POTENTIAL OF LOWER TESLA MRI FOR KNEE INJURIES- A CASE STUDY

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INTRODUCTION

HISTORY OF THE MRI

The history of NMR begins with a french mathematicians Jean baptisteJoseph fourier (1768-1830) Who developed a mathematical method to analyze the heat transfer between solid bodies. Later this discovery made rapid processing of phase and frequency signals possible in the unit of strength of a magnetic field is the tesla (1 tesla = Newton/Ampere - meter) and named after serbian inventor Nikola tesla (1856-1943) who is NMR.

Pictures1. Nikola tesla

MRI (magnetic resonance imaging) is made with radio-frequency pulse in the range of 1-80 MHz. NMR (Nuclear Magnetic Resonance), MRI and spectroscopy are the terms used alternatively.

Picture2. Paul C. lauterber

Bloch, therefore, is to MRI what Roentgen is to x-ray imaging. Bloch proposed that nucleus behave like a small magnet. He describes thisnucleus magnetism by that is known as Bloch equation. NMR is not an imaging technique but rather a method to provide spectroscopic data concerning a sample placed in device. In the early 1970s, Dramandian first showed that of normal tissue. He accomplished his first body image in 1976 using magnetic field gradient to localize NMR signal and the image took almost 4 hours to produce. At this time Paul lauterber was engaged in similar research. Clinical imaging application of MRI increased in the mid -1980.

GENERAL ANATOMY

Features:

The knee is the largest and most complex joint of the body. The complexity is the result of fusion of three joints in one. It is formed by fusion of the lateral femorotibial, medial femorotibial, and femoropatellar joints.

Type:

It is a condylar synovial joint, incorporating two condylar joints betweenthe condyles of the femur and tibia, and one saddle joint between the femur and the patella. It is also a complex as the cavity is divided by the menisci.

Ligament:

The knee joint is supported by the following ligaments.

1. Fibrous capsule.
2. Ligamentum patella.
3. Medial ligament.
4. Fibular ligament.
5. Oblique popliteal ligament.
6. Arcuate popliteal ligament.
7. Medial & Lateral meniscus.

Bursae around the knee: As the many 12 Bursae have been

Described around the knee - four anterior, four lateral, and four medial.

