed consent was obtained from each patient and a detailed history was elicited from all the patients. Relevant past history was also recorded. Findings of general physical and specific systemic examination were recorded in detail. X-ray knee joint (AP and lateral view) were done and findings were recorded. Any other view of knee joint e.g. oblique view etc., if done was documented. Then the MRI was done, and findings were also correlated with clinical diagnosis. MR findings were recorded in a proforma and correlated with clinical observations/ other radiological investigations/ arthroscopic findings (wherever performed) MRI Protocol MR scans were carried out on 1.5 tesla MR machine (Siemens) with sense extremity coil. Patient was placed in supine position and feet first in MR imager, with knee to be imaged in approximately 15-20-degree external rotation to aid the imaging of anterior cruciate ligament in the sagittal plane. Knee was also flexed 5-10 degrees for assessing patella femoral compartment. Knee to be imaged was centered with the 160 mm field of view, including in the image both the suprapatellar bursa and insertion of patellar ligament on the tibial tubercle. Localizer was taken in axial, sagittal and coronal planes after making proper positioning of the patient. The MRI protocol consisted of sagittal T2W, T2WFFE, PDSPiR sequences; coronal PD, T2W, STIR sequences; Axial T2 Sequences, T2FSE. Additional 3D sequences and higher sequences were done whenever required. 140 mm field of view and a 212 x 168 matrix were taken. The slice thickness was 4 mm with 0.4 mm gap.

Data Analysis

Data was analyzed using SPSS (Statistical Package for Social Sciences) version 20 (IBM Inc.Chicago). Data was entered in excel sheet was imported to SPSS for statistical analysis. Variables were of qualitative nature and hence have been expressed as proportions in terms of percentages. Sensitivity, specificity and predictive values were calculated for MRI findings by comparing them with arthroscopic findings.

Results

Age and Sex

There were 77 (77%) male and 23 (23%) female subjects out of the total 100 subjects. Right knee was injured in 55 (55%) patients (44 males; 11 females) While left knee injury occurred in 45 (45%) patients (33 males; 12 females). There were maximum numbers of patients in age group 21-30 years 39 (39%) patients followed by 20(20%) patients in age group 11-20 years and 18(18%) patients in age group of 31-40 years. No patient younger than 10 years was observed. Sports related injuries (32%) and roadside accident (30%) accounted for the highest number of the injuries (62%). It was followed by falls (23%). Least number of cases with slipping injuries (15%) was seen.

MRI Analysis of Ligament Injury Patterns

(Complete and partial) in 100 patients is as follows: ACL tear: 50 tears; PCL Tears: 19; MCL tears: 17; LCL tears-16. Hence amongst the 102 ligamentous injuries in 100 subjects, ACL tears (complete/partial) was the most commonly encountered pathology in this series (50%) followed by PCL, MCL and LCL tears which did not show significant variation with each other. Site of ligament tear was most commonly encountered at femoral attachment (28 cases) followed by mid substance site (15 cases). Least common site was fibular/tibial attachment with 7 cases.

Analysis of Meniscal Injury Patterns Identified on MRI

Some patients had both medial and lateral meniscus tear. 49 cases were having abnormal signal intensity in medial meniscus tears. Incidence of grade III signal intensity (medial meniscal tears) were seen in 30 cases, grade II signal intensity were seen in 10 cases followed by grade 1 signal intensity seen in 9 cases. There were 31 cases having abnormal signal intensity in lateral meniscus tears. Grade III signal intensity (tear) was seen in 17 cases followed by grade II signal intensity and grade 1 signal intensity 7 cases each.

Type and Location of Grade III Meniscus Tears (LM + MM) on MRI

Total No. of Grade III Medial meniscal tears observed on MRI were 30 (30%) cases. Most common Type of tear was Bucket handle tear which comprised of 10 cases, followed by oblique meniscal tears and complex meniscal tears 7 cases each. Peripheral and radial tears constituted 4 cases and 2 cases respectively. Most common location of medial meniscal tear was in posterior horn, (19 cases), 11 of the cases showed tears in anterior horn which was second most common location. No tear was noted in the body of medial meniscus. Grade III Lateral meniscal tear seen in MRI were 17 cases and most common location was in posterior horn which was found in 11 cases followed by location in anterior horn seen in 6 cases. Most common type of tear was oblique tear seen in 7 cases followed bucket handle tear and complex tear seen in 4 cases each. Peripheral type of tear was seen 2 cases of lateral meniscus tears. No tear was noted in the body of lateral meniscus.

