Original Research Article

Role of magnetic resonance imaging in the evaluation of traumatic knee joint injuries

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Abstract

Background: Traumatic knee injuries constitute a major source of morbidity especially in young active individuals attending orthopaedic outpatients department. MRI is a non-invasive, nonoperator dependent effective imaging modality and plays a pivotal role in early detection of these injuries with a very high negative predictive value. MRI of knee would save us many unnecessary diagnostic arthroscopy, which is an invasive procedure with associated complications. MRI has offlate become the imaging modality of choice for the evaluation of the painful Knee following injury. It can detect soft tissue abnormalities (meniscal, cruciate, collateral, Ligament tears) and microtrabecular fractures that cannot be detected by plain film. The purpose of our study was to identify various MRI imaging findings in patients with painful knee following traumatic injuries. **Materials and Methods:** This study was performed in the department of Radio diagnosis, on patients referred from orthopedics department from January 2017 to september 2018. Fifty patients with painful knee following traumatic knee injury (36 men, 14 women; mean age 26.9 yrs) were included in this prospective study. They were evaluated with detailed clinical history, clinical examinations and were subsequently subjected to imaging of knee using 3 T MRI 32 channel Siemens MRI machine. Sequences used were axial, sagittal and coronal PD Fat Sat, saggital T2 Fat Sat and T2 Saggital GRE. **Results :** In our study, the most common abnormal MRI finding was joint effusion seen in 42 cases (84%), followed by complete tear of ACL which was seen in 29 cases (58%).Most common type of meniscal injury was a Grade III tear involving posterior horn of medial meniscus (60%). ACL was the commonest ligament to be injured with complete tear being more common than partial tear. LCL was the commonest ligament to be torn in association with ACL. Indirect signs of ACL injury were evaluated and found to helpful in corroborating the tears. **Conclusion:** MRI is an excellent non-invasive modality with high level of accuracy in diagnosis of meniscal and ligamentous injuries of knee. It is an appropriate screening tool and helps to avoid unnecessary diagnostic arthroscopy in most cases of traumatic knee injuries.

Key Words: Diagnostic accuracy, Magnetic resonance imaging, Traumatic knee joint injuries.

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INTRODUCTION

Knee being one of the major joints involved in kinesis, also bears the consequences of increased mobility. The price of its mobility is a tendency to instability. With increasing involvement in sports related activities especially in young people, trauma related knee pathologies have increased. MRI has emerged as an excellent modality for imaging of ligaments, cartilage, menisci and other structures around the knee joint[1]. This is due to the combination of multiplanar capability and superior soft tissue characterization. This modality has superseded already available modalities like conventional radiographs and CT, over last two decades.

AIMS AND OBJECTIVES

Objectives of this study are:

1. To identify the various MRI imaging findings in clinically suspected cases of knee joint injuries.

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2. To correlate imaging findings with clinical examination findings.

MATERIALS AND METHODS

This prospective study was performed in the department of Radiodiagnosis in a tertiary health care institute including fifty patients referred from orthopaedic department with history of traumatic knee injury over a period of twelve months.. Both male and female patients of age group15 to 50 years presenting with knee joint injuries were included in this study. Patients with pre-existing knee pathology or post operative cases and those with any absolute contraindication for MRI like metal implants and pacemakers were excluded from the study. The study group patients were evaluated with clinical examinations and subsequently subjected to MRI of knee using dedicated knee coil on 3 T MRI 32 channel Siemens Verio MRI machine. Routine imaging knee protocol was done using PD Fat sat axial, coronal and sagittal images, T2 FS sagittal, and GRE Sagittal sequences.

RESULTS

Age and sex distribution of patients: There were 36 males and 14 females in this study. Male patients exceeded the number of female patients in all the age groups. It was mostly young adult male who underwent MR for clinically suspected traumatic knee injuries.

Ligamentous Tears: Tears of various ligaments around the knee were identified involving either a single ligament or combination of ligaments. Out of 50 cases, ACL tear was seen in 33 (66%), PCL tear in 5 (10%), MCL tear in 20 (40%) and LCL tear in 12 (24%) of cases. Associated joint effusion was seen in 40 cases (80%) and bone bruise/contusion was noted in 22 case (44%).