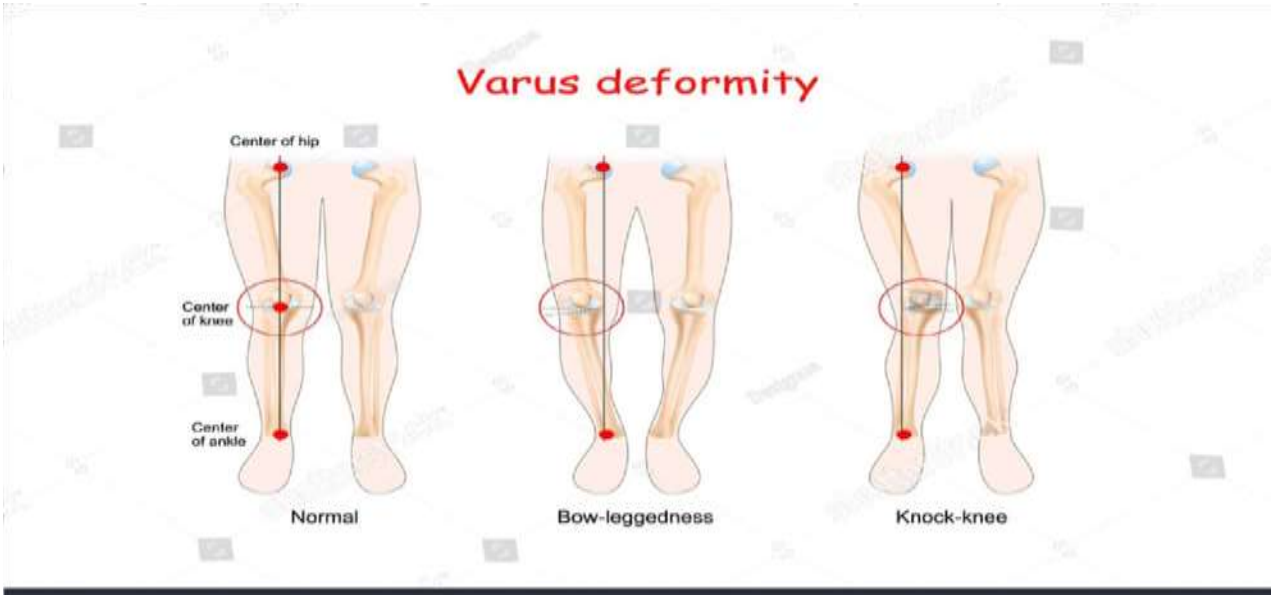
Picture 3. Knee joint

CLINICAL ANATOMY

Osteoarthritis: is an age related cartilage degeneration of the articularsurfaces. It is characterized by growth of the osteophytes at the articular ends which make movements limited and painful. However,osteoarthritis may set in at an early age also due to underlying congenital deformities or fractures around the knee joint.

Deformities of Knee.

The angle between the long axis of the thigh and that of leg may be abnormal and the leg may be abnormally abducted or abnormally adducted. This may occur due to rickets, and posture, or as a congenitalabnormality.



Picture 4. Various deformities of knee

Diseases of the knee-

The knee joint may be affected by various diseases. These include osteoarthritis and various infections. Infections may be associated with collection of the fluid in the joint cavity. This gives rise to swelling above, and at the sides of patella. Patella appears to float in the fluid. Aspiration of fluid can be done by passing a needle into the joint on either side of the patella. Bursae around the joint mat get filled with fluidresulting in swellings.

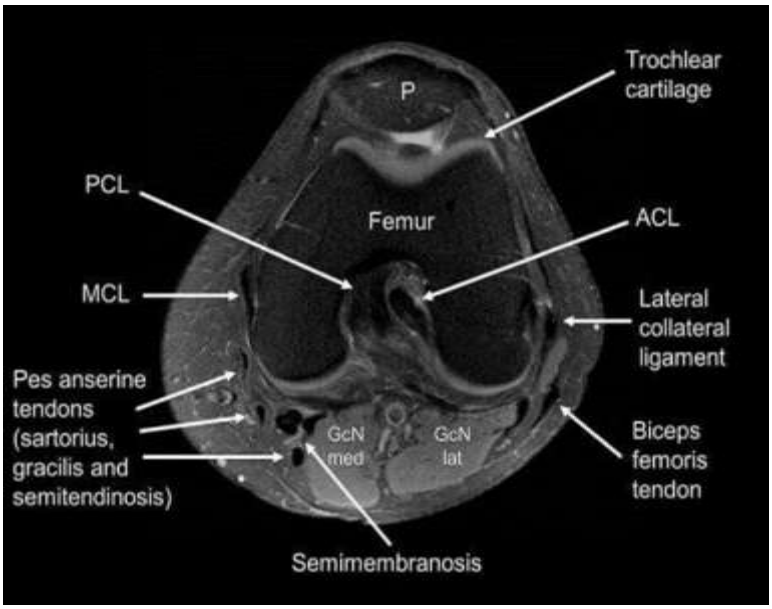
Injuries to Menisci-

Strains in a slightly flexed knee, as in kicking a football, the meniscus may get separated from the capsule, or may be turned longitudinally or transversely.

