



Research Article

MAGNETIC RESONANCE IMAGING (MRI) FINDINGS IN PATIENTS WITH KNEE TRAUMA IN A RURAL BASED TERTIARY HOSPITAL OF NORTH INDIA

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ABSTRACT

Background: To diagnose and characterize imaging findings in patients with trauma to knee using MRI in a hilly and rural area of North India.

Material/Methods: This prospective study was conducted for a period of one year from April 2016 to March 2017 in the departments of Radiodiagnosis and Orthopaedics of our institute. A total of 74 patients who had history of trauma to knee joint fulfilling the inclusion and exclusion criteria were included in the study.

Results: In our study, age range was from 6 years to 85 years with mean age of 33 years and 54% being male patients. ACL tear was the most common detected pathology (66%). Partial tear (75%) was more common than complete tear. Hyperintensity in the ligament (69%) was the most common imaging finding and the mid substance tear (44%) was the most common site involved. PCL tear was much less common and was seen in 14.8 % of the patients. Medial meniscus tear was much more common than lateral meniscus tear. Medial meniscus tear was seen in 44% of the patients. Grade 3 tears were most common (54%). Lateral meniscus tear was seen in 24% of the patients. MCL and LCL injury was seen in 20% and 40% of the patients respectively.

Conclusions: MRI plays an invaluable role in the evaluation of patients with knee pain. ACL tear is the most common finding in trauma patients. Medial meniscus tears and MCL tears are commonly associated with ACL tears. PCL tear is less common. Medial meniscus tears are more common than lateral meniscus tears.

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INTRODUCTION

The knee is one of the important weight bearing joints capable of performing complex and extensive movements. Due to its anatomical configuration and because of it being the biggest joint of the human body, the knee is frequently subjected to direct trauma that can result in injuries of variable gravity¹. Acute knee injury commonly affects young people during their most productive years. The majority of knee joint injuries results from direct trauma to the knee joint or is caused by torsional or angulatory forces which can result in simple ligamentous sprain to complex injuries involving ligamentous disruption with meniscal damage and associated fractures.² The role of MRI in imaging of knee has steadily increased over years. MRI with its excellent soft tissue contrast, multi-planar imaging capabilities, non-invasive nature and lack of ionizing radiation has overcome the

limitation of other imaging modalities. With the development of new sequences, improved signal to noise ratio, high resolution, reduced artifacts and shorter imaging times, the role of MRI in the diagnosis of patients with knee complaints has increased many folds. MRI provides superior anatomical and pathological definition of soft tissues, ligaments, fibrocartilage & articular cartilage, bone contusions and marrow changes. MRI is non-invasive, free from known morbidity and is safer and less expensive than arthroscopy. Properly performed and interpreted MRI not only contributes to diagnosis but also serves as an important guide to treatment planning.

In this article, we discuss the MRI features of post traumatic knee affecting the population of the North Western region of the Indian state of Himachal Pradesh. We also characterize the findings in detail according to grading of tear, site of tear, signal intensity of tear and coexisting injuries.

MATERIAL AND METHODS

This prospective study was conducted for a period of one year from April 2016 to March 2017 in the departments of

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Radiodiagnosis and Orthopaedics of our institute. A total of 74 patients who had history of trauma to knee joint were included in the study. Previously operated patients and patients with impaired renal function or contraindications for MRI were excluded. After obtaining a detailed history, patient's physical examination was performed. The patients were placed supine, feet first with the leg in full extension. The knee was placed in 10 to 15° of external rotation in the QUADKNEE coil (Medical advances inc.). Multiplanar images were obtained in all three orthogonal planes i.e the axial, sagittal and coronal planes. The following sequences were used in orthogonal planes: FSE T1, PD FatSat, FSE T2, T2* GRE, STIR. Image analysis was done independently by two experienced radiologists and in case of a discrepancy between them, the senior radiologist's findings were considered final.

RESULTS

The age of patients ranged between 6 years to 85 years with the mean age of 33 years. Maximum number of patients was in age group 31-40 years comprising 34 patients (34%). Among 74 patients studied, 40 were males (54%) and 34 were females (46%).

Majority of the patients who were clinically diagnosed as internal derangement of knee were having anterior cruciate ligament tear and medial meniscal tear. Medial meniscal injuries were more common than the lateral meniscal injuries.

