

MRI Evaluation of Ligament Injuries of the Knee Joint

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Abstract

Background and Objective: Knee joint is the complex joint. It is much frequently injured joint due to trauma. The principle intra articular structures in the knee are the 2 cruciate ligaments, 2 menisci and the 2 collateral ligaments. The main objective is to study the MRI findings in ligament injuries of knee joint. **Materials and Methods:** MRI knee of 110 patients with suspected ligament injuries of knee joint was performed on 1.5-T MR system using flexible surface knee coil. **Results:** A total of 110 patients in a period of 2 years were collected and analysed comprising of either single ligament or combination of ligament tears. Anterior Cruciate Ligament (ACL) tear was most common and seen in 61 patients followed by Medial Collateral Ligament (MCL) in 31, Lateral Collateral Ligament (LCL) in 22 and Posterior Cruciate Ligament (PCL) in 16 patients. Majority of the patients belonged to age group 18-30 years with right knee involvement. Males dominated in this study constituting 63.64% of total population. **Conclusion:** MRI is non-invasive prime imaging modality with non-ionizing radiation and multi planar capabilities. It accurately detects, localizes and characterizes various ligament injuries of the knee joint and help in arriving at accurate final diagnosis thereby guiding further management of the patient.

Keywords: ACL - Anterior Cruciate Ligament, LCL - Lateral Collateral Ligament, MCL- Medial Collateral Ligament, MRI - Magnetic Resonance Imaging, PCL- Posterior Cruciate Ligament, T – Tesla

1. Introduction

Knee joint is the complex joint of the body and it is much frequently injured joint due to trauma. The principle intra articular structures in knee are the two menisci, two cruciate ligaments and the two collateral ligaments. The stability of the knee joint is mostly dependent upon its supporting ligamentous structures and therefore injuries of ligament and menisci are extremely common¹.

Ligament injuries of the knee due to trauma occurring due to road traffic accidents and sports related constitute a large proportion of musculoskeletal injuries seen in emergency.

An accurate diagnosis regarding the involvement of structures and extent of injuries is essential for early operative and also non operative treatment. This requires detail clinical history, a thorough physical examination and complimentary diagnostic tools.

The most widely used investigation of choice to assess the ligament injuries is Magnetic Resonance Imaging (MRI).

MRI is used as a first-line diagnostic examination in patients with suspected ligament injuries of the knee joint and thus a large number of unnecessary diagnostic arthroscopies can be avoided².

2. Aims and Objectives of the Study

To study the Magnetic Resonance Imaging (MRI) findings in the various ligament injuries of knee joint.

3. Materials and Methods

This study was conducted over a period of 2 years in MRI section of Department Radio-diagnosis of Medical College and Tertiary Health Care Center with due permission from ethics committee. After satisfying the eligibility criteria, One hundred and ten (110) patients were included in the present study. Written informed consent was taken from all study participants. The clinical history in detail and bio data was noted.

All these patients were subjected to Magnetic Resonance Imaging (MRI) of the knee joint with MRI (MRI Siemens 1.5 T) machine and MRI findings are noted.

3.1 Inclusion Criteria

- All the patients in age group 18-74 yrs referred from IPD and OPD of all departments preferably orthopedic department having injuries to either of the knee joints are included in this study.
- Patients giving consent for the study.
- Patients with clinically suspected ligament injuries of knee joint.

3.2 Exclusion Criteria

- Patients those who underwent surgery previously like arthroscopy for knee injuries.
- Patients not consenting for the study.
- All patients having contraindications for MRI like cardiac pacemaker, metal implants, claustrophobia.

4. Results

Total 110 patients study was conducted for duration of 2 years at the Tertiary Health Care Centre with the objective of describing MRI findings in ligament injuries of knee joint in patients that presented with painful knee joints.

Table 1. Age wise distribution of patients

age group	no. of patients	%
18-30	32	29.09
31-40	19	17.27
41-50	27	24.55
51-60	13	11.82
>60	19	17.27
Total	110	100

Among 110 patients Anterior Cruciate Ligament (ACL) tear was most common and seen in 61 patients followed by Medial Collateral Ligament (MCL) in 31, Lateral Collateral Ligament (LCL) in 22 and Posterior Cruciate Ligament (PCL) in 16 patients.

Protocol for MRI of Knee Joint

Sequence	FOV in mm	Matrix	Slice thickness	TR (ms)	TE (ms)	Aver age	Time (min:sec)
Localizer-Axial	300	192 × 256	6 mm	7.7	3.28	1	0:06
Localizer- Sagittal, Coronal, Axial	300	192 × 256	6 mm	8	3.46	1	0:15
PD fs – Axial	180	192 × 256	4 mm	3000	26	1	2:21
PD fs – Coronal	180	192 × 256	4 mm	3000	26	1	2:51
PD fs – Sagittal	180	192 × 256	4 mm	3000	26	1	2:51
STIR – Coronal (T2 fircor)	180	205 × 256	4 mm	4490	48	1	3:00
T2 Weighted- Axial	160	223 × 384	4 mm	3510	85	2	2:59
T2 Weighted- Sagittal	180	240 × 320	4 mm	3210	92	1	2:53
T1 Weighted- Coronal	180	224 × 320	4 mm	450	12	1	3:06
T1 Weighted- Sagittal	180	224 × 320	4 mm	470	12	1	3:03
PD spc fs 3D- Sagittal	180	258 × 256	1 mm	1000	39	1	3:09