Misalignment of patella -

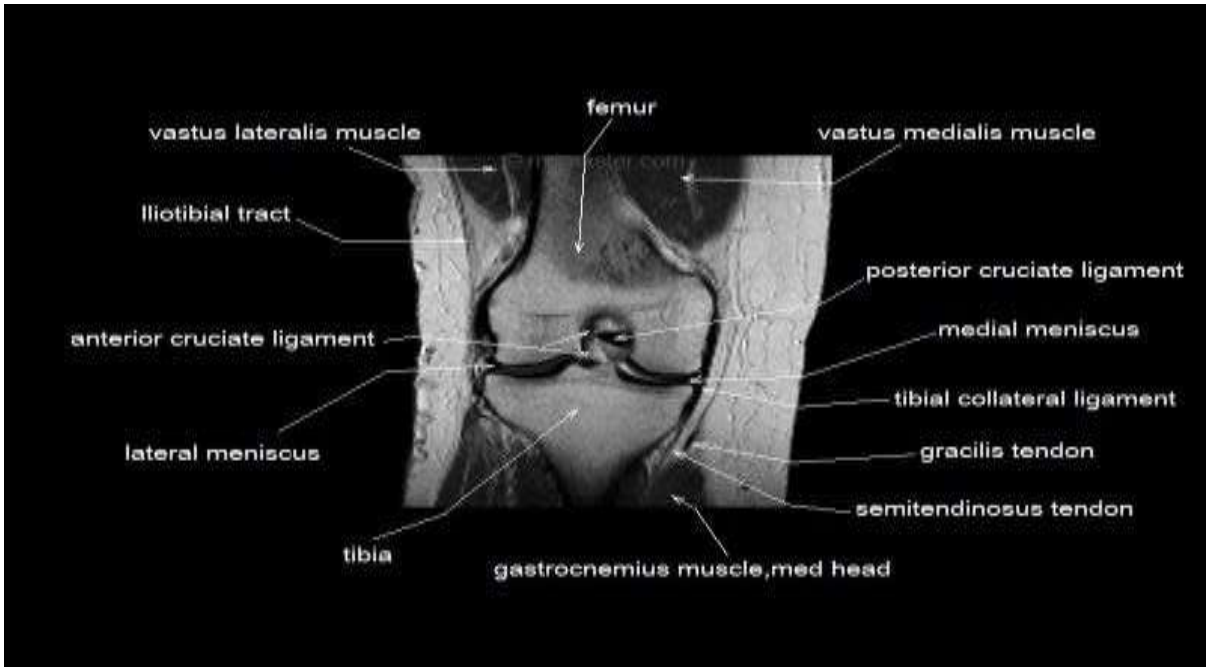
Ideally the patella is resting in the center of the width of the femur in a relaxed standing position. However, the patella position may be altered congenitally or due to tightness of surrounding structures which may lead to painful conditions of the patellofemoral joints.