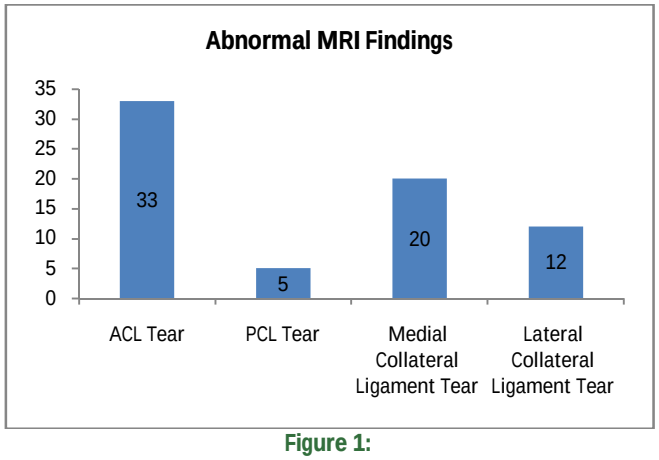

Figure 1:

ACL TEARS: ACL tears were imaged in 33 cases. Of the 33 cases of ACL tears, 66.6% was complete tear and 88% of them involved the midsubstance. Indirect signs of ACL tear in the form of Objective criteria such as Sagittal ACL – Tibial angle, Blumensaat line – ACL angle, PCL angle and anterior tibial displacement were used. The mean Sagittal ACL – Tibial angle was 40^{o} in case of partial ACL tear while the mean was only 21^{o} in complete ACL tears. The mean Blumensaat line – ACL angle was + 5^{o} in partial ACL tear and was + 26^{o} in complete ACL tears. The mean PCL angle was 121^{o} in partial ACL tear and more acute angled with a mean angle of 102^{o} in complete ACL tears. Mean anterior tibial displacement measured 6 mm in partial ACL tear and 9 mm in complete ACL tears.

PCL tears: In our study PCL tear was found in 5 (10%) patient in which 3 patient have complete tear. Bone bruise was found in 3 cases (75%) of PCL tears. Joint effusion is found in all cases of PCL tear. Posterior drawer test was positive in all the case of complete tear and was not demonstrated in 2 cases.

Meniscal Tears: Of the total cases with meniscal tears, 18 (51.4%) were isolated medial meniscal, 10 (28.6%) were isolated lateral meniscal and 7 (20 %) involved both menisci.

Medial Meniscus Tears: Meniscal tears were evaluated on the basis of site and type of tear and grading was done according to standard criteria. In medial meniscus, posterior horn was most commonly involved site noted in 11 (61%) and the predominant type of tear in posterior horn was oblique tear that occurred in 6 (54%), horizontal tear was seen in 3 (27.2%) and complex tear is seen in 2 (18.1%). Anterior horn was involved in 1 patient (5%), which was also oblique tear. Bucket handle tear was seen in 2 cases (11%). Complex tear involving body and posterior horn was seen in 4 cases

Table 1: Grade III tear were the commonest seen in 12 cases (66%) followed by Grade II in 5 (27.7%) and grade I (5.5 %).

Medial Meniscus Tear	Number of patients	Percentage
Grade I	1	5.5%
Grade II	5	27.7%
Grade III	12	66.6%

Lateral meniscus tears site and type of tear: In lateral meniscus, also posterior horn was commonest site of involvement, occurring in 5 (50%) followed by anterior horn in 3 cases (30%) and complex tear was seen involving body and posterior horn in 2 cases (20%). Overall in lateral meniscus predominant type of tear was radial was seen in 4 cases (40%), oblique tear in 3 cases (30%) and complex tear in 2 cases (20%).

Table 2:

Lateral Meniscus Tear	Number of patients	Percentage
Grade I	1	10%
Grade II	4	40%
Grade III	6	60%

Tears involving both medial and lateral menisci were predominately complex tears involving body and posterior horn of both meniscus seen in 5 cases (71%) which was of grade III. In 2 cases (29%) only posterior horn of both menisci were involved.

Clinical Tests: On clinical examination Lachman test was conclusive for ACL tear in 89 % of cases, posterior drawer test in 60%. Mcmurray's test in 68% of medial meniscal tear, 80% of lateral meniscal tear, valgus stress test in 75% of MCL tear and varus stress in 100% of LCL tear.

