# ORIGINAL RESEARCH ARTICLE

# Evaluation of Various Types of Traumatic Knee Injuries by Magnetic Resonance Imaging (MRI)

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## ABSTRACT

**Introduction:** The knee joint is a biggest joint of the human body with complex articulation characterized by the presence of ligamentous and meniscal structures that plays an important role in the stability and mobility. MRI has significant advantages over plain X-rays and CT scan due to its excellent soft tissue contrast resolution and multiplanar imaging capabilities which surpasses other imaging techniques in the evaluation of traumatic injuries of knee joint. Study aimed to study the role of MRI in the evaluation of traumatic injuries of knee joint.

**Material and methods:** A total number of 200 patients referred with history of knee injury were imaged with 1.5 Tesla Siemens Magnetom Aera MRI machine in the department of radiodiagnosis over a period of one year.

**Results:** Commonest injuries found in our study are anterior cruciate ligament tear, medial meniscus tear, bone contusions and joint effusions. Clinical presentation and plain radiographs were not of much use in diagnosis in most of the cases of acute knee injury, especially in multiple ligament injuries. MRI detected soft tissue injuries very well in addition to the bony injuries.

**Conclusion:** Magnetic resonance imaging is the excellent non-invasive diagnostic tool for knee injury due to excellent soft tissue contrast resolution and multiplanar imaging capabilities which provides excellent soft tissue details of the knee joint.

**Keywords:** Meniscal Tear, Cruciate Ligament Tear, Traumatic Knee, Joint Injuries, MRI, The Knee Joint.

## INTRODUCTION

Being one of the most important weight bearing joints, knee is capable of performing complex and extensive movements, it is therefore susceptible and frequently affected by traumatic and degenerative conditions. Since, its inception magnetic resonance imaging (MRI) has been found to be a very precious, informative imaging modality widely accepted by orthopaedicians for the evaluation of the knee joint. As magnetic resonance imaging (MRI) is precious tool for evaluation of knee, hence, it reduces the number of diagnostic arthroscopies and choose the ideal patients for therapeutic arthroscopies.[1,2] MR imaging is excellent for soft tissue resolution and gives excellent soft tissue differentiation among cortex, marrow, ligaments, tendons, muscles, synovium, vascular and cartilage elements.[3]

It is a non-invasive diagnostic tool with high sensitivity, specificity and accuracy in the evaluation of meniscal injuries. And on many occasions if MRI is done without doing arthroscopy, solely for the diagnosis of ligament and meniscal injuries, that may end up in negative results along with added surgical trauma and stress to the patients. As it a commonly used diagnostic modality to assess a wide spectrum of internal knee derangements and articular pathologies it has virtually replaced conventional arthrography in the evaluation of the menisci and cruciate ligaments and has reduced unnecessary diagnostic arthroscopies.[4] The knee joint is invasively visualized by arthroscope, by an orthopaedic surgeon with the help of a small camera introduced into the joint cavity through a small orifice for the diagnosis of meniscal, ligamentous injuries and arthritis.[5] With the recent advancements in MRI, introduction of newer MRI sequences, improved SNR (signal to noise ratio), excellent soft tissue resolution, reduced artefacts, imaging times and improved accuracy, it has significantly changed the traditional algorithm for the evaluation of knee joint pathologies, particularly the meniscus and cruciate ligaments.[6]

## MATERIAL AND METHODS

A cross sectional study was conducted in 200 patients having knee injury at B.R.D Medical college, Gorakhpur over a period of one year. All the patients with knee injury, referred for MRI evaluation were included in the study. Patients with neoplasm, infective or inflammatory pathologies of knee, post-operative cases and those having contraindications to

MRI were excluded from the study. Informed consent was taken from all the patients. The purpose of this study was to evaluate the various types of knee injuries in all the patients of traumatic knee, referred for MRI. MRI of the knee was performed on SIEMENS Magnetom Aera MR Machine with field of strength 1.5 T using an extremity coil.