CLINICAL IMPORTANCE OF PLANES

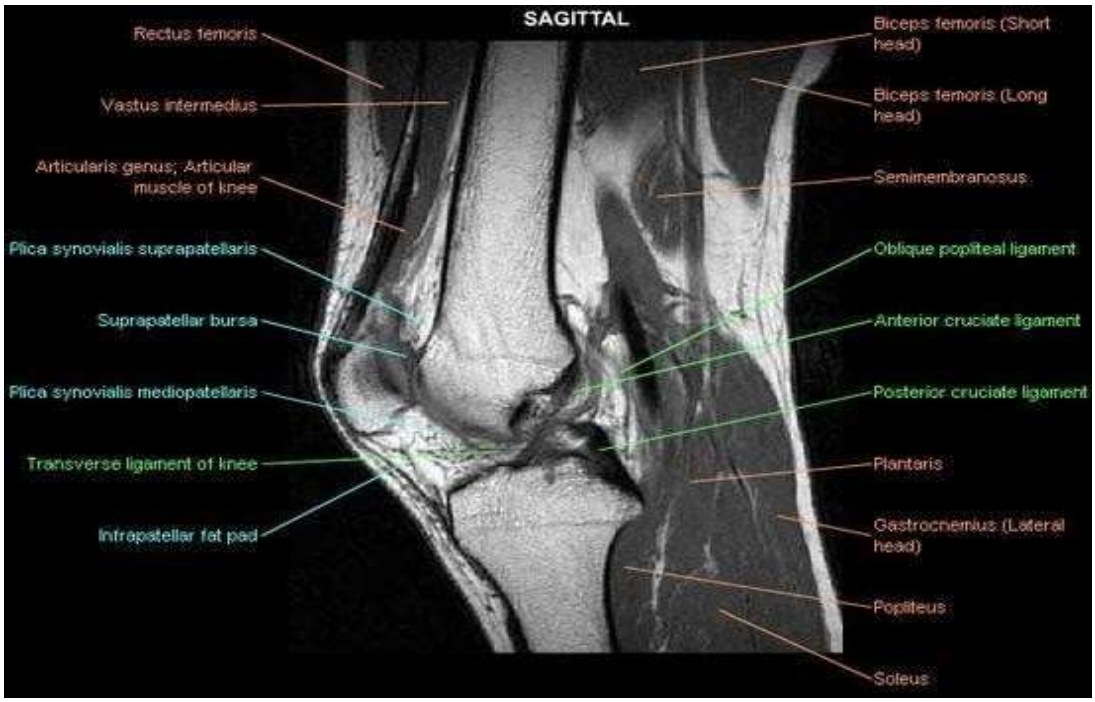


Picture 5. Axial Planes Knee

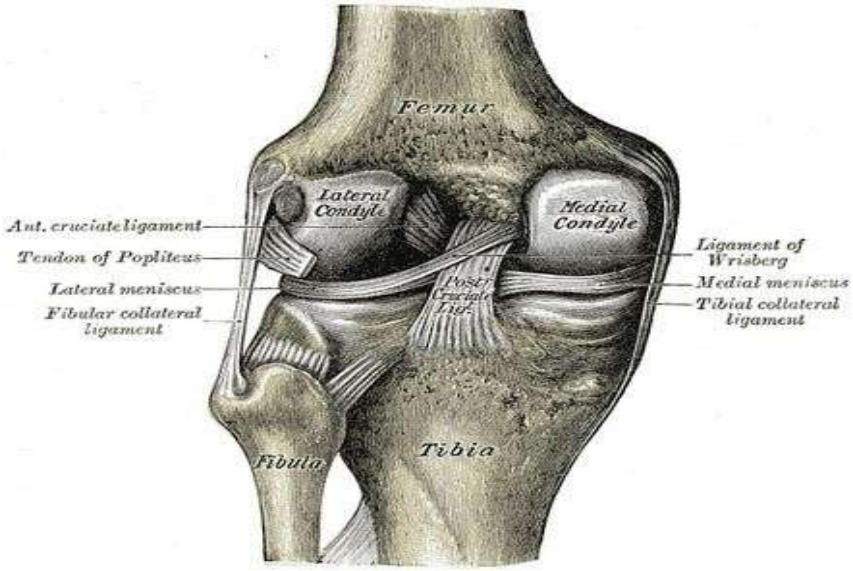
The sagittal plane is the most important plane in assessing the menisci, with the coronal plane providing supportive rather than new informationand the axial plane increasing the accuracy of the sagittal and coronal planes combined. In general, sagittal images optimally show the anteriorand posterior horns of the medial and lateral menisci, coronal images help in evaluating the meniscal bodies, and thin section axial images provide an additional view of the menisci and their free edge. Picture 5. Axial section of knee Picture 6. Coronal section of kneePicture 7. Sagittal section of knee on sagittal images, the anterior and posterior horns of the menisci appear as Isosceles triangles. The posterior horn of the medial meniscus is almost twice the size of the anterior horn. Anterior and posterior horns of the meniscus are more similar in size, with the posterior horn slightly largerthan the anterior horn. The posterior horn of either meniscus should never appear smaller than the anterior horn. The most peripheral sagittal images show the body of medial and lateral menisci, although not optimally. On both sides, the meniscus appears as flat bands. On the lateral side, the more central slices take on a "bowtie" configuration because of the small radius of the curvature.



Picture 6. Coronal section of knee



Picture7. Sagittal section of knee



Picture 8. Knee menisci

NORMAL VARIANTS

Normal anatomic meniscal variants are rare. The most frequent is the discoid meniscus, which refers to a meniscus that is not C-shaped but is dislike, covering most the tibial plateau to varying degrees rather than just covering its periphery. The discord meniscus is almost always seen in the lateral meniscus. It is prone to tearing and usually seen in childrenand adolescents, in whom it may be asymptomatic and noted incidentally. The discoid meniscus is believed to be more likely development than congenital because the fetal meniscus never assumes such a shape. Although much has been written about the increase the number of sequential sagittal images that will depicted the discoid meniscal body ,it is simpler to judge for the presence of the enlarged meniscus on the coronal view .A discoid Meniscus is suggested when the meniscal body is wider than 15 mm or extends into the intercondylar notch.

The wrisberg variant is a subtype of the lateral discoid meniscus that

Lacks a posterior attachment to the tibia, resulting in a hypermobile meniscus. In these cases, the wrisberg ligament become the only posterior Stabilizer of the lateral meniscus. This variant is often symptomatic the knee may snap during flexion and lock in extension.