Table 3:

Clinical test	Number of patient with positive Test	Number of patient having tear	%
Lachman test	29	33	89%
McMurray's Test	24	35	68%
Posterior Drawer test	3	5	60%
Valgus Stress test	15	20	75%
Varus Stress test	12	12	100%

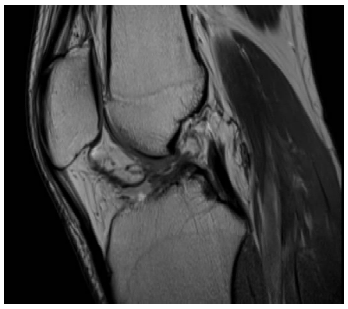

Figure 1

Figure 2

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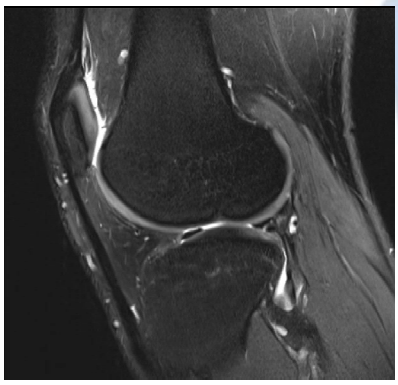

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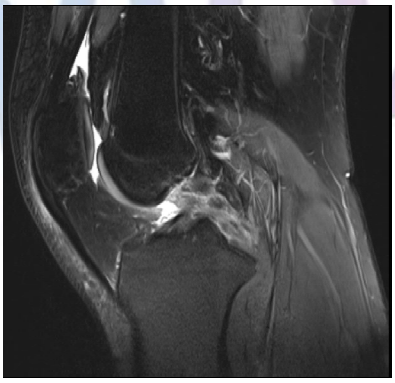

Figure 5

Figure 6

Figure 1: Saggital PD Fat suppressed MR image shows loss of continuity of ACL fibers with abnormal signal within – Complete ACL Tear.
Figure 2: Coronal PD Fat suppressed MR image shows medial meniscal tear with flap in the intercondylar notch.
Figure 3: Coronal PD Fat suppressed MR image shows Grade II signal in medial collateral ligament – Complete tear.
Figure 4: Sagittal T2 Fat suppressed MR image shows oblique tear of lateral meniscus involving posterior horn.
Figure 5: Sagittal T2 Fat suppressed MR image shows loss of continuity of PCL fibres with wavy contour and abnormal signal within – Complete PCL tear.
Figure 6: Coronal PD Fat suppressed MR image shows bone contusion in medial femoral condyle with joint effusion.

DISCUSSION

Disruption of various ligaments and cartilage around the knee joint leads to significant morbidity, especially in young adults involved with sporting activities. Invent of MR imaging and its increasing use in musculoskeletal imaging has revolutionized the understanding of pathologies around knee joint. Many studies have been published on sensitivity and specificity of MRI in identifying ligamentous and meniscal pathologies and imaging features compared with arthroscopy or surgical findings. These have suggested MR to be an effective tool for evaluation of knee joint. This study included 50 patients with painful knee following trauma who were referred for MRI. The study group constituted of 36 men and 14 women with mean age 26.9 yrs.

Ligamentous Injury: In this study, ligamentous injury

was most common pathology seen in 76%. Of them 66% had ACL injury, 10% had PCL injury, 40% had MCL injury and 24% had LCL injuries.

ACL tear: Of the 33 cases of ACL tears, 66.6% was complete tear and 88% of them involved the midsubstance. In study done by Mink *et al*[2] midsubstance tear was demonstrated in 90% of ACL tears. The indirect signs of ACL tears were assessed. Presence of these indirect signs corroborated the presence of ACL tear in our study. The mean Blumensaat line – ACL angle was + 5^o in partial ACL tear and was + 26^o in complete ACL tears. The mean PCL angle was 121^o in partial ACL tear and more acute angled with a mean angle of 102^o in complete ACL tears. Mean anterior tibial displacement measured 6 mm in partial ACL tear and 9 mm in complete ACL tears. Our study was in tandem to that of Amilcare Gentili *et al*[3] who performed an retrospective study to establish the sensitivity and specificity of indirect signs of ACL tears on MR. They reported a sensitivity and specificity were as follows; 90%, 97% for ACL angle < 45^o, 89%,100% for Blumensaat – ACL angle > 15^o; 52%, 94% for PCL angle <107^o and 41%,91% for anterior displacement of tibia > 7 mm.

89% of cases with Positive Lachman's test had complete ACL tears on MR. In only 11% of cases, ACL tear were not suspected clinically on Lachman's test but was detected on MR. These were all cases of partial disruption of a bundle of ACL. Complete ACL tears were suspected clinically by positive Lachman test and confirmed on MR examination. Study done by Malanga *et al*.[4] on physical examination of knee demonstrated that the Lachman test is sensitive and specific for the detection of anterior cruciate ligament tears. Similar results were found in our study also.***PCL tear was noted in five cases**. Out of 5 complete tear found in 3 and partial tear in 2 cases. Bone bruise was found in 3 patient (75%), predominantly involving the anterior and lateral tibial surface in all the cases. Sonin *et al*.5 reported high incidence of bone bruise in association with PCL tear ranging from 32 to 83%. Knee joint effusion is found in all cases.