Correlation of Clinical and MR Findings

Correlation between Clinical and MR findings regarding presence or absence of ACL tear was - 80/100 (80%), PCL tear: 93/100 (93%), MCL tear: 84/100 (84%), LCL tear: 90/100 (90%), medial meniscal tear: - 70/100 (70%), lateral meniscal tear: - 82/100 (82%)

Arthroscopy

Arthroscopic knee surgery was performed in 39 subjects out of the total 100 subjects. Rest of the patients were managed conservatively. Correlation of MRI findings and arthroscopy findings in 39 patients are listed below

Table 1: Findings on MRI

MRI	ACL	PCL	MM	LM
Tear	29	4	25	4
Normal	10	35	14	35
Total	39	39	39	39
Findings on arthroscopy	ACL	PCL	MM	LM
Tear	28	2	21	2
Normal	11	37	18	37
Total	39	39	39	39

Table 2: Correlation of MRI and Arthroscopic Findings in ACL & PCL Tears

ACL Tear on MRI	
Anterior Cruciate Ligament (ACL)	No of subjects
Tear on MRI	29
Tear on Arthroscopy (TP)	28
Normal on Arthroscopy (FP)	1
ACL Normal on MRI	
Anterior Cruciate Ligament (ACL)	No of subjects
Normal on MR	4
Tear on Arthroscopy (TP)	2

Normal on Arthroscopy (FP)	2
PCL Tear on MRI	
Posterior Cruciate Ligament (PCL)	No of subjects
Tear on MR	4
Tear on Arthroscopy (TP)	2
Normal on Arthroscopy (FP)	2
PCL Normal on MRI	
Posterior Cruciate Ligament (PCL)	No of subjects
Normal on MR	35
Tear on Arthroscopy (TP)	0
Normal on Arthroscopy (TN)	35

Table 3: Lateral Meniscus Tears on MRI

Lateral Meniscus Tears on MRI	
Lateral Meniscus	No of subjects
Tear on MRI	4
Tear on Arthroscopy (TP)	2
Normal on Arthroscopy (FP)	2
Lateral Meniscus Normal on MRI	
Lateral Meniscus	No of subjects
Normal on MR	35
Tear on Arthroscopy (FN)	0
Normal on Arthroscopy (TN)	35
Medial Meniscus tears on MRI	
Medial Meniscus	No of subjects
Tear on MR	25
Tear on Arthroscopy (TP)	21
Normal on Arthroscopy (FP)	4
Medial Meniscus Normal on MRI	
Medial Meniscus	No of subjects
Normal on MR	14
Tear on Arthroscopy (FN)	0
Normal on Arthroscopy (TN)	14

Discussion

100 patients of knee injuries had undergone MR imaging. Arthroscopic knee surgery was performed in 39 out of the total 100 subjects. Rest of the 61 subjects underwent conservative management. Incidence of knee injuries was much more common in younger generation with peak incidence of 39% occurring in age group 21-30 years in present study. Similar results have been shown with mean age varying from 24-36 years[6].

Aetiology of Knee Injury

There was almost equal incidence of knee injuries occurring due to sports (32%) and roadside accidents (30%) followed by falls (23%) and slipping injuries (15%). This is due to the fact present is a multi-specialty hospital with tertiary trauma care centre, so all kinds of patient referrals come to us thus almost equally distributing the subjects in above categories. In literature between 27% to 48% have been reported to be sports related (Kannus & Jarvinen, Nielsen & Yde, Ansari et al. So incidence of sports related knee injuries of present study matches the incidence shown in these studies[7].

Comparison of Correlation of Clinical and MRI Finding

Correlation between Clinical and MR findings regarding presence or absence of ACL tear was - 80/100 (80%), PCL tear: 93/100 (93%), MCL tear: 84/100 (84%), LCL tear: 90/100 (90%), Medial meniscal tear: 70/100 (70%), Lateral meniscal tear: 82/100 (82%). Odgaard et al observed correlation between clinical MR findings regarding presence or absence of ACL tears in 74% cases, PCL tear- 98% cases, MCL tear- 66% cases, LCL tear- 88% cases, Medial meniscus tear-62% cases and LCL tear in 81% cases[8].