Another normal variant of the menisci is the so called menisci flounce. The meniscal flounce is a way or S-shaped fold along the free edge of the menisci that occurs in the absence of a tear. It may be represent normal physiological distortion related to the knee positioning, or it may be observed in the setting of true ligament laxity in which femorotibial sliding result in buckling of the free edge of the meniscus. It has no known clinical significance, and its presence does not increase the prevalence of meniscal tears may also assume a wavy appearance, a flounce should be considered only in the absence of altered signal intensity or morphology indicative on a tear. On coronal images, the meniscal flounce can appear truncated and simulate a tear or degeneration.

The menisci Ossicle is rare lesion, found in young individuals, that is thought to be either developmental or posttraumatic. It is usually seen in the posterior horn of the medial meniscus near the tibial attachment and is associated with meniscal tears. It can be symptomatic or associated with pain and a sensation of joint locking, and it may clinically simulate a torn meniscus. Because they are calcified, meniscal assicles can be mistaken on radiographs for loose bodies. On MRI, t h e meniscal follows the signal intensity of the bone marrow, with high signal intensity centrally on T1- weighted images surrounded by a low signal - intensity margin representing the cortex.

Trauma Incidence

Meniscal injuries can result from either excessive mechanical load on thedegenerating. Meniscus. Acute traumatic tears are found in the young, athletic population. In this situation, the lateral meniscus is most commonly torn, from twisting Strains on the knee when it is either only slightly flexed or fully extended. Tears found in the older population generally occur at sites of meniscus is more commonly injured than the lateral meniscus, possibly because it is less mobile and because it transmit a greater load during

most activities. The posterior horns two third of the meniscus are uncommon. In the posterior horn of the medial meniscus, tear are more frequent seen on the interior surface because of increased stress and strain with femoral tibial rotations.

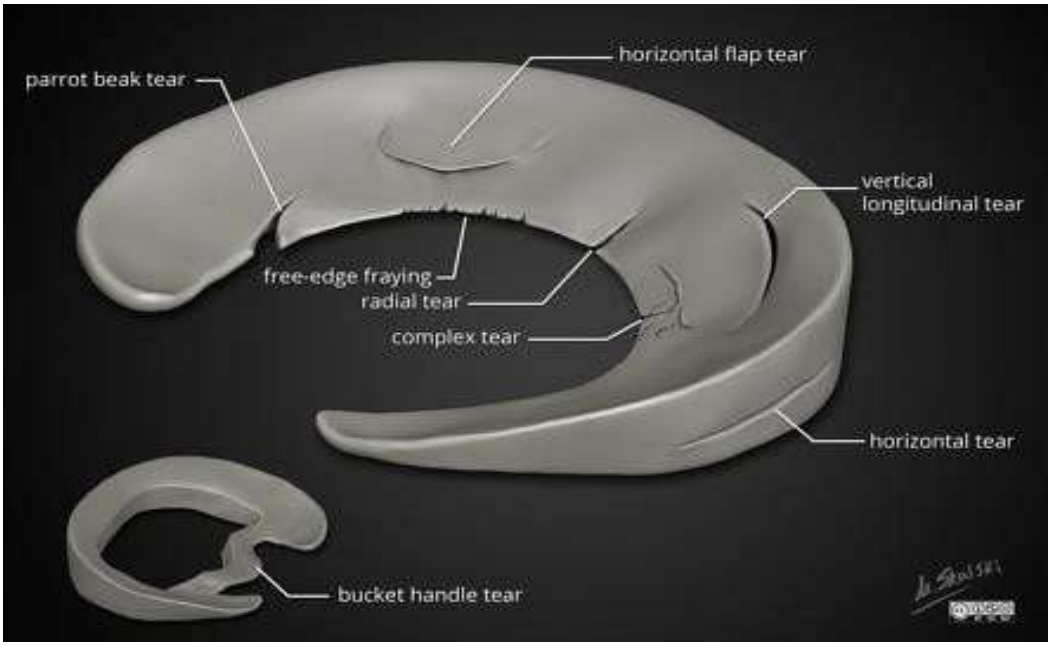
Diagnostic criteria

The diagnosis criteria for meniscus tears seen on the knee MRIs are (1) intrameniscal signal extending to the articular surface of the meniscus and (2) abnormal meniscal morphology.

