Magnetic Resonance Imaging Evaluation of Cruciate Ligament Injuries and Associated Knee Joint Injuries

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Abstract: *Fifty consecutive knee injury patients were examined and investigated for this study. Aim of this study was to assess the significance/accuracy of MR imaging in evaluation and categorization of cruciate ligament injuries with study of associated injuries of ligaments, menisci, bones and surrounding soft tissue of knee joint. MRI is more sensitive than clinical tests to detect the cruciate ligaments injuries, meniscal tears, associated lesions and classifying them into grades. MRI being noninvasive does not involve morbidity associated with other tests like arthroscopy.*

Keywords: Magnetic resonance imaging (MRI) - Knee, meniscus injury, ligament injuries

1. Introduction

The knee is one of the most commonly involved joint in the external injuries. Internal derangement of knee joint is a common cause of morbidity in the young, active individuals like athletes. The most widely used investigations are arthroscopy and Magnetic Resonance Imaging (MRI). Arthroscopy is an invasive procedure requiring hospitalization and anaesthesia and is associated with complications. Hence Magnetic Resonance Imaging (MRI) has now been accepted as the best imaging modality for non-invasive evaluation of knee injuries.

This study has been done to know the pattern of distribution of different types and incidence of injuries in traumatic knee joint by MR imaging. Besides, most of the injury related work on knee joint is on comparison between MRI and arthroscopy; clinical correlation has been somehow overlooked. Therefor an age and clinical correlation related study of cruciate ligament and associated knee injuries was undertaken.

2. Aims and Objectives

- To assess the significance/accuracy of MR imaging in evaluation of cruciate ligament injuries of knee joint.
- To categorize the cruciate ligament injuries on the basis of MRI appearance.
- To study associated injuries of ligaments, bones and surrounding soft tissue.
- To correlate the clinical profile of cruciate and associated ligament injuries with MR imaging findings.

3. Materials and Methods

This was observational type of the study. The study will be conducted on 50 patients with knee injury who were referred to the department of radio-diagnosis, tertiary care hospital during the period one and half year. Before evaluating a patient by MRI imaging informed consent will be obtained from the patient or guardian.

Inclusion criteria
1) All post traumatic patients of knee joint of all age groups irrespective of sex.
2) Clinically suspected ligament injury.

Exclusion criteria
Patients who are already diagnosed cases of cruciate ligament injury and patients who are negative for ligament injury on MRI.

MR imaging of the affected knee was performed with a 1.5-Tesla MR ACHIEVA (PHILIPS Medical Systems), by using a quadrature receiver knee coil for signal reception. Sequences and planes used were T1W sequence in coronal plane followed T2W & PDW sequences in axial, coronal and sagittal plane and GRE in coronal and sagittal plane.

Patients were placed in supine position with the knee in closely coupled QD (Quadratus extremity) coils. The knee was externally rotated 15-20 degree, in order to facilitate the visualization of anterior cruciate ligament completely on sagittal images and flexed 5-10 degree to increase the accuracy of assessing the patello-femoral compartment and patellar ligament.

4. Observations and Results

The study compromise of 33 males(66%) and 17 (34%) females patients. The commonest age group affected was 21-30 years in males and in females there was equal occurrence in the age groups 11-20, 41-50, and 51-60 years.

Table 1: Distribution of the patients according to age & sex

Age	Male		Female		Total	
	No. of cases	(%)	No. of cases	(%)	No. of cases	(%)
11-20	04	12%	04	23%	08	16%
21-30	**13**	**39%**	02	12%	15	30%
31-40	06	18%	03	18%	09	18%
41-50	06	18%	**04**	**23%**	10	20%
51-60	04	12%	**04**	**23%**	08	16%
Total	33	66%	17	34%	50	100%

The **most common cause** of knee injuries was road traffic accidents (44%) followed by sports related injury (36%). The least affected group was patients with minor trauma (20%).

