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Acute Knee Trauma : Role of MRI in diagnosis of Internal knee derangements

Dr.Shreyansh.S. Kothari	Resident, DEPARTMENT OF RADIODIAGNOSIS, MGM MEDICAL COLLEGE & HOSPITAL, KAMOTHE, NAVI MUMBAI - 410 209.
Dr.Shishir Kumar	Senior Resident, DEPARTMENT OF RADIODIAGNOSIS, MGM MEDICAL COLLEGE & HOSPITAL, KAMOTHE, NAVI MUMBAI - 410 209.
Dr.Priti Kapoor	Professor, DEPARTMENT OF RADIODIAGNOSIS, MGM MEDICAL COLLEGE & HOSPITAL, KAMOTHE, NAVI MUMBAI - 410 209.

ABSTRACT

MRI primarily assesses the menisci and ligaments of knee joint, integrity of osseous structures and muscles can also be evaluated.1 MRI Knee is currently imaging modality of choice for the diagnosis of injuries to menisci, ligaments and tendons and also bone contusion and occult fractures.2 MRI is non invasive, free from known morbidity, safer and less expensive than arthroscopy. Accuracy rates for detecting meniscal tears is about 90% and disruption of Anterior cruciate ligament by 93% as compared to arthroscopy. Peripheral meniscal tears and osteochondritis can be missed in arthroscopic evaluation.3 In our study we have studied 30 patients with complaints of internal knee derangement secondary to trauma. In most of cases MRI detected injuries to cruciate ligaments, menisci and mucles.

KEYWORDS *Knee trauma, Knee derangements, S Kothari, S Kumar, P Kapoor.*

Introduction :

Trauma to knee may result in injury to menisci, cartilage, ligaments and bone. Physical examination of a painful knee in acute cases is difficult and so imaging plays an important role to aid in assessment of these injuries. MRI is modality of choice for diagnosis of internal knee derangements compared to plain radiography as later lacks sensitivity for detection of meniscus, cartilage, bone marrow and ligamentous injury. MRI has replaced diagnostic arthroscopy as a modality of choice for diagnosis of internal knee derangement.[4,5] MRI is selectively diagnostic in evaluating meniscal abnormalities.[6,7]

Aim and Objective :

- Radiological evaluation of internal derangement of knee joint using magnetic resonance imaging.
- To assess pattern of internal knee derangement in relation to mechanism of injury.

Material and Methods :

Source of Data : 50 patients clinically presenting as case of internal derangement of knee secondary to trauma were evaluated with MRI in Department of Radiodiagnosis, MGM Medical College, Navi Mumbai

Inclusion Criteria :

All pateints who will be clinically diagnosed as case of internal knee derangement secondary to trauma.

Exclusion Criteria :

Patients with age related degenerative arthrosis of knee.

Patients with any operative history or with any congenital abnormality.

Any absolute contraindication for MRI.

Data Collection ;

After all exclusions data of 50 patients were included in our study which fulfilled our inclusion criteria. A prospective cross sectional study was done. Study was conducted for a period of 1 year.

Results :

It was a prospective and observational type of cross sectional study which included 50 patients.

The study concludes that MRI is the modality of choice in imaging of internal derangement of knee joint secondary to trauma.MRI also helps in assessing the pattern of internal derangement which helps in pre procedure evaluation.

Discussion :

The primary observation in this study states that MR Imaging has very good performance in diagnosis tears of menisci and cruciate ligaments.[8]

MRI findings of internal derangement of knee reveal different patterns of injury which are as following.

Menisci

The C-shaped fibrocartilaginous menisci or semilunar cartilages are attached to the condylar surface of the tibia and provide added mechanical stability for femorotibial gliding. The meniscus protects the articular cartilage, provides joint lubrication, and increases joint stability (by providing congruence between femoral and tibial articular surfaces). This congruence is assisted by deepening of the articular surface of the tibial plateaus to accommodate the articulation between the femoral condyles.[9]The proximal or superior meniscal surface is smooth and concave, producing greater contact with the femoral condyles. The inferior meniscal surface is flat and rests on the opposing surface of the tibia. Except for the peripheral 10% to 25% of the meniscus, which is supplied by the perimeniscal capillary plexus, the meniscus in adults is relatively avascular.[10,11]

Intact menisci demonstrate uniform low signal intensity on T1, T2 and T2* weighted images. They are triangular in cross-section, with an outer convex curve. The apex is directed toward the intercondylar notch. The meniscus is arbitrarily divided into thirds: the horn, the body, and the posterior horn. Peripherally, the meniscus has a bowtie appearance . On sagittal sections close to the intercondylar notch, the meniscus is visualized with opposing triangular shapes representing the anterior and posterior horns.

Grades of Meniscal degeneration on MRI12

Grade I : a non articular focal or globular intrasubstance increased signal intensity is seen.

Grade II : horizontal, linear intrasubstance increased signal

intensity usually extends from the capsular periphery of the meniscus without involving an articular meniscal surface.
Grade III : when the area of increased signal intensity communicates or extends to at least one articular surface.
Grade 1 and grade 2 signal intensity represent intrasubstance degeneration and not fibrocartilaginous tearing. Grade 3 signal intensity represents a meniscal tear.