Classification of Meniscal Tears

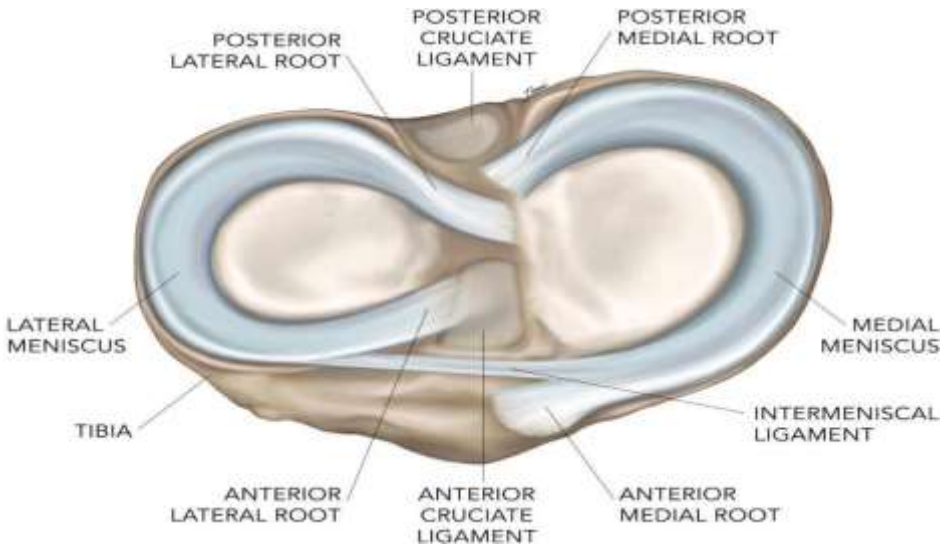
Horizontal Tears, the pure horizontal cleavage type extend to the apexand divides the meniscus into upper and lower halves, sometimes they are preferred to as fish mouth tears. Then on cleavage type horizontal tear extends to superior or interior articular surface of the meniscus. Horizontal tears are more common within the posterior horn of themedial meniscus. Linear horizontally oriented grade II signal intensity is sometimes mistaken for a complete horizontal tear. Meniscal cyst formation is commonly associated with horizontal tears.

Vertical tears -vertical tears are perpendicular to the tibial plateau. A vertical longitudinal tear occurs between the circumferential collagen fibres parallel to the long axis of the meniscus. Longitudinal tears may beobliquely oriented, but they are not parallel to the tibial plateau. Vertical grade III of the meniscus is considered a peripheral Longitudinal tear. If the Vertical or oblique signal is located in the inner third of the meniscus, it usually represents a flap tear. A Vertical radial tears occurs perpendicular to the circumferential collagen fibers are also known as free edge tears because they involve the inner age of the meniscus. MR images obtained perpendicular to the orientation of a radial tear easily demonstrate to the tear as a small gap of cleft in the meniscus, which sometimes can be observed to move across the meniscus on successive image . If the orientation of the imaging plane is in the same direction as a full thickness radial tear ,a section though the same plane of the tear will demonstrate an absent meniscus or high signal intensity not representing of a meniscus because of volume averaging, which results in a so- called ghost sign.



Picture 9 . Vertical tear of menisci

Root tears . Root tears are full -thickness radial tears at the central tibial

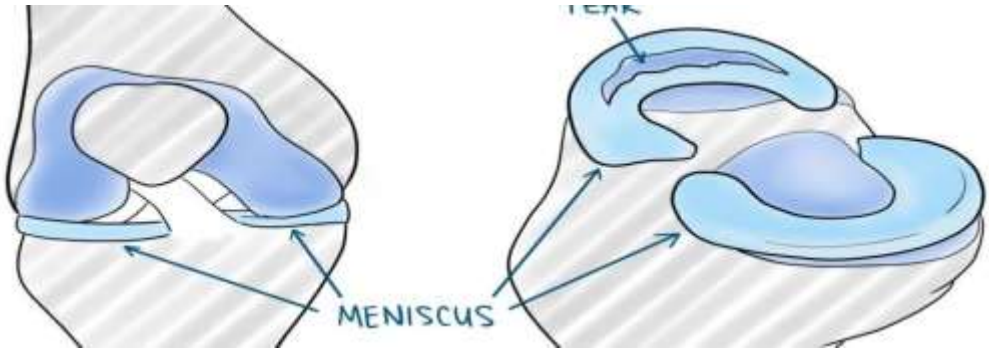


Attachment sites of the menisci and are called the root ligaments. In posterior horn of the medial meniscus, meniscus tissue should be presentimmediately medial to the tibial attachment of the PCL. In the lateral meniscus, the posterior horn should cover the medial portion of the lateral tibial plateau. If this is not the case, a root tear is highly suspected. A secondary sign of root tear is the presence of subluxation ofthe meniscus in the absence of osteoarthritis.