Table 2: Causes of knee injuries

Age (Year)	Minor trauma	Trauma		Total
		Sports related injury	Road traffic accidents	
11-20	0	4	4	8
21-30	0	8	7	15
31-40	2	3	4	9
41-50	3	3	4	10
51-60	5	0	3	8
Total	10	18	22	50
% Age	20%	36%	**44%**	100%

The clinical profile of the patients showed pain and tenderness along the joint line to be the most common presenting clinical features, which were seen in all patients (100%). The least commonest feature was locking (14%)

Table 3: Different clinical features associated with cruciate ligament injuries

Clinical features	No. of cases (frequency)	(%)
Pain	50	100%
Tenderness along the joint line	50	100%
Instability	15	30%
Locking	7	14%
Audible click	12	24%
Joint effusion	42	84%

According to our study, the **commonest lesion** found was **tear of anterior cruciate ligament (90%)** followed by medial meniscus (60%),lateral meniscus (40%), medial collateral ligament (12%), posterior cruciate and lateral collateral ligament (10% & 6%) in decreasing order of frequency.

Table 4: Distribution of the injuries

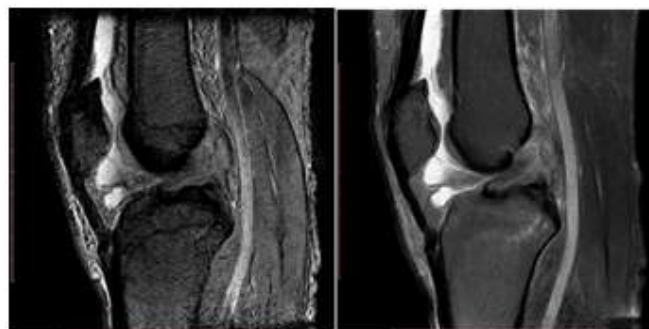| Ligament/ Menisci	NO. of cases	(%)
Anterior cruciate ligament (ACL)	45	90%
Posterior cruciate ligament (PCL)	05	10%
Medial meniscus (MM)	33	68%
Lateral meniscus (LM)	20	40%
Medial collateral ligament (MCL)	06	12%
Lateral collateral ligament (LCL)	03	6%

Figure 1: There is mild thickening and laxity of anterior cruciate ligament with hyperintense signal on T2W & PD images indicates near complete tear near femoral attachment
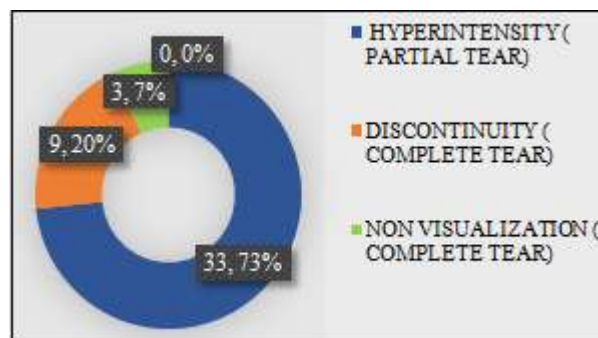

Figure 2: Pie depiction of observed MRI signs for ACL tears

According to our study medial meniscus tear was more common (32.69%) than lateral meniscus tears. Posterior horn was the most commonly injured part of the meniscus, followed by anterior horn tear and tear of body in our study

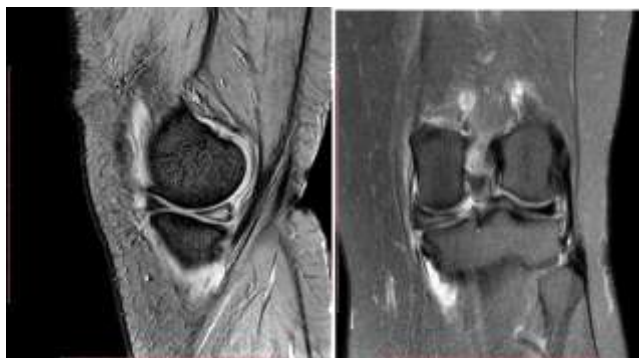**Figure 3:** Location of meniscal tears

Figure 4: Hyperintense signal on GRE & PD FSAT image in the posterior horn of medial meniscus, which is reaching upto the root of the posterior horn represents Grade- III meniscal injury.

Figure 5: Linear hyperintense signal on T2W sagittal image in the anterior horn of lateral meniscus, which is not reaching upto the articular surface represents Grade- II meniscal tear.

Grading of meniscal tear:
Grade 1- Globular signal within the meniscus
Grade 2- Linear signal within the meniscus not reaching the articular surface
Grade 3- Linear signal within the meniscus reaching the articular surface

The **most common associated MRI features** with anterior and posterior cruciate ligament tears was **joint effusion (86.6%)**. PCL buckling was seen in 55.5% patients and bone bruises were seen in 22.2% patients.