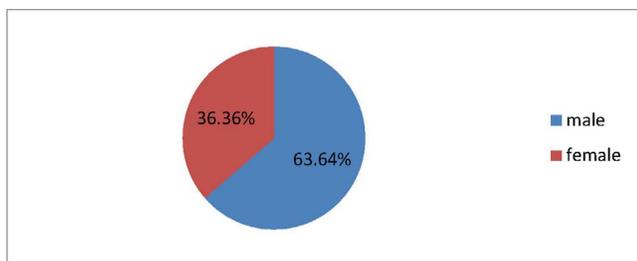


CHART 1: Pie diagram showing male predominance.

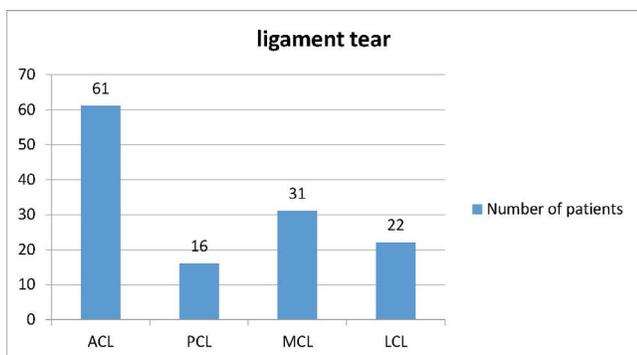


CHART 2: Bar diagram showing type of ligament tears.

The salient observations are as follows:

Age group most commonly involved was 18 to 30 years young patients (Table 1).

Males predominated in this study constituting 63% of total study population (Chart 1).

Representative Images

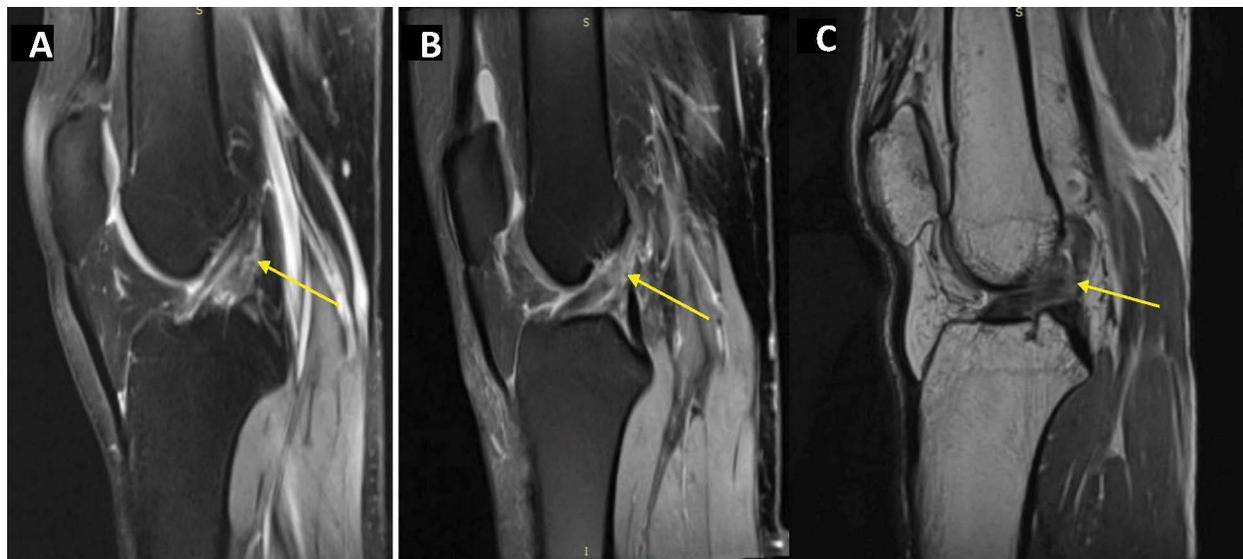


Figure 1. A-Low grade partial thickness tear of ACL seen as disruption of few fibers with hyper intense signal within on PD fs sag image. B = High grade partial tear of ACL with disruption of more than half of the fibers and only few intact fibers maintaining the continuity as seen on PD fs sag image. C = Complete tear of ACL.

Table 2. Grades of ACL tear

ACL grade tear	no. of patients	%
Complete tear	18	29.51
High grade partial tear	28	45.90
Low grade partial tear	15	24.59
Total	61	100.00

ACL tears were seen in 61 (55.45%) patients, PCL tear in 16 (14.55%) patients, MCL tear in 31 (28.18%) patients and LCL tear in 22 (20%) patients (Chart 2)

Among ACL tears, partial tears were seen in 43 (70.49%) patients and complete tears were seen in 18 (29.51%) patients. Low-grade partial tears were seen in 15 (24.59 %) patients and high-grade partial tear in 28 (45.90%) patients.