On posterior coronal MR images, abrupt loss or blunting of the normal menisci tibial attachment and forshortening of the meniscus towards the posterior aspect of the intercondylar notch are seen. On central sagittal images adjacent to the intercondylar notch, absent meniscal tissue or diffuse increased signal intensity in the aspect location of the posterior root ligament is seen, resulting in a ghost appearance and the so- called ghost sign of radial tears.

Bucket – Handle Tears. Bucket- handle tears are displaced longitudinaltears. The displaced inner fragment often has the appearance of a handle,and the remaining peripheral segment attached to the tibial plateau resemble a Bucket hence the name Bucket handle tear. A sensitive but nonspecific sign of MRI is the absent bowtie sign, in which fewer than two consecutive sagittal image of the bowtie shaped meniscus body is seen.A caveat of the absent bowtie sign is that it may be identified in the intact small meniscus of the child or small adult and in the partially resected meniscus. Thus, confirmation of Bucket handle tear ismandatory and can be made by identification of a displaced fragment. In fact, the most reliable sign in the finding of a displaced fragment of meniscus in the intercondylar notch, which can be seen batter on coronalimages this sign is associated with a truncated or shortened meniscus on coronal images. On sagittal images, the displaced fragment can be seen lying anterior and parallel to the PCL. This is known as the double PCL sign.

Flap tears. Flap tears are commonly described as short segment horizontal tears with fragments displaced into notch or superior or interior gutters. In general, flap tears can result wherever there is a change in direction of the tear. For instance, a horizontal tear that extends superiorly on inferiorly resulting in a change in direction is a flap tear .A radial tear with a secondary longitudinal component, sometimes termed a parrot-beak tear , is also considered by stroller and colleagues to be a flap tear. May develop following only minimal meniscal trauma of the degenerative meniscus from chronic shear stresses. They are frequently associated with oblique signal intensity on sagittal images and are sometimes referred toas obliquetears.



Picture12.Flap tear of knee

Coronal images at the midportion of the knee produce the best images ofthe bodies of both menisci. They appear triangular and slightly larger laterally than medially. The capsular attachment on the medial side is incorporated into the tibial collateral ligament. A small amount of fat may be interposed between the body of the medial meniscus and the capsule.

On posterior coronal cross sections, the posterior horn appears as a flat band. On lateral cross section, the popliteal tendon courses upward andlaterally at 45 degrees.

PLANE SCAN OF MRI

The manual project describes procedures for the follow up knee MRI exams. We obtained bilateral knee MRIs on participants who reported knee pain and a random sample of controls without knee pain at the year 2 examination. At the 5 years examination, all the participants with knee pain who had an MRI and a random sample of the controls will be asked to obtain a follow up knee MRI. The participant with knee pain will have a bilateral knee MRI, while the control participant will have only one knee examined, as designated by coordinating center.
The acquisition sequences for the follow up exams are identical to those used at the base line examination, as are most forms and quality assurance procedures.

NOTE : The goal for the follow up exam is to duplicate the baseline measurement as closely as possible by carefully following the protocols and procedures described below.

BACKGROUND AND RATIONALE:

Despite the proven value of knee radiography in epidemiological studies of osteoarthritis, radiography is fundamentally limited in a number of ways. Conventional radiographs provide detailed images of cortical andtrabecular bone but cannot directly visualize the articular cartilage or other noncalcified structures in the knee. Osseous findings are common in osteoarthritis, but tend to arise late in the disease process and may be only secondary consequences of changes in other structures, such as the cartilage, menisci and intra-articular ligament. Also, radiography is a projectional technique that casts two-dimensional (2D) shadows of the 3D anatomy on to flat sheets of film. This results in morphological distortion, magnification and superimposition of overlying structures.

