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A prospective study of role of MRI evaluation in knee injuries in a tertiary care hospital

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Abstract---Background: The knee is a major weight bearing joint that provides mobility and stability during physical activity as well as balance while standing. Traumatic knee injuries are frequently encountered both in general practice and in the hospital setting. These injuries are often caused by sports activities and may lead to severe pain and disability. Magnetic resonance imaging (MRI), with its multi-planar capabilities and excellent soft tissue contrast, has established itself as the leading modality for noninvasive evaluation of the sports related knee injuries. Materials and methods: A prospective study was conducted at the department of radiology in BLDE (DU), Shri B M Patil Medical College & RC during the period February 2020 to February 2022. 100 patients (100 knees) were examined, 84 patients were males and 22 patients were females their ages ranging

from (16-61) years, presented with various knee joint injuries and were referred from Orthopedics Department BLDE (DU), Shri B M Patil Medical College & RC, Vijayapur, Karnataka. Results: In our study MRI examination was performed on (100) patients with complaints of knee injury. Regarding the most common age group affected was the age group of (21-39) and this is explained by the fact that this age group being the most active group. From (100) patients examined in this study, 84 patients (76%) were males and 16 of them were females. Of them 72(76%) had ACL tears, 6 (6%) had PCL tears, 34(34%) had MM tears and 22(22%) had LM injuries. Conclusion: Ligamentous and meniscal injuries occur frequently in patients with trauma to the knee. It is noted that ACL and MM are more commonly torn when compared to PCL and LM While ACL and MCL tears show predilection towards medial meniscus tear, LCL tear showed a strong relationship with lateral meniscus tear MRI is highly sensitive and accurate at identification of both anterior cruciate and posterior cruciate ligament tears. A close agreement was obtained between MRI and arthroscopic diagnosis. The diagnostic yield is increased with appropriate use of sequences and proper analysis of images in all planes. Misinterpretations are more likely to happen in the case of partial anterior cruciate ligament tear where it can be missed or it can be over diagnosed on MRI.

Keywords---Traumatic knee, Magnetic resonance imaging, arthroscopic diagnosis.

Introduction

The knee is a major weight bearing joint that provides mobility and stability during physical activity as well as balance while standing. Traumatic knee injuries are frequently encountered both in general practice and in the hospital setting. These injuries are often caused by sports activities and may lead to severe pain and disability. Magnetic resonance imaging (MRI), with its multi-planar capabilities and excellent soft tissue contrast, has established itself as the leading modality for noninvasive evaluation of the sports related knee injuries.¹

Magnetic resonance imaging is a well accepted imaging modality in the diagnostic workup of patients with knee complaints and has largely replaced diagnostic arthroscopy for this purpose. It is regarded as the top imaging and diagnostic tool for the knee joint as a result of its ability to evaluate a wide range of anatomy and pathology varying from ligamentous injuries to articular cartilage lesions.²

Magnetic Resonance Imaging [MRI], a non-invasive modality, is now routinely used to assess a wide spectrum of internal knee derangement. Potential of MRI in assessing the knee injuries were first reported in 1983 in literature.³ Since then it has changed the traditional algorithm for work up of knee joint pathology, particularly when meniscal and cruciate ligament injuries are suspected. Additional advantages of MRI are multiplanar and thin section capabilities. It does not utilise ionizing radiation therefore it is entirely safe.⁴ It is also non-

invasive, painless and allows acquisition of images in multiple planes without repositioning the patient. In addition, MRI provides excellent spatial and contrast resolution of both intra and extra articular structure. Thus, MRI clearly emerged as primary imaging tool in work up of knee joint pathology.⁵

We wanted to study MRI appearances of cruciate ligaments and meniscal tears in cases of knee injury, correlate the MRI findings of knee injury with clinical observations/other radiological investigations/ arthroscopic findings and determine the sensitivity, specificity, PPV, NPV and accuracy of MRI in detecting knee injuries taking arthroscopy as gold standard (wherever performed).

Materials and Methods

A prospective study was conducted at the department of radiology in BLDE (DU), Shri B M Patil Medical College & RC, Vijayapur, Karnataka, during the period February 2020 to February 2022. 100 patients (100 knees) were examined, 84 patients were males and 22 patients were females their ages ranging from (16-61) years, presented with various knee joint injuries and were referred from Orthopedics Department in BLDE (DU), Shri B M Patil Medical College & RC, Vijayapur, Karnataka.

MRI examination

Instrument: The examination done using 1.5 Tesla GE Signa HDxt scanner, with dedicated extremity coils (surface coils) as both transmitter and receiver of radio-frequency waves was applied. The imaging system is enclosed in a radio frequency room.

Inclusion Criteria: Patients of adult population (16-61years) willing to undergo MRI scanning with clinically suspected injuries of the knee and consenting for the same.

Exclusion criteria:

All patients who present with pain and/swelling at the knee joint without any history of injury and inflammatory, degenerative, neoplastic, infective etiologies causing pain and/ swelling at knee joint are excluded from study.

Patients who had previously undergone arthroscopy with repair of menisci and ligaments. Patients not consenting for the study.

- Patients on cardiac pace maker.
- Patients on metal implants.
- Patients on neuro stimulators.