Medial collateral ligament tear: 40% of ligamentous injuries involved the MCL. Grade I tear was found in 10 (50%), Grade II tear in 5 (25%) and Grade III tear in 5 (25%). Concomitant ACL tear was found in 60% of cases.

***O' Donoghue 's traid (combination of ACL, MCL and medial meniscus tear) was seen in 3 cases.**

Lateral collateral ligamentous tear: Lateral compartment injuries are less commoner than medial compartment injuries. LCL injuries were found in 24% of cases in our study. Grade I tear was found in 2 (16%), Grade II tear in 3 (25%) and Grade III tear in 7 (58.4%). Varus and valgus stress tests were used to test for LCL and MCL respectively. Valgus stress test was positive in 75% of cases with MCL injury and varus stress test was present in 100% of cases with LCL injury. According to Malanga *et al*[3] although collateral ligament testing seems to be sensitive and specific, there is a lack of well designed studies that scientifically validate the sensitivity and specificity of these tests.

Meniscal Tear: Meniscal tears were found in 35 cases in this study. 51.4% involved only the medial meniscus, 28.4 % only the lateral meniscus and 20% involved both menisci. *Medial meniscus was commoner to get torn as it is a less mobile structure and transmits more force during weight bearing. 61 % of tears involved the posterior horn. Jee *et al*[5] reported prevalence of torn posterior horn of medial meniscus to be about 56%. Anterior horn tear was found in 5% of cases in our study which is comparable to the study done by De Smet *et al*.[6] that showed involvement of anterior horn of medial meniscus in 2% of cases. Grade III tear were the commonest seen in 12 cases (66%) followed by Grade II in 5 (27.7%) and grade I (5.5 %).

***Lateral meniscal tears:** Lateral meniscal tears also commonly occurred in posterior horn 5 (50%), as in medial meniscus. But anterior horn of lateral meniscus was more commonly torn 3 (30%) than that of medial meniscus (5%). Complex tear was seen involving body and posterior horn in 2 cases (20%). According to Malanga *et al*[4] for meniscal tears, the McMurray test is very specific but has a very low sensitivity. In our study population, McMurray test was positive in 68% of meniscus tear. Helms *et al*.[7] reported that 10% of tears of medial meniscus were of bucket handle type. Our study also found similar occurrence of bucket handle tears (11%).

CONCLUSION

Knee joint injuries are common in young active male. The need to accurately evaluate the knee injuries is very crucial for the proper management and outcome, otherwise it will lead to chronic debility to the patient. MRI is an excellent, non invasive, radiation free precise imaging modality with multiplanar capabilities and excellent soft tissue delineation. Appropriate sequences and analysis of images in all three planes helps to accurately detect, localise and characterise various injuries to ligaments and menisci of knee joint thereby guiding further management of patient. Both MRI and arthroscopy have their limitations. These shortcomings might be overcome by combining both modalities when clinically indicated. Also post-traumatic pre-arthroscopic MR imaging evaluation serves as a road map and has proved to be cost-effective. MRI should be the initial investigation of choice in the evaluation of all cases of

knee joint injuries. Because it can detect both intra and extra articular pathologies and also osseous structures.

REFERENCES

1. Stoller DW. Magnetic Resonance Imaging in Orthopaedics and Sports Medicine. 3rd ed. Philadelphia: Lippincott Williams and Wilkins; 2007
2. Mink JH, Deutsch AL. MRI of the musculoskeletal system. New York: Raven, 1990; 251- 85.
3. Gentili A, Seeger LL, Yao L, Do HM. Anterior cruciate ligament tear: indirect signs at MR imaging. Radiology 1994; 193:835–840.
4. Malanga GA, Andrus S, Nadler SF, McLean J. Physical examination of the knee: a review of the original test description and scientific validity of common orthopedic tests. Arch Phys Med Rehabil2003 Apr;84(4):592-603
5. Sonin AH, Fitzgerald SW, Hoff FL, Friedman H, Bresler ME. MR imaging of the posterior cruciate ligament: normal, abnormal, and associated injury patterns. Radiographics 1995; 15(3):551–61.
6. Jee WH, McCauley TR, Kim JM, Jun DJ, Lee YJ, Choi BG, et al. Meniscal tear configurations: categorization with MRimaging.AJR Am J Roentgenol 2003; 180(1):93–7.
7. Helms CA, Laorr A, Cannon WD. The absent bow tie sign in bucket-handle tears of the menisci in the knee. AJR 1998; 170:57–61.

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