MAGNETIC RESONANCE IMAGING (3 TESLA) OF KNEE JOINT: A CONCISE, DAY TO DAY PRACTICE OVERVIEW

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Introduction

A gross knowledge of knee joint anatomy and the common differential diagnoses are very much essential when dealing with the imaging studies of knee joint. Magnetic Resonance Imaging (MRI) reduces the number of diagnostic arthroscopies and selects the patients for therapeutic arthroscopies.[1,2]

Anatomy

The knee joint is a complex hinge joint, formed by four bones; Femur, tibia, fibula and patella, except fibula all other bones are functional in knee joint. The articular disks of the knee-joint are called menisci, the “C” shaped two disks, the medial meniscus and the lateral meniscus, consist of connective tissue with extensive collagen fibres containing cartilage-like cells. They help to reduce the frictions of the articular surfaces of the bones during movements.The ligaments of the knee joint are divided into the extra-capsular ligaments and intra-articular ligaments. The extra-capsular ligaments are the patellar ligament, medial collateral ligament (MCL), lateral collateral ligament (LCL), oblique popliteal ligament, and arcuate popliteal ligament. The intra-articular ligaments are the anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), and the posterior menisco-femoral ligament.

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Magnetic Resonance Imaging Technique

MRI Machine- 3.0 Tesla (Superconductive Coil) MRI machine, WIPRO-GE made, Model Signa HDxt. A dedicated knee coil is used for the study of knee joint.

Imaging Planes

Three anatomical planes are usually taken for the imaging; Sagittal (SAG), Coronal (COR) and Axial planes, the scout views for imaging planes are showing in (Fig. 1). Four millimetre sections are used for sagittal, coronal and axial images of knee joint.[3,4]

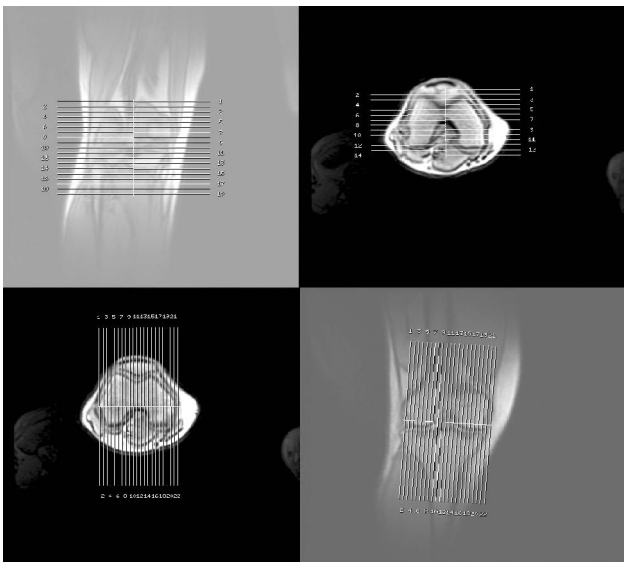

Figure 1

Imaging Sequences

A combination of fluid sensitive fat saturated (T2 FS, PD CUBE FS, STIR) and non-fat saturated (T1,PD) along with Gradient echo (GRE) image sequences are taken in all three anatomical planes. In knee imaging practice the main importance of fat suppression is to study bone contusion and cartilage pathologies.[5,6] Typical echo times (TE) are from 7milliseconds (ms) to 9.2 ms in T1, 100.5 ms in T2, 23 ms to 33.1 ms in PD, 11.5 ms in GRE, 39 ms in STIR. Time to repeat (TR) are 440 ms to 600 ms in T1, 3340 ms to 3840 in T2, 1520 ms to 2800 ms in PD, 772.8 ms in GRE and 3240 ms in STIR.