Table 1 Showing MRI findings in patients with history of trauma

Cases	Number	Percentage
ACL injury	49	66.2%
PCL injury	11	14.8%
Medial meniscus injury	33	44.5%
Lateral meniscus injury	18	24.3%
MCL injury	15	20.2%
LCL injury	30	40.5%

Out of 74 patients who had history of trauma, 49(66.2%) had ACL tear. ACL tears were described as partial or complete. Thirty seven patients (75.5%) had partial tear and 12 patients (24.4%) had complete tear. Hyperintensity in the ligament was seen in 34 patients (69.3%) and discontinuity in 8 patients (16.3%). Seven patients (14.2%) showed non-visualization of ACL. Out of 49 patients, 22(44%) patients had mid substance tear, 12 (24%) had femoral attachment site tear and 7 (14%) had tibial attachment site tear.

Table 2 Showing co existing injuries in patients with anterior cruciate ligament injury.

Co-existing injury	Number of patients	Percentage of patients
PCL	6	12.2%
MM	17	34.6%
LM	15	30.6%
MCL	12	24.4%
LCL	24	48.9%

LCL injury was seen in 48.9% of patients and medial meniscus injury was seen in 34.4 % of patients with ACL injury.

PCL tear was seen in 11 patients (14.8%). Complete tear was seen in 3 patients (27.2%) and partial tear was seen in 8 patients (72.7%). The imaging signs were hyper intensity in 7 patients (63.6%), discontinuity in 3 patients (27.2%) and non-visualization in one patient (9%). Six patients (54.5%) had mid

substance tear, 4 (36.3%) had tibial attachment site tear and one (9.0%) had femoral attachment site tear.

Out of 74 patients who presented with history of trauma, 33 patients(44.5%) had medial meniscus injury. 9 patients(27.2%) had Grade1 signal, 6 patients(18.1%) had Grade 2 signal and 18 patients(54.5%) had grade 3 tear. Posterior horn was involved in 30 patients (90%), body in 2 patients (6.06%) and anterior horn in 1 patient (3.03%). There was horizontal tear in 15 patients (45.4%), vertical tear in 3 patients (9.0%) and complex tear in 4 patients (12.1%).

Lateral meniscus injury was seen in 18 patients (24.3%). Grade 1 signal was seen in 6 patients (33.3%), grade 2 signal was seen in 5 patients (27.7%) and grade 3 tear was seen in 7 patients (38.8%). Five patients (27.7%) showed involvement of anterior horn, 2 patients (11.1%) had involvement of body and 11 patients (61.1%) had involvement of posterior horn. Horizontal tear was seen in 9 patients (50%), vertical tear was seen in 2 patients (11.1%) and complex tear was seen in 2 patients (2%).

Out of 74 patients who had history of trauma 15 patients (20.2%) had Medial collateral ligament injury and 30 patients (40.5%) had lateral collateral ligament injury.

Forty patients (40%) had bony contusions seen as hyperintensity on STIR images. 26 out of 49 patients (53.0%) having ACL tear showed bone contusions. 5 out of 11 patients (45.4%) having PCL tear had bone contusions.

Majority of patients had co-existing multiple ligament injuries.

Table 3 Showing multiple ligament injuries.

Associated injury seen	ACL injury	PCL injury	MM injury	LM injury	MCL injury	LCL injury
ACL	-	6	17	15	12	24
PCL	6	-	5	4	5	5
MM	17	5	-	8	8	10
LM	15	4	8	-	3	9
MCL	12	5	8	3	-	8
LCL	24	5	10	9	8	-

DISCUSSION

Multiple imaging modalities are currently used to evaluate pathological conditions of the knee. Over the past several years, the role of MRI in knee imaging has steadily increased and is often the main or only imaging tool for evaluation of suspected internal derangement.³ Complete evaluation of the capsule, collateral ligaments, menisci and tendons around the knee has been difficult with conventional imaging modalities. Multiplanar MR images provide significant improvement in assessing these structures.

Present study was undertaken to evaluate the MR imaging findings in patients with knee pain. Patients presenting with trauma to knee joint can have wide range of MR imaging abnormalities depending on the etiology. MRI can reliably identify and localize the abnormalities so that further management can be planned accordingly. In our study 74 patients were studied who had history of knee trauma.

Age range was from 6 years to 85 years with male predominance. The common age group was in the range of 31 to 40 years in which 34(34%) patients were seen. Shetty *et al*⁴ studied 113 patients with knee pain and found 21 to 30 years as the most common age group. Venkateshwaran *et al*⁵ did a

study on 120 patients and found that the age group 20 - 30 years accounted for maximum number of cases.

ACL tear was the most common ligament injury detected in our study. It was seen in 66.2% of patients presenting with history of trauma. This was more as compared to Shetty *et al*⁴ who reported 37%, Venkateshwaran *et al*⁵ who reported 45% and Singh *et al*⁶ who reported 45.08% of knee injuries to the ACL.