## IMAGING PROTOCOLS AND TECHNICAL FACTORS

The use of a dedicated knee coil is mandatory for adequate study as it improves the signal to noise ratio. The patient was placed in supine position, feet first with full extension and the knee externally rotated 15-20 degree to facilitate the proper visualization of anterior cruciate ligament (ACL) completely on sagittal images. The knee was imaged in three standard planes i.e. coronal, axial and sagittal planes using T1W, T2W, PD, PD FS, STIR (proton density, proton density fat saturation, short tau inversion recovery) sequences with 4 mm slice thickness. The various MRI findings were recorded and entered in the set proforma for further evaluation.

## RESULTS

There were total two hundred pateints, among them 165 (82.6%) were males and 35 (17.5%) were females (Table-1). So in this study male preponderance in distribution of knee injury was found. Out of two hundred patients of knee injury, 37 (18.5%) were of 0-20 years, 75 (37.5%) patients were of 21-30 years, 56 (28%) were of 31-40 years of age, 20 (10%) were of 41-50 years of age, 7 (3.5%) were of 51-60 years of age, 4 (2%) were of 61-70 years of age and 1(0.5%) pateints were of 71-80 years of age. Hence majority of the patients were young aged between 21-30 years and least affected group was 61-80 years. (table-2). The male preponderance

| Sex | Number | Percentage (%) |
|---|---|---|
| Male | 165 | 82.6% |
| Female | 35 | 17.5% |
| **Table-1:** Distribution according to sex. | | |

| Age - group | Number | Percentage (%) |
|---|---|---|
| 0-20 | 37 | 18.5% |
| 21-30 | 75 | 37.5% |
| 31-40 | 56 | 28% |
| 41-50 | 20 | 10% |
| 51-60 | 07 | 3.5% |
| 61-70 | 04 | 2% |
| 71-80 | 01 | 0.5% |
| **Table-2:** Distribution according to age group | | |

| Cases | Male | Female | Total |
|---|---|---|---|
| ACL tears | 125 | 16 | 141 |
| PCL tears | 15 | 05 | 20 |
| Medial meniscus tears | 71 | 14 | 85 |
| Lateral meniscus tears | 25 | 08 | 33 |
| LCL injuries | 05 | 02 | 07 |
| Joint effusion. | 120 | 20 | 140 |
| **Table-3:** Distribution of different injuries according to gender | | | |

indicates that females are less active than males, road traffic accidents and involvement in outdoor games also contributes to injuries in them.

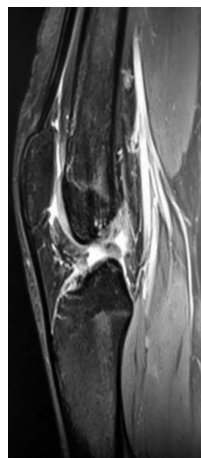Males continued to show increased incidence of ACL



**Figure-1:** Sagittal PDFS image showing altered signal intensity with fluid collection in the substance of ACL suggestive of complete ACL tear.
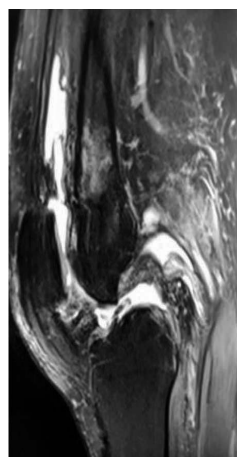


**Figure-2:** Sagittal PDFS image showing altered signal intensity in the substance of PCL with ill-defined fibres and fluid collection suggestive of PCL tear.
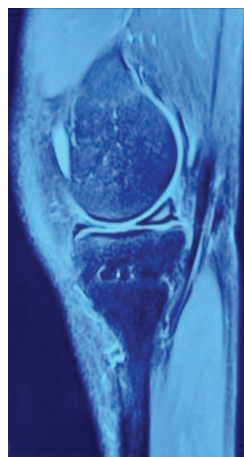


**Figure-3:** Sagittal PDFS image showing linear increased signal intensity in the posterior horn of medial meniscus suggestive of grade 11 tear.
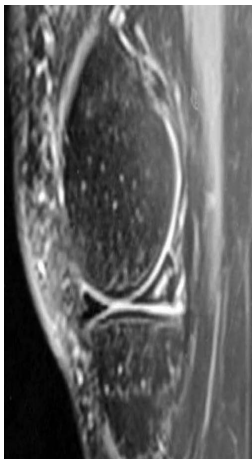
**Figure-4:** Sagittal PDFS image showing linear increased signal intensity communicating with the articular surface in the posterior horn of medial meniscus suggestive of grade 111 tear.