Pathology

The followings are the common differential diagnoses for knee pain:

1. ACL tear (Fig. 2, Fig. 3)
2. PCL avulsion of tibial plateau (Fig. 4)
3. Patellar Ligament Avulsion (Fig. 5 & 6)
4. Medial meniscus tear (posterior horn) (Fig. 7 & 8)
5. Flipped meniscus (Anterior horn flips posteriorly) (Fig. 9)
6. Bucket handle tear of meniscus,[7,8] showing Double PCL sign (Fig. 10)
7. Osgood Schlatter disease (OSD)(Fig. 11)
8. Osteochondritis dissecans (Fig. 12 & 13)

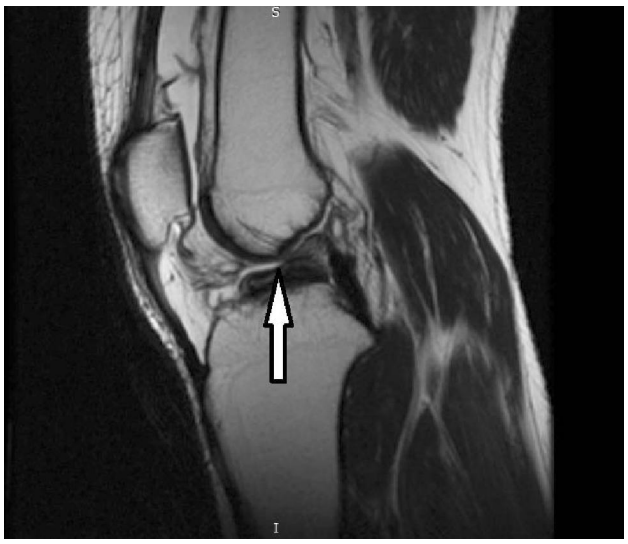

Figure 2

1. **ACL Tear:** (Fig. 2) shows an alter signal intensity (hyperintense in SAG T2) and discontinuation of ACL. A cloud like increased signal intensity within the ligament indicates edema. Buckling (Question Mark configuration) of PCL is an indirect sign of ACL tear is seen in SAG PD image (Fig. 3).

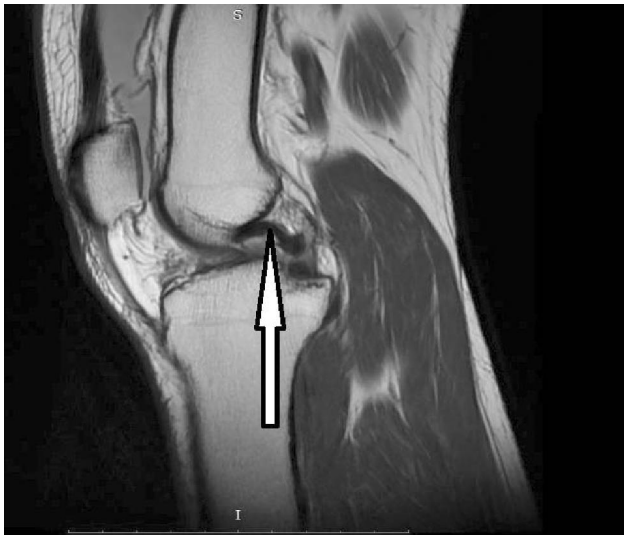

Figure 3

2. **PCL avulsion:** Sagittal images are the best to diagnose PCL injury. Incresed signal intensity is noted with disruption of the fibre of PCL. Edema amd haemorrhage also cause increased signal intensity around the PCL. SAG GRE image (Fig. 4) demonstrating detach bony fragment at pcl near tibial surface owing to pcl avulsion of tibial plateau.

Figure 4

3. **Patellar Ligament avulsion:** Sagittal T2 image (Fig. 5) shows a small bone chip in tibial attachment part of patellar ligament owing to patellar ligament Axial T2 shows (Fig. 6) altered intra substance signal intensity in patellar ligament.