In our study, we found hyper intensity in the ligament as the most common sign which was seen in 34 patients (69.3%)(Figure 1). 8 patients (16.3%) showed discontinuity of fibers and 7 patients (14.2%) showed non visualization of ACL. These findings are corresponding with studies of Singh *et al*⁶ and Shetty *et al*⁴.

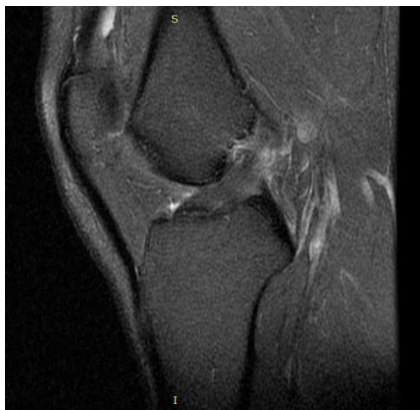


Figure 1 Partial ACL tear: Sagittal PDFS showing amorphous hyperintense signal in ACL.

Table 4 Comparison of imaging finding in ACL tear in our study with other studies.

	Our study	Singh <i>et al</i> ⁶	Shetty <i>et al</i> ⁴
Hyperintensity	69.3%	66.67%	68.2%
Discontinuity	16.3%	20.51%	24.3%
Non visualization	14.2%	12.82%	14.6%

In our study, 22(44%) patients had mid substance tear, 12 (24%) had femoral attachment site tear and 7 (14%) had tibial attachment site tear. These findings are consistent with the study done by Shetty *et al*⁴ who found out 67.94% mid substance tears, 19.23% femoral attachment site tears and 10(12.8%) tibial attachment site tear. Berquist *et al*⁷ in their study reported midsubstance tears as the most common type. Secondary signs such as PCL buckling, anterior tibial displacement, uncovered meniscus sign and bone contusions assisted in diagnosis in indeterminate case (Figure 2).

Associated meniscal tear was seen in 17 patients (34.6%), which correlated with 27.7% incidence reported by Venkateshwaran *et al*⁵. The O'Donoghue unhappy triad comprises three types of soft tissue injury that frequently tend to occur simultaneously in knee injuries. O'Donoghue described the injuries as anterior cruciate ligament (ACL) tear, medial collateral ligament (MCL) tear/sprain and medial meniscal tear (lateral compartment bone bruise). We had six patients having O'Donoghue unhappy triad.

PCL tear was seen in 11(14.8%) patients. It correlated with 12.5% incidence as reported by Venkateshwaran *et al*⁵. Sonnin *et al*⁸ in their study found an incidence of 2-23% of PCL injury. Shetty *et al*⁴. reported an incidence of 4.34% and Singh *et al*⁶ reported an incidence of 5.78 % for PCL tear. The imaging signs were hyper intensity in 7 patients (63.6%),

discontinuity in 3 patients (27.2%) and non-visualization in one patient (9.09%) (Figure 3). Venkateshwaran *et al*⁵ found hyperintensity in 60% of patients and discontinuity in 40% of patients. Increased antero-posterior diameter of PCL on sagittal images was other common finding.

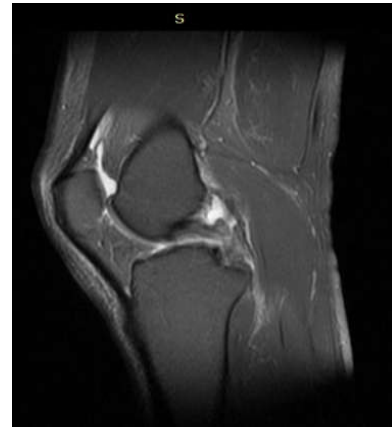


Figure 3 Partial PCL tear: Sagittal PDFS image showing hyperintense signal in PCL.

The most common injury associated with PCL tear was found to be ACL tear in our study which was seen in 6 patients (54.5%) and MCL tear which was seen in 5 patients (45.4%). These findings were consistent with Willam *et al*⁹ who reported coexistence of ACL in 59% and of MCL tear in 35% of patients with PCL tear.

The MM tear was more common (44.5%) than LM tears (24.3%) in our study which corresponded with study by Shetty *et al*⁴ who found medial meniscus tear in 36.7% and lateral meniscus tear in 17.3% of patients. Singh *et al*⁶ found medial meniscal tears in 38.23% and lateral meniscal tears in 29.41% of patients. La Prade and colleagues¹⁰ reported that medial meniscal tears are twice as common as lateral meniscal tears.

Grade 3 tear (increased signal intensity extending to articular surface) was most common followed by grade 1 (focal/globular intrasubstance tear) and grade 2 (linear intrasubstance tear). 18 patients (54.5%) had grade 3 tear, 9 patients (27.2%) had Grade1 signal (Figure 4) and 6 patients (18.1%) had Grade 2 signal.



