ORIGINAL RESEARCH ARTICLE

# Study of Various Knee Injury Findings in Magnetic Resonance Imaging (MRI)

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**ABSTRACT**

**Introduction:** Since its introduction in the 1980s, Magnetic Resonance Imaging (MRI) has become a staple in the assessment of knee injuries. MRI has significant advantages over plain x-rays and CT scans. MRI enables physicians to see very subtle abnormalities in the soft tissues of the body, including ligaments, tendons, and cartilage. MRI scans are very sensitive to the composition of soft tissues, such as fat, muscle, bone and cartilage, allowing a detailed assessment of most joints. Study was done to assess the diagnostic usefulness of MRI in patients in various cases of knee injuries.

**Material and Methods:** Patient attending OPD or indoor in NSCB medical college hospital, Jabalpur in duration of Sept. 2010 to October 2011. 75 patients with h/o trauma to knee and clinically suspected to have meniscal or ligament tears or any other pathology related to knee joint.

**Results:** In our study we found that with h/o knee injury most common lesion found in symptomatic knee was anterior cruciate ligament tear and followed by medial meniscus tear.

**Conclusion:** In conclusion, MRI is an excellent noninvasive modality in imaging of the knee and a noninvasive replacement for arthrography and non therapeutic arthroscopy.

**Keywords:** MRI, Meniscal, Synovium, Articular.

## INTRODUCTION

Since its introduction in the 1980s, Magnetic Resonance Imaging (MRI) has become a staple in the assessment of knee injuries. MRI has significant advantages over plain x-rays and CT scans. MRI enables physicians to see very subtle abnormalities in the soft tissues of the body, including ligaments, tendons, and cartilage. Common knee injuries such as ligament cartilage and tendon tears, as well as muscle strains and tears, are well demonstrated on MRI scans.

MRI is a diagnostic test in which pictures are taken of the structures inside the body. MRI, unlike CT scans, does not use radiation or X-rays to generate the pictures. Instead, MRI scanners use a magnetic field, and different radio waves to create images. MRI scans are very sensitive to the composition of soft tissues, such as fat, muscle, bone and cartilage, allowing a detailed assessment of most joints.[1-3]

Magnetic resonance imaging (MRI) uses magnetic fields and radio waves to create detailed images of the body's soft tissue structures, such as ligaments, tendons, and cartilage, which do not appear on an x-ray image of the same part of the body. A computer converts signals from the MRI scan into frontal, lateral, and cross-sectional images.

In an MRI of the knee, many separate images are produced, each one representing a 'slice' of the knee (like very thin slices of bread but a lot thinner).

The most significant advances in knee imaging have been made in the realm of MR imaging. The reports in 1983 by Kean and coworkers and Moon and associates were the first to describe the potential of MRI in assessing the knee. Since then because of its improved signal to noise ratio (SNR), higher resolution, reduced artifacts, shorter imaging times and improved accuracy.

The main aim of this study was to assess the diagnostic usefulness of MRI in patients with knee injury. To study MRI appearance in various cases of knee injuries, common lesion affecting the knee in such cases and limitation of MRI in detecting lesions.

## MATERIAL AND METHODS

Study was done after ethical clearance on patient attending OPD or indoor in NSCB medical college hospital, Jabalpur. 75 patients with H/O trauma to knee and clinically suspected to have meniscal or ligament tears or any other pathology related to knee joint were studied using Signa Profile HDX(GE) MR machine with a superconducting magnet and field strength of 1.5 Tesla, using a Quadknee coil (transmit + receive coil).

### Imaging protocol

Technique for imaging the knee varies greatly among imaging centres. Experience, individual preferences and equipment such as the coil and magnetic field strength affect the resulting protocol.

### Pulse sequences and imaging planes

We used SE, fast sequences such as GRE, FSE and STIR

sequences. The 3 standard imaging planes used are the direct coronal, sagittal and axial views. Examination of the knee is done in these three planes using a FOV of 18 cm and 4 mm slice thickness.

An axial acquisition through patella-femoral joint is used as an initial localiser for subsequent sagittal and coronal plane images.

The coronal plane optimally evaluates the collateral ligament and body of the menisci. The sagittal plane reveals the Cruciate Ligaments. Menisci and synovial anatomy especially the suprapatellar pouch. Overall the bones, muscles tendons, neurovascular structures are fully evaluated with integration of all three planes.

| Sequences routinely used | | | | | | |
|---|---|---|---|---|---|---|
| | | TR | TE | Flip angle | Slice thickness (mm) | FOV (mm) |
| T1 | AXIAL | 500 | 12 | $90^0$ | 4 | 18 |
| T1 | SAG | 625 | Min full | $90^0$ | 4 | 14 |
| T1 | COR | 620 | Min full | 180 | 4 | 18 |
| T2 | SAG | 3820 | 85 | 90 | 4 | 18 |
| T2 | COR | 4520 | 85 | 180 | 4 | 18 |
| T2 | AXIAL | 4000 | 42 | 90 | 4 | 18 |
| STIR | COR | 4700 | 50 | $180^0$ | 4 | 18 |
| GRE | SAG | 600 | Auto | 90 | 4 | 18 |
| **Special sequence: for ACL and PCL** | | | | | | |
| PD FAT SAT | OBL | 3000 | 42 | 45 | 3 | 18 |