**Figure-5:** Sagittal T2W image showing bucket handle tear of medial meniscus.

tears, PCL tears, MM tears, MCL tears and joint effusion (Table-3).

Injuries due to road traffic accidents, 40% was the major cause, followed by injuries related to sports 32%, followed by minor trauma 28%. Minor trauma were maximum in age group 41-60 years of age and sports related injuries and road traffic accidents in 21-40 years of age group (Table-2).

## DISCUSSION

In this study, done at department of radiodiagnosis, BRD Medical College, Gorakhpur, we studied 200 patients out of which 162(82.6%) males and 35 (17.5%) were females. The most common range of age affected was 21-40 years. This age range is in concordance with the study of Shetty et al.[7] Men in their 3rd decade were most commonly affected in their study. Out of 200 patients, major cause of trauma to the knee joint was road traffic accident, sports injury, fall and twisting knee injury. The common presenting complaints were, knee pain, decreased range of movement, knee swelling and joint stiffness. In our study with the history of knee injury, the most common lesion encountered was ACL (141) 70.5%, followed by medial meniscus tear (85) 42.5%

which was consistent with the study of Lakhkar et al.[8] Out of 141 cases of ACL tear, mid substance tear 99 (70.21%) was most common, followed by femoral 34 (24.11) and tibial attachments 15 (10.63) which is consistent with the study of Berquist et al in which most common tear was mid substance of ACL.[9] Hyperintensity in the substance of ACL (Figure 1} in our study was most common 88 (62.41%) followed by discontinuity 40 (28.36%) and by non – visualization 14 (9.92%), which is consistent with the study of Gentili et al.[10] PCL tear (Figure 2)was found to be 20 (10%). Discontinuity 12 (60%)followed by buckling 4(20%) was found which is comparable with the study done by Sonin et al.[11]

Out of 200 patients 128 (64%) were with meniscal tears, out of which 95 (74.21%) were medial meniscus (Figure 3)and 33 (25.78%) with lateral meniscus tear which corresponds with the study done by La Prade et al in which medial meniscus tear was more common than lateral meniscus tear.[12] Grade III meniscal tear (tear communicating with the articular surface) was found in majority of patients (Figure 4) of meniscal tear in 70 cases (54.68%), grade II (linear increased signal intensity with no extension to the articular surface) was found in 15 (11.71%) and grade I tear (focal / globular signal intensity with no extension to the articular surface) was in 36 (28.12%) which is consistent with the study done by Crues et al.[13]

Bucket handle tear (Figure 5) was found in 12 cases in our study, 10 were found in medial meniscus tears which is consistent with the study done by Singson et al who reported that medial meniscus bucket handle tear were more common than lateral meniscus.[14]

Out of 200 patients with knee injury, bone contusions/ bruise were noted in 45 patients (22.50%) which corresponds to the study done by Anil Madurwar et al.[15]

In our study of 200 patients joint effusion was seen in 140 (70%) patients. Collateral ligamentinjury was seen in 10 (5%) patients, out of which 3(1.5%) were medial collateral ligament and 7 (3.5%) were lateral collateral ligament. Subchondral fractures of tibia, fibula and fracture of patella was seen in 15 (7.5%) patients.

## CONCLUSION

MRI is outstanding, non -invasive diagnostic imaging tool and has excellent capability to access the soft tissue of the injuries of the knee joint. Due to its high soft tissue contrast resolution and multiplanar capabilities it surpasses the other imaging modalities like CT scan, plan x-ray and is modality of choice in the clinically suspected cases of soft tissue injury where plain radiographs are normal. Clinical findings may suggest soft tissue injuries, but MRI is significant for further evaluation. It has unique ability to evaluate ligaments,menisci, bone marrow etc. It should be considered in soft tissue injury of the knee joint to prevent unwanted arthroscopies. Commonest injuries in our study are anterior cruciate ligament tear, medial meniscus tear, bony injury and joint effusion.

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