Analysis of Ligament and Meniscal Injury Pattern on MRI Examination

In present study out of 100 patients 50% showed ACL tears, 19% showed PCL tears, (30%) showed MM tears (GRADE III), 17%

(grade III) showed LM-tears. Findings of present study matches and in variance with study of Ranjan and Mohammad[9,1].

Conclusion

100 cases of knee injury were evaluated with MRI examination. There was 77% males and 23% females. Large number of patients were present in the age group of 21 to 30 years 39% followed by 20% in the age group of 11-20 year and 18% in age group of 31-40 year. A good Correlation between MR findings and clinical findings was observed. MR diagnosis of 100 cases was as follows: in ACL tear 50%; PCL tear 19%; MCL tear 17%; LCL tear 16%; MM tear 49%; LM tear 31%; Sensitivity, specificity, NPV, PPV and accuracy of MRI in detecting the knee injuries taking arthroscopy as gold standard are as follows ACL-100%, 90.9%, 100%, 96.5% and 97.4%; lateral meniscus-100%, 94.5%, 100%, 50% and 94.8%; medial meniscus 90.4%, 66.7%, 85.7%, 76% and 79.5% respectively. Correlation between MRI and arthroscopic findings regarding presence and absence of posterior cruciate ligament tear was highest with sensitivity -100%, specificity-94.5%, NPV-100% and accuracy-94.8%. There were 6 false positives for meniscus tear MR examinations in present study accounting for low positive predictive value (72%) of MR examination. Posterior horn tears of menisci are likely to be missed on arthroscopy. Thus, acceptance of MRI findings as false positive is controversial. Out of 6 false positive cases of meniscus tear 4 were located in the posterior horn and 2 in the anterior horn. MRI is a useful non-invasive modality having high diagnostic accuracy, sensitivity and negative predictive value making it a very reliable screening test for diagnosis internal derangements of knee joints. Hence MRI should be done in evaluation of patients with knee injuries saving them from unnecessary arthroscopies.

References

1. Rodriguez W JR, Vinon EN, Hlems CA, Toth AP. MRI appearance of posterior cruciate ligament tears. *AJR Am J Roentgenol* 2008; 191(4):W155-W155.
2. Sanders TG, Medynski MA, Feller JF, Lawhorn KW. Bone contusion patterns of the knee at MR imaging: footprint of the mechanism of injury. *Radio Graphics* 2008; 20(6):S135-S151.
3. Ng WHA, Griffith JF, Hung EHY, Paunipagar B, Law BKY, Yung PSH. Imaging of the anterior cruciate ligament. *World J Orthop* 2011; 2(8):75-84.
4. Vinson EN, Major NM, Helms CA. The posterolateral corner of the knee. *AJR Am J Roentgenol* 2008; 190(2):449-458.
5. Chen L, Kim PD, Ahmad CS, Levine WN. Medial collateral ligament injuries of the knee: current treatment concepts. *Curr Rev Musculoskeletal Med* 2008; 1(5):108-113.
6. Smet AAD. How I diagnose meniscal tears on knee MRI. *AJR Am J Roentgenol* 2012; 199:481-499.
7. Helms CA. The meniscus: recent advances in MR imaging of the knee. *AJR Am J Roentgenol* 2002; 179(3):1115-1122.
8. Haims AH, Medvecky MJ, Pavlovich R, Jr, Katz LD. MR imaging of the anatomy of and injuries to the lateral and posterolateral aspects of the knee. *AJR Am J Roentgenol* 2003; 180(5):647-653.
9. Recondo JA, Salvador E, Villanua JA, Barrera B, Gervas C, Alustiza JM. Lateral stabilizing structures of the knee: functional anatomy and injuries assessed with MR imaging. *Radio Graphics* 2000; 20(6):S91-S102.
10. Hetta W, Niazi G. MRI in assessment of sports related knee injuries. *The Egyptian Journal of Radiology and Nuclear Medicine* 2014; 45(3): 1153-1161.

Conflict of Interest: Nil

Source of support: Nil