Bucket Handle Tear : Common tear in young patients with trauma. Usually associated with ACL injury, an unstable meniscal fragment locks into the intercondylar notch and involves at least two thirds of the meniscal circumference. Diagnosis of a bucket-handle tear requires identification of displaced meniscal tissue from posterior to a relative anterior coronal location. A double delta sign and/or a double PCL sign are sagittal MR findings of a displaced bucket-handle tear.

Ligaments
The cruciate ligaments are intracapsular and extrasynovial.

Anterior Cruciate Ligament (ACL) : The ACL and PCL are enveloped by a fold of synovium that takes origin from the posterior intercondylar area of the knee. Proximally, the ACL is attached to a fossa on the posteromedial aspect of the lateral femoral condyle. At its origin, the ACL is 16 to 24 mm in diameter, located posteriorly within the intercondylar notch. Distally the ACL extends inferior and medial to the anterior tibial intercondylar area and attaches to a fossa anterior and lateral to the anterior tibial spine, between the anterior attachments of the menisci.

On coronal, sagittal, and axial images, the normal ACL is seen as a band of low signal intensity with separate fiber striations visible near attachment points.

ACL Tears
Primary Signs
- Abnormal course of ligament
- Abnormal ligament signal intensity
- Ligament discontinuity

Secondary Signs
- Lateral compartment ossesous contusions
- Posteromedial tibial plateau contusion or fracture
- Anterior tibial displacement
- Uncovered posterior horn lateral meniscus
- Posterior cruciate line and angle

Posterior Cruciate Ligament (PCL) : The PCL originates in the lateral aspect of the medial femoral condyle, crosses the ACL, and attaches to the posterior intercondyloid fossa of the tibia.[15,16] It averages 38 mm in length and 13 mm in width at the midportion.[17] The cross-sectional area of the PCL decreases from its proximal to distal attachments. The smaller tibial insertion of the PCL attaches onto an inclined recessed shelf, posterior and inferior to the articular plateau of the tibia. The large femoral origin is on the lateral wall of the medial femoral condyle, where the PCL attaches to a flat upper border and a convex lower border that parallels the articular surface of the medial femoral condyle.

The normal PCL is seen as a uniform low-signal-intensity band. The morphology and signal intensity of the PCL are routinely evaluated on axial, coronal, and sagittal images.

PCL Tears - Any increase in PCL signal intensity on T1, PD, T2, T2*-, or FS PD weighted FSE images is abnormal. In an interstitial tear, the entire ligament or long segment may be difficult to identify because of diffuse widening and increased signal intensity. A long segment of interstitial tear may produce a division of the PCL into separated fiber bundles. In complete tears, there is amorphous high signal intensity without definable ligamentous fibers.18 Alternatively, focal discontinuity or a gap may be seen at the site. Partial tears display increased signal intensity, with discernible fibers identified along the course of the ligament

Collateral ligaments :
Medial Collateral Ligament (MCL) : The MCL, or *tibial collateral ligament,* is 8 to 11 cm long and extends from its medial epicondylar origin to attach inferior to the tibial plateau and posterior to the pes anserinus insertion . The insertion of the MCL on the tibia is covered by the muscle group of the pes anserinus. The MCL is considered to be composed of two layers: (1) deep fibers, that attach to the capsule and medial meniscus peripherally and (2)superficial fibers19, superficial MCL can be further divided into anterior and posterior portions.

MCL ligament injuries are classified into three grades:
Grade I lesions are minimal tears without instability.
Grade II injuries are partial tears with increased instability.
Grade III injuries are complete ruptures with gross instabilities.20

Lateral Collateral Ligament (LCL) : The LCL, or fibular collateral ligament, is 5 to 7 cm long. It is extracapsular and free from meniscal attachment in its course from the lateral femoral epicondyle to its conjoined insertion with the biceps femoris tendon on the fibular head.21 The intracapsular popliteus tendon passes medial to the LCL, and the posterior fibers of the LCL blend with the deep capsule, which contributes to the arcuate ligament.

The LCL is best seen on posterior coronal images and appears as a band of low signal intensity.

Edema and hemorrhage, are seen as ligamentous thickening with increased signal intensity on T2 or FSE PD weighted images. Edema and hemorrhage may also be confirmed on peripheral sagittal images. Signal intensity is not as high in LCL injuries as in MCL disruptions,perhaps because the normal capsular separation of the LCL excludes accumulation of extravasated joint fluid. In complete disruptions, the LCL demonstrates a wavy or serpiginous contour and loss of ligamentous continuity. There may be proximal migration of the avulsed ligament from its fibular attachment.

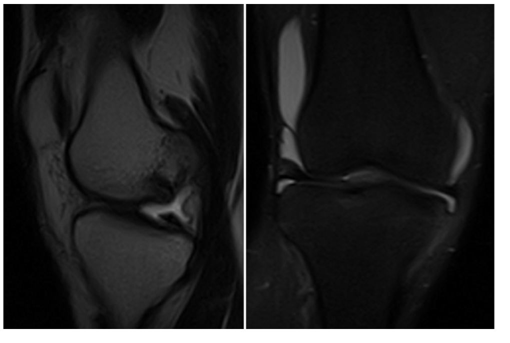

Figure 3 & 4 : Sagittal PD images of left knee joint of a 32 years female patient reveal partial tear of ACL and tear of posterior horn of medial meniscus

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