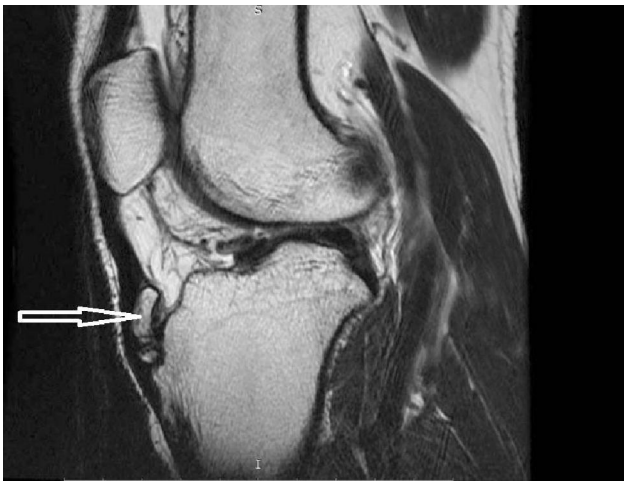

Figure 5

Figure 6

4. **Medial Meniscus tear:** Both Sag PD cube (Fig. 7) and Sag GRE (Fig. 8) images show intrame-niscal (Posterior horn of Medial meniscus) hyper-intense linear signal intensity which is not extending to the articular surface, suggestive of Grade II tear of Posterior horn of medial meniscus.

Figure 7

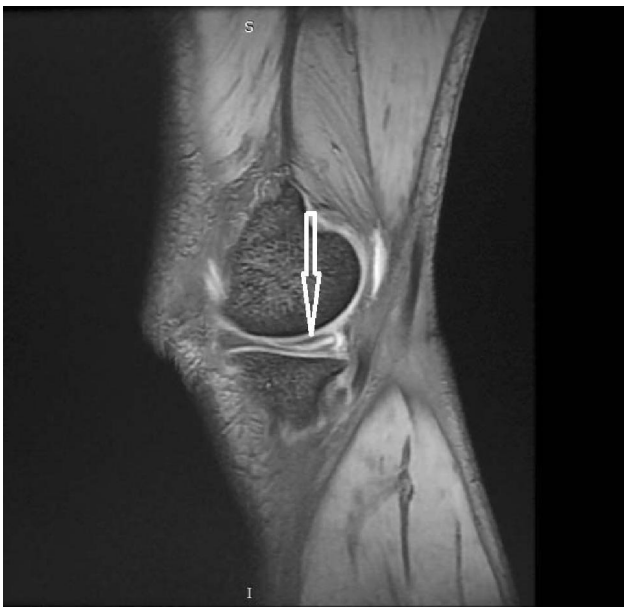

Figure 8

5. **Flipped Meniscus:** A flipped meniscus is a special form of bucket-handle tear.It occurs when the ruptured anterior or posterior horn of Medial meniscus fragment is flipped away towards the opposite horn so the horn of meniscus appears to be enlarged. SAG PD CUBE FS image (Fig. 9) show absence of bowtie sign in medial meniscus, no signal for anterior horn and post horn appears large with a notch indicative of flipped meniscus.

Figure 9

6. **Bucket handle tear of Meniscus:** Sag T2 (Fig. 10) shows two PCL like structures.Bucket handle tears are displaced longitudinal tear of meniscus. Here the displaced fragment is seen in lying anterior and parallel to the PCL. Thus in this double PCL image the anterior structure is the displaced fragment and the posterior structure is the PCL. This is known as "Double PCL sign.

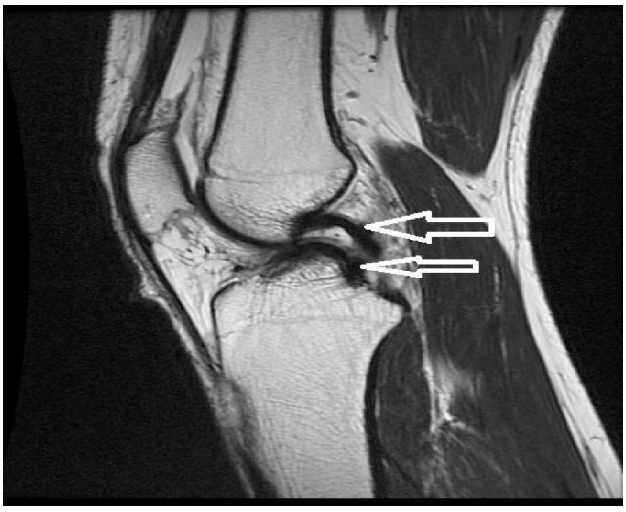

Figure 10:

7. **Osgood Schlatter disease:** SAG T1 (Fig. 11) image shows loss of sharp inferior angle of infrapatellar fat pad (Hoffa's fat pad), change of signal intensity at the lower part of patellar tendon. This is a case of Osgood-Schlatter disease (OSD). It is a chronic fatigue injury caused by repeated micro trauma at the patellar ligament insertion site of tibial tuberosity. OSD is most commonly seen in active adolescent boys, aged about 12-15 years.

Figure 11

8. **Osteochondritis dissecans:** COR STIR (Fig. 12) and SAG T2 FS (Fig. 13) images of right knee show high signal line, parallel to the articular surface, demarcating fragment from medial femoral condyle, along with low signal loose body, outlined by high signal intensity fluid, suggestive of osteochondritis dissecans. It is the end result of aseptic separation of an ostochondral fracture with gradual chronic repeated fragmentation of articular surface, which is often associated with intra articular loose bodies outlined by fluid.It is different from classical fracture(perpendicular fracture to the cortical surface) as this fracture is parallel to the cortical surface of bone.

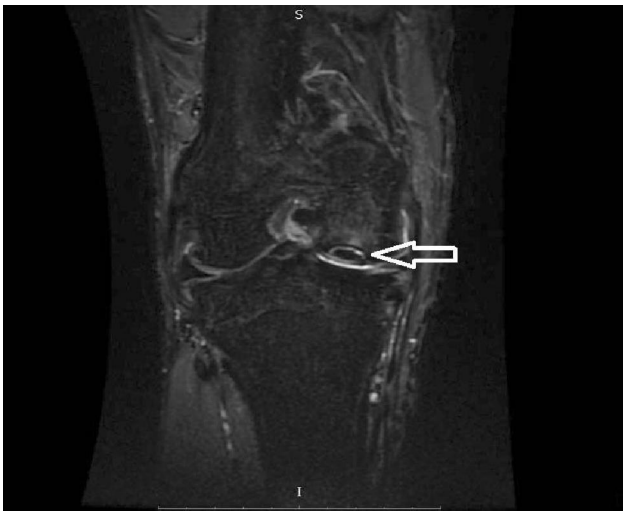

Figure 12

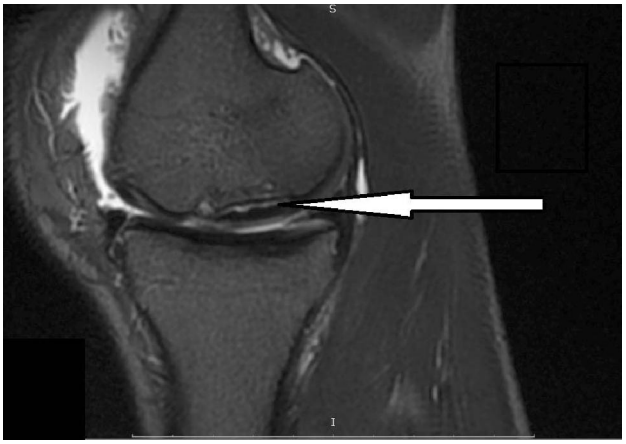

Figure 13

Teaching Point

1. Three planes (sagittal, coronal and axial) high resolution anatomical imaging is essential for proper diagnosing of knee joint pathology.

2. A clear sound knowledge of differential diagnosis of knee joint pathology is very much essential to rule out the exact cause of knee joint pain complaints.

Conclusion

A general knowledge of three plane anatomies, differential pathology and the common causes of knee joint pain are very important during the imaging of knee joint in day to day practice. All the three planes (sagittal, coronal and axial) should be taken with fat saturated fluid sensitive as well as non-fat saturated sequences. Common pathologies which are listed above should be in mind when dealing with imaging of a painful knee.

Competing interests
The author declares that they have no financial or personal relationships that might have inappropriately influenced him in writing this article.

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