Data Acquisition

Once a patient satisfied the inclusion criteria for this study, he or she was administered the study proforma. The patients were briefed about the procedure. The noise due to gradient coils (heard once the patient was inside the bore of the magnet) and the need to restrict body movements during the scan time was explained to the patient. Patient is placed in supine position with the knee in a closely coupled extremity coil. The knee is externally rotated 15 – 200 (to facilitate

visualization of the ACL completely on sagittal images) and is also flexed 5-100 (to increase the accuracy of assessing the patella-femoral compartment). MRI scan was done using sagittal (T2 FSE, PDFAT SAT, STIR, T2 FRFSE fatsat) Coronal PD FATSAT and Axial STIR sequences using the standard imaging protocol.

Results

In our study MRI examination was performed on (100) patients with complaints of knee injury. Regarding the most common age group affected was the age group of (21-39) and this is explained by the fact that this age group being the most active group. From (100) patients examined in this study, 84 patients (76%) were males and 16 of them were females. Of them 72(76%) had ACL tears, 6 (6%) had PCL tears, 34(34%) had MM tears and 22(22%) had LM injuries.

Table 1: Various injuries in knee joint trauma in study population

Type Of Tear	No. Of Cases (N)	Percentage (N%)
ACL	76	76%
PCL	6	6%
MM	34	34%
LM	22	22%
MCL	28	28%
LCL	18	18%
BC	42	42%
Fractures	14	14%
Joint effusion	50	50%

MRI diagnosis was placed into one of the four categories after arthroscopic evaluation:

1. **True positive:** MRI diagnosis of tear, confirmed on arthroscopic evaluation
2. **True negative:** MRI diagnosis of no tear was confirmed on arthroscopy
3. **False positive:** MRI showed a tear but arthroscopy was negative
4. **False negative:** If MRI images were negative but arthroscopy showed a tear.

Table 2: MRI diagnosis was placed into one of the four categories after arthroscopic evaluation

Test	True positive	False positive	False negative	True negative
ACL MRI finding	70	4	2	24
PCL MRI finding	6	0	0	94
MM MRI finding	26	8	54	12
LM MRI finding	18	4	70	8

Based on the above categories, sensitivity, specificity, PPV, NPV were calculated to assess the reliability of the MRI results.

Table 3: Accuracy of MRI findings using Arthroscopic findings as the reference data

Tears	Sensitivity	Specificity	PPV	NPV	Accuracy
ACL	94.59%	80%	94.50%	80.00%	94%
PCL	100%	100%	100%	100%	100%
MM	68.42%	86.66%	76.47%	81.20%	80%
LM	69.23%	94.10%	81.81%	81.88%	88%

Discussion

Imaging of knee presents a special challenge because of its complex structure. A variety of imaging modalities are currently used to evaluate knee abnormalities. These modalities include standard radiography, scintigraphy, computed tomography, magnetic resonance imaging and arthrography. MR imaging has revolutionized knee imaging. It has been compared by various studies between magnetic resonance and arthroscopic findings. These studies validate the role of MR imaging in the clinical arena especially for the evaluation of knee injuries.⁶

The study population consisted in the age group of 16 to 61 years. Maximum number of patients who underwent MRI of the knee for injuries belonged to the age group of 18 to 28 years. Out of total 100 patients, ACL tear was most common finding affecting 76 patients (76%) among which 60(79%) had complete tear and 16 patients (21%) had partial tear, followed by Medial meniscus tear in 34 (34%) and lateral meniscus tear seen in 22 patients (22%). In a similar study by Singh et al., 45.08% showed ACL tear, among which 66.67% were partial and 21.13% were complete ACL tear. The authors concluded ACL tears to be more common than other ligamentous injuries.⁷

PCL injuries are less common than ACL injuries and reported rates vary from 3% to 20%. The PCL being a stronger ligament has a low incidence of tears. The sensitivity, specificity and accuracy of MRI in identifying PCL tear is 100% which is similar to a study by Manoj et al in which the accuracy of MRI in detecting PCL tears is 100%.⁸

MRI of the knee has been found to be highly accurate in the diagnosis of meniscal tears. All the medial meniscal tears are associated with ACL tears in present study. The biomechanical forces that result in the ACL tear also result in medial meniscal tear.⁹ Because of multiple tear the sensitivity of the medial meniscal tear is reduced. Due to presence of multiple tears one peripherally located meniscal tear was over looked on MRI in two patients. The sensitivity of medial meniscal tear is reduced in the presence of ACL tears. The medial meniscal tears are usually peripheral tears when associated with ACL tears.¹⁰

Conclusion

Ligamentous and meniscal injuries occur frequently in patients with trauma to the knee. It is noted that ACL and MM are more commonly torn when compared to PCL and LM While ACL and MCL tears show predilection towards medial meniscus tear, LCL tear showed a strong relationship with lateral meniscus tear

MRI is highly sensitive and accurate at identification of both anterior cruciate and posterior cruciate ligament tears. A close agreement was obtained between MRI and arthroscopic diagnosis. The diagnostic yield is increased with appropriate use of sequences and proper analysis of images in all planes. Misinterpretations are more likely to happen in the case of partial anterior cruciate ligament tear where it can be missed or it can be over diagnosed on MRI.

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