**Positioning and coil selection**

Patient is placed in supine position with the knee in a closely coupled extremity coil. The knee is externally rotated 15-$20^0$, in order to facilities the visualization of ACL completely on sagittal images. The knee is flexed slightly 5-$10^0$, to increase the accuracy of assessing the patella-femoral compartment and patellar alignment. Excessive flexion or hyperextension does not permit accurate evaluation of patellar alignment.

## STATISTICAL ANALYSIS

Descriptive statistics like total and percentages were used to interpret the results. Microsoft office 2007 as used to interpret the results.

## RESULTS

Among total seventy five patients 50(66.6%) were males and 25(33.3%) were females. So in this study male preponderance in distribution of knee injury was found. seventy five patients of knee injury out of which five patients (6.67%) were of 0-20 years, 42 (56%) patients were of 21-40 years. 26 (34.7%) were of 41-60 years of age and 2(2.67%) were of 61-80 years of age. Hence most of patients were young between age of 21-40 years and least affected group was 61-80 years. 46.67% cases were of BPL and 53.33% cases were of non BPL (table-1).

The gender wise distribution, however, showed anterior crucite ligament and medial meniscus tears to be of equal occurrence in females. Males continued to show increased incidence of ACL tears, PCL tears, MM tears MCL tears and joint effusion (table-2).

| Sex | Number | Percentage (%) |
|---|---|---|
| Male | 50 | 66.67 |
| Female | 25 | 33.33 |
| **Age group** | | |
| 0-20 | 5 | 6.67 |
| 21-40 | 42 | 56 |
| 41-60 | 26 | 34.7 |
| 61-80 | 2 | 2.67 |
| **Physical Activity** | | |
| Sedentary | 30 | 40 |
| Sports Injury | 24 | 32 |
| Heavy Worker | 21 | 28 |
| **Socioeconomic status** | | |
| Non BPL | 40 | 53.333 |
| BPL | 35 | 46.67 |

**Table-1:** Distribution of cases according to basis of different variance

| Cases | Male | Female | Total |
|---|---|---|---|
| ACL tears | 26 | 10 | 36 |
| PCL tears | 7 | 4 | 11 |
| Medial meniscus tears | 23 | 10 | 33 |
| Lateral meniscus tears | 6 | 6 | 12 |
| MCL injuries | 8 | 5 | 13 |
| LCL injuries | 1 | 1 | 2 |
| Joint effusion | 13 | 5 | 18 |

**Table-2:** Distribution of Different Injuries According To Gender

| Age (years) | Minor trauma | Trauma | | Total |
|---|---|---|---|---|
| | | Sports related | Road side accidents | |
| 0-20 | 1 | 3 | 1 | 5 |
| 21-40 | 7 | 17 | 18 | 42 |
| 41-60 | 11 | 4 | 11 | 26 |
| 61-80 | 2 | 0 | 0 | 2 |
| TOTAL | 21 | 24 | 30 | 75 |
| Percentage | 28 | 32 | 40 | 100 |

**Table-3:** Distribution of knee injury according to cause

Maximum injuries were of road traffic accidents 40% followed by sports related injuries 32%, followed by minor trauma 28%. Minor trauma were maximum in age group 41-60 years of age group and sports related injuries and road traffic accidents in 21-40 years of age group (table-3).

## DISCUSSION

In this study, done at Department of Radio diagnosis, N.S.C.B. Medical college hospital Jabalpur, we studied 75 patients; this included 50(66.67%) cases of males and 25 cases of females (33.33%).

The most common age range affected was 21-40 years. This is in accordance with the study of Shetty et al.[1]They reported men in their 3rd decade to be most common population affected by knee injuries.

**Cruciate ligament lesion**

In our study out of seventy five patients with the history of knee injury, the most common lesion found in symptomatic

knee,was anterior cruciate ligament tear, closely followed by medial meniscus tear. Lakhkar et al[2] also found anterior cruciate ligament tear to be the commonest lesion detected.

In our study ACL tears were more among male cases(52%) than female 40% as against study by Cimino et al.[3] Out of 36 cases of ACL tears most common tear location was mid substance. In our study mid substance tears were in 25(69.44%) and the femoral attachment tears were in 8(22.22%) and tibial attachment tears were found in 3 (8.33%) cases. Berquist et al[4] in their study reported mid substance tears as the most common type.

According to our study sign of hyper intensity was most common finding seen in ACL tears 22(61.1%) cases, followed by sign of discontinuity 10(27.78%), cases followed by non visualization in 4 (11.1%) cases, which corresponds with Gentil et al[5] study.