Figure 4 Grade 1 signal: Sagittal PDFS image showing Grade 1 signal in posterior horn of medial meniscus.

Grade 3 tear was the most common medial meniscus injury in the studies conducted by Shetty *et al*⁴ and Venkateshwaran *et al*⁵. The latter found 45% of medial meniscus injuries to be

grade 3 tear. Normal anatomical structures such as transverse intrameniscal and meniscomfemoral ligaments, popliteus tendon, genicular artery and other artifacts such as capsule attachment, bursae of MCL, can cause pseudo-tears in the menisci which have to be taken note of.

In our study, posterior horn was involved in 30 patients (90%), body in 2 patients (6.06%) and anterior horn in 1 patient (3.03%). These findings are similar to those of Singh *et al*⁶ who found posterior horn tear in 78.95% and anterior horn tears in 21.05% of patients.

Horizontal tear was the most common tear pattern in our study (Figure 5). We found horizontal tear in 15 patients (45.4%), vertical tear in 3 patients (9.0%) and complex tear in 4 patients (12.1%) (Figure 6). Won-Hee-Jee *et al*¹¹ conducted a study to evaluate the accuracy of MR imaging for categorizing the configuration of meniscal tears of the knee found horizontal tears to be the most common type (40.9%).



Figure 5 Grade 3 tear: Sagittal PDFS image showing horizontal Grade 3 tear of posterior horn of medial meniscus

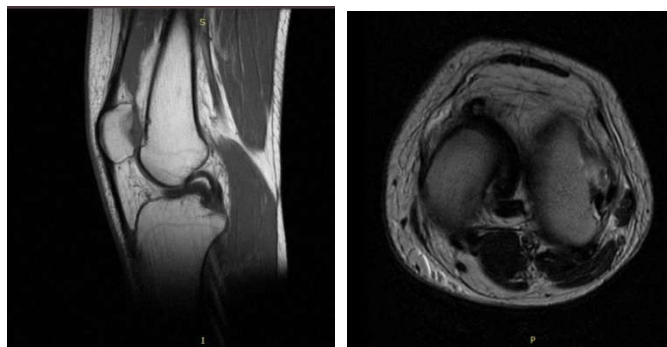


Figure 6 Bucket handle tear of medial meniscus: Sagittal T1W image showing double PCL sign. Axial T2W image showing displaced meniscal fragment lying in intercondylar notch.

In our study, lateral meniscus injury was seen in 24.3% of the patients. Grade 1 signal was seen in 6 patients (33.3%), grade 2 signal was seen in 5 patients (27.7%) and grade 3 tear was seen in 7 patients (38.8%).

Posterior horn was the most common involved site in our study. 11 patients (61.1%) had involvement of posterior horn, 5 patients (27.7%) showed involvement of anterior horn, and 2 patients (11.1%) had involvement of body. In the study done by Singh *et al*⁶ posterior horn tears of lateral meniscus was seen most commonly (89.29%) and anterior horn tears was seen in 10.71% of the patients.

50% of the patients had horizontal tear of lateral meniscus and 11% had vertical tear. Bucket handle tear was seen more commonly in the medial meniscus than the lateral meniscus. This is corresponding with study by Singson *et al*¹² who reported that medial meniscus bucket handle tears are more common than lateral meniscus.

In our study we found medial collateral ligament injury in 15 patients (20.2%) and lateral collateral ligament injury in 30 patients (40.5%). Venkateshwaran *et al*⁵ reported MCL sprain/tear in 22.5% and LCL sprain/tear in 10% of the patients. We had much higher percentage of patients with LCL injury as described by other authors. This could be due patients in our study having different mechanism of injury as compared to the other studies. The main findings in collateral ligament injuries were adjacent fascial oedema and increased signal intensity.

CONCLUSION

Assessment of the patient presenting with knee trauma is a common problem in clinical practice. MRI plays an invaluable role in the evaluation of patients with knee pain. Imaging with MRI, in our study, helped in formulating a cause and provided a recommendation for proper evaluation, optimum and efficacious treatment of patients with knee pain and also investigated the incidence and coexistence of multiple knee joint pathologies and the distribution of knee joint pathologies according to age and sex.

ACL tear is the most common finding in trauma patients. Medial meniscus tears and MCL tears are commonly associated with ACL tears and should be cautiously looked for. Various indirect signs also help to look for ACL tear. PCL tear is less common. Medial meniscus tears are more common than lateral meniscus tears. Various normal anatomic structures like transverse intra-meniscal ligament can mimic meniscal tear. Incidence of LCL tear was more in our study as compared to previous studies.

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