Table 5: Other injuries associated with acl tears

Associated Feature	No. of Cases	(%)
PCL buckling	25	55.5%
Anterior Tibial subluxation	10	22.2%
Uncovered lateral Meniscus	01	2.2%
Bone Bruise	10	22.2%
Joint Effusion	39	86.6%
Meniscal Tears	33	73.3%
MCL Tear	01	2.2%
LCL Tear	02	4.4%
PCL Tear	03	6.6%
Soft Tissue/ Muscle Injury	02	4.4%

5. Discussion

This study was conducted at department of radiodiagnosis, SMIMER Hospital for time period of eighteen months. The total number of patients were 50, comprising 33 males and 17 females.

In our study the most common age group affected was 21-30 years. This correlated with the study of Shetty et al.

The most common cause of knee injuries in 21-30 years age group was due to road traffic accidents and sports activities in our study which are more likely to be caused because of the range being of a potentially active group.

The most common lesion found in symptomatic knee in our study, was anterior cruciate ligament tear, closely followed by medial meniscus and lateral meniscus tears which was in accordance with the study by **Lakhkur et al.**

In our study anterior cruciate ligament tear was the commonest condition accounting for 45 patients and the least common structure to be injured was the posterior cruciate ligament, which is in accordance with the study **Sonnin et al.**

Hypersensitivity was the most common MR sign, found in anterior cruciate ligament tears. In our study hypersensitivity in ligament was seen in 33 patients (73.3%) and discontinuity in 9 patients (20%), 3 patients (6.70%) with ACL tear showed non-visualisation of ACL. **Gentili et al**. in his study also found MR features in similar frequency.

Mid substance tear were the most common lesion found in anterior cruciate ligament injuries. In our study ACL ligament injuries in the form of midsubstance hypersensitivity was noted in 29 patients (64.4%). **Berquist et al.** also reported in their study mid-substance tear as the most common type.

The medial meniscus tear was more common (32.69%) than lateral meniscus tears (19.23%) in our study which corresponded with study by **La Prude and colleagues.**

In our study Grade-III tear (increased signal intensity extending to articular surface) was most common followed by grade-II (linear intrasubstance tear) and grade-I (focal/globular intrasubstance tear) as supported by **Rubin et al.**

Posterior horn was the most commonly injured part of the meniscus, followed by anterior horn tear and tear of body in our study, which corresponds with the study by **Lukhkar et al.**

In our study three patients showed bucket handle tears of which two were found in the medial meniscus and one in the lateral meniscus, this corresponds with the study by **Wright et al.**

The MR appearance of both ACL and medial meniscal tears served as indirect evidence of MCL injury, with irregular MCL thickening indicative of prior injury. Similar MR appearance was reported by **Staron et al.**

In our study specific clinical features and test suggesting involvement of a particular structure were inferior as compared to the detection of lesions on MRI. However, MRI

showed the lesions even when the lesion was not suspected primarily on clinical criteria.

6. Conclusion

The study compromise of 33 males(66%) and 17 (34%) females patients.

Among males **most commonly affected age** group was 21-30 and among females 41-50 years.

The **most common cause** of knee injuries was road traffic accidents(44%) followed by sports related injury (36%).

In our study, the **commonest lesion** found was **tear of anterior cruciate ligament (90%)** followed by medial meniscus (60%),lateral meniscus (40%), medial collateral ligament (12%), posterior cruciate and lateral collateral ligament (10% & 6%).

Pain and tenderness along the joint line were the most common presenting clinical features, which were seen in all patients.

The most common MR sign of an anterior and posterior cruciate ligament tear was **hyper-intensity** in the ligament **on T2-weighted** images.

The **most common site of** an anterior and posterior cruciate ligament tear was **mid substance** followed by femoral and tibial attachment.

Meniscal injury was the **commonest associated injury** with anterior and posterior cruciate ligament injury.

Medial meniscus was the commoner of the two meniscito be injured. Posterior horn was the most commonly injured part of the meniscus, whether medial or lateral.

The **most common associated MRI features** with anterior and posterior cruciate ligament tears was **joint effusion**.

MRI is an excellent modality to detect the lesions in an injured knee, it has great capability in diagnosing meniscal tear and classifying them into grades.

According to our study MRI is **more sensitive than clinical tests** to detect the cruciate ligaments injuries, meniscal tears, associated lesions and **classifying them into grades**.

MRI being noninvasive **does not involve morbidity** associated with other tests like **arthroscopy**.

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