Associated meniscal tears were seen in 20 cases (55.5%) as against (70%) seen by Robertson et al[6]

Out of the 6 cases with ACL tears which had undergone arthroscopy, one among these was detected as pseudotear, comparing the result, MRI depicted tears in all cases suggesting the usefulness of MRI over arthroscopy, which can be reserved for therapeutic purposes. This has been suggested by various studies previously Pappenport et al[7]who reported that ACL tears can be detected with accuracy rate of 93% compared with arthroscopy.

In our study PCL tears were found in 11(14.67%) which is comparable to study by Sonnin et al[8] who found in their study an incidence of PCL injury (2-23%). Among these discontinuities were seen in 6(54.55%) cases, hyperintensity were seen in 3(27.27%) cases and buckling were seen in 2(18.18%) cases.

**Meniscal tears**

Out of seventy five patients 45 (60%) patients were seen with meniscal tears in which 33 (73.33%) cases were of medial meniscus tears and 12 (26.67%) were of lateral meniscal tears.Medial meniscus tear was more common than lateral meniscal tear which corresponds with La Prade and collegues[9] reported in their study medial meniscal tear twice more common than lateral meniscal tear.

Among 45 cases of meniscal tear, 33 cases were of medial meniscal tear and 12 cases were of lateral meniscus tear. Among 45 cases of meniscal tear, Grade III (increased signal intensity extending to articular surface)meniscal tears were found in 23 (51.11% patients), grade II (Linear intra-substance tear) tears were found in 9(20%) patients and grade-I (Focal/ globular intra-substance tear) tear were found in 13 (28.89%) cases, means Grade 3rd meniscal tears were found to be most common type which is in accordance with the study of Crues et al.[10]

The tears of menisci demonstrated high signal intensity due to imbibed synovial fluid. These tears were better demonstrated on short TE images like T1, PD and GRE images. This was explained by Stoller et al[11] in their study as the interaction of synovial fluid with large macromolecules in menisci, slows rotational rates of proton s and shortens T1 and T2 values. In our study we found that T2 weighted GRE image clearly depict the meniscal tear than FSE images as supported by Rubin et al[12] study.Posterior horn was the most commonly injured part of the meniscus in our study, which is in tandem with study by Lakhkar et al[2] who also found posterior horn to be commonly torn, followed by anterior horn tear and tear of body.Of the 7 cases with meniscal taers which were followed by arthroscopy one case had been falsely reported as positive of MRI because of pseudotear appearance of; lateral meniscus caused by menisco femoral ligament

Raunst et al[13] reported that arthroscopic and arthrographic surface evaluation are insensitive to grade 1and garde 2 intrasubstance degenerative changes.

In our study out of 4 cases Bucket handle tears 3 were found in medial meniscus tear which were confirmed by subsequent arthroscopy. This is corresponding with study by Sighson et al[14]who reported that medial meniscus Bucket handle tears were more common than lateral meniscal tears.

In our study 4(5.33%) cases of Discoid menisci were found in which lateral discoid menisci were more common which is correlated to Weiner et al.[15]

Of the four cases with Bucket handle tears, one case showed double PCL sign (Singson et al[14]).Watts et al[16]described that double PCL sign is 98% specific but 32% sensitive.

**Quardicep tendon injuries**

One case showed partial tear at insertion in to patella appearing hypo intensity on T1 weighted images and hyper intensity at T2 weighted images indicating bleed. Axial and GRE T2 weighted images are helpful to demonstrate the extent of tears. [81]

**Bone contusion**

Bone contusion was found in 15(20%) patients,

**Joint effusion**

Joint effusion was seen in 18(24%) patients out of which three showed heamarthrosis.

**Collateral ligament**

Out of total 15 cases of collateral ligament injuries 13(86.67%) cases were of medial collateral ligament injury and one of these showed associated LCL injuries.

**Fracture**

Fracture was seen in 7(9.33%) patients.

## CONCLUSION

Our study sought to define the role of MRI imaging in evaluation of knee injuries. Based on the observations made in course of study, the following conclusions were made

Commonest lesion detected in our study was ACL tear and medial meniscal tears.MRI is excellent non invasive modality in imaging of knee and noninvasive replacement for arthrography and non therapeutic arthroscopy. MR is unique in ability to evaluate the internal structure as well as the surface of the meniscus.MR is advantageous in conditions where arthroscopy is not useful like peripheral meniscal tears, inferior surface tear, osteochondritis without apparent damage to cartilage.MR is more sensitive in detection of multiple meniscal tear that may be overlooked in arthroscopyMR being noninvasive does not involve morbidity associated with arthroscopy

But some pitfalls occur in evaluating the knee are related to normal anatomy or variants and artifacts created by flow,

motion and software problems.MR can be concluded as best noninvasive preoperative modality in assessment and treatment planning of meniscal and ligament injuries and the only method for subtle fracture /bone contusion.

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