Posterior Cruciate Ligament tear was seen in 16 (14.54%) patients. Out of these complete tears were 2 and partial tears were seen in 14 patients.

Among the collateral ligaments medial collateral ligament tears (28.18% patients) outnumbered Lateral Collateral Ligament tears (20% patients). Grade I tears were more common in MCL and LCL.

Other associated findings like cystic lesions around knee, chondromalacia patellae, joint effusion, features suggestive of osteoarthritis, synovial pathologies, mucoid degeneration of ACL and discoid meniscus were detected accurately and well characterized on MRI.



Figure 3. A = Grade I LCL tear as soft tissue edema (arrow) superficial to LCL on STIR cor image and B = Grade II MCL tear as hyper intense signal within the ligament (arrow) on PD fs cor image.



Figure 2. A = PD fs sag image and B = PD spc 3D sequence showing complete tear of PCL as disruption of fibers and fiber discontinuity (arrows). C = Partial tear of PCL.

5. Discussion

There are various modalities available for evaluation of knee joint, but now a days MRI has become imaging modality of choice for ligamentous injuries of knee joint. Role of MRI for evaluation of knee joint has increased in past few years. Internal structures like ligaments of knee joint are better evaluated with MRI as compared to USG, conventional X-rays, CT scan and arthrography.

As per study done by Crues *et al.*, (1987) even arthroscopy cannot detect grade I and II injuries, which are better evaluated on MRI³.

In our study, Anterior Cruciate Ligament (ACL) tears were observed in 61 patients (55.45%). In our study, ACL tears were most common tears. Anterior Cruciate Ligament tears were graded as partial tears and complete tears. Partial tears were graded into low-grade and high-grade partial tears.

Hong SH *et al.*, (2003)⁴ in their study graded the severity of the ACL injury using a 4-point system from MRI, *viz.* intact, low-grade partial tear, high-grade partial tear and complete tear and they compared the results with arthroscopic findings. In our study complete ACL tears were seen in 18 (29.51%) patients and partial tear in 43 patients (70.49%). Low-grade partial tear was seen in 15 (24.59%) patients and high-grade partial tear in 28 (45.9%) patients. Similar study was conducted by Singh JP *et al.*, (2004)⁵ in 173 patients, 78 patients (45.08%) showed ACL tears, among these 52 (66.67%) were partial and 16 (20.51%) were complete and 10 (12.82%) cases showed non visualization of ACL. Our study findings correlated with observations of this study.

Chaudhuri S (2013)⁶ studied 138 adult cases for evaluating role of MRI in traumatic knee injuries and found that ACL tears were the most common injuries.

In our study of 110 patients, Posterior Cruciate Ligament tear was seen in 16 (14.55%) patients. Out of these tear 2 were complete tears and 14 were partial tears. PCL tears seem to be much less common than ACL tears.

Takahashi N *et al.*, (2001)⁷ in their study of 39 patients with PCL injuries identified on MR imaging found out 14 patients (35.9%) had complete tears of the PCL, 21 patients (53.8%) had partial tears and 4 patients (10.3%) had avulsion fractures. A total of 12 patients (30.7%) had isolated PCL tears and the remaining 27 patient's demonstrated evidence of other coexistent knee injuries, such as meniscal tears and ligamentous injuries. These findings were similar to our study findings.

Sonnin *et al.*, (1995)⁸ found the incidence of PCL tear to be 3%. In a series of study analyzing 350 cases of knee injury only 10 patients had PCL tear. Grover JS *et al.*, (1990)⁹ studied 610 consecutive MRI examinations with suspected internal derangements of the knee, emphasizing on PCL tears. They observed PCL tear in 11 patients.

In our study, MCL tears (28.18 %) was found to be more common than the LCL tear (20%). Medial Collateral Ligament (MCL) tears were seen in 31 (28.18%) patients. Out of these 18 were grade I, 9 were grade II and 4 were grade III tears. Bone contusion was associated in 14 patients, which were more commonly located medially involving medial femoral condyle and tibial condyle/plateau.

These findings were in similar to study done by Rasenberg EI *et al.*, (1995)¹⁰, who in their study observed 14 patients had a Grade I MCL tear, 4 had Grade II and 2 patients had a Grade III tear on MRI. Associated bone contusion was present in 3 patients.

Schweitzer ME (1995)¹¹ studied 76 patients and found that most number of patients with MCL tears belonged to grade II. This was in contradiction to our study.

In our study Lateral Collateral Ligament (LCL) tears were seen in 22 (20%) patients. Out of these, 12 were grade I LCL tears, 9 were grade II and 1 was grade III. LCL tears were less common than MCL tears.

O'Donoghue's triad consisting of Anterior Cruciate Ligament tear, Medial Collateral Ligament tear and Medial Meniscal Tear was seen in 14 patients.

6. Conclusion

MRI is excellent noninvasive prime imaging modality with non-ionizing radiation and multiplanar capabilities. It accurately detects, localizes and characterizes various ligament injuries of the knee joint and help in arriving at accurate final diagnosis thereby guiding further management of the patient.

7. References

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