MRI offers a number of advantages over radiography for imaging knee osteoarthritis. MRI has tomography viewing perspective, and thus provides cross sectional images of the anatomy, free of projectional distortion, magnification or superimposition . This allows osteophytes and other abnormalities to be delineated in regions that might otherwise be obscured with conventional radiography. Moreover, MRI is uniquely able to directly visualize all components of joints, including the articular cartilage, menisci, intra-articular ligaments, synovium ,capsular structures, bone contours and bone marrow. This allows the knee joint tobe evaluated as a whole organ, and provides a much richer picture of the changes associated with osteoarthritis than is possible with other techniques.

AIM AND OBJECTIVES

The purpose of this project is to standardize the imaging technique and administrative procedures related to the MRI component of the health ABC protocols for evaluating participants with osteoarthritis of the knee.

The case study describes the Role of 0.5 Tesla MRI to diagnosis the Knee Injuries.

The role of the osteoarthritis and arthritis Research Group at UCSF will be to verify that all sequences in the protocol were included and that the pulse parameters used were in agreement with the protocol. The image will also be checked for adequate anatomical coverage, signal to noise ratio, and the presence of artifacts. If any problems or deficiency are Detected, the osteoporosis and arthritis Research Group at UCSF will notify the MRI site and work with them towards a solution. Only rarely would this require repeat examination of a participant.

The osteoporosis and arthritis Research Group at UCSF will perform centralized analysis of MRI data. Assessment will include semiquantitative scoring of articular cartilage, osteophytes subarticular cyst, bone marrow and edema and sclerosis, attrition and remodeling of osseous articular surfaces, the menisci, the cruciate and collateral ligaments, joints effusion, synovitis, intra-articular loose bodies, andsynovial cysts and bursae about the knee.

METHOD AND MATERIAL

Method: - Method required in MRI involves
. Patient Details
. Patient history
. MRI Sequences
. Finding
Material:-MRI scanner (magnet, gradient), RF coil, PDU (power distribution unit) Head coils, MRI table, computer system, operating console, printer.

MRI EVALUATION

MR images will be analyzed with a semi quantitative whole – organ scoring method.

TRAINING AND CERTIFICATION OF MRI TECHNOLOGIST

Each MRI facility participating in health ABC should designate a study coordinator who is responsible for assigning technicians to the study assuring that the procedure described in this project are followed.

Only designated and certified technicians should perform the examinations for Health ABC.

A representative of the UCSF OARG will visit each site to review the study procedures with the study coordinating and MRI technicians.

PROTOCOLS OF MRI

. Field of view (FOV) –small 10 to 14 cm.
. A matrix of 256 x 256 is usually standard.
. Detected knee coil is mandatory as it improves the signal to noise ratio.

INDICATIONS OF MRI

1. Meniscal disorders:
Nondisplaced and displaced tears, discoid menisci, meniscal cyst.
2. Marrow abnormalities : Vascular necrosis, marrow oedema syndromes, and stress fractures.
3. Congenital and development conditions:blount disease dysplasia, normal variants.
4. Synovial based disorders: symptomatic plicae, synovitis, bursitis, and popliteal cysts.
5. Muscle and tendon disorders: strains, partial and complete tears,tendinitis, tendonopathy.
6. Machanical knee symptoms: catching, locking, snapping, crepitus.
7. Vascular conditions: entrapment, aneurysm, stenosis, occlusion.
8. Neoplasm of bone, joints and soft tissue.9.Infection of bone ,joints or soft tissue.
10. Ligament tears : cruciate ligament, collateral ligament, retinacularligament.
11. Osteochondral and articular cartilage infections.
12. Osteochondral fractures.
13. Osteochondritis.
14. Degenerative chondrosis.
15. Chondromalacia.
16. Acute trauma.
17. Fractures.

CONTRAINDICATIONS OF MRI

The following are standard contraindications for MRI These should be assessed at the Field Center using the Health ABC from at the time of enrollment into the MRI follow-up study and participant should be excluded from the study as appropriate. Each facility may have additional assessments to identify exclusions.

1. Body weight in excess of about 250 lb. Participants with large bodycircumference may not fit in the MRI bore.

2. Any electrically, magnetically or mechanically activated implant (e.g. cardiac pacemaker, insulin pump biostimulator,neurostimulator, cochlear implant, and hearing aids)
3. Intracranial aneurysm clips (unless made up neurostimulator), Pregnancy (risk vs benefit ratio to be assessed)
4. Ferromagnetic surgical clips or staples.
5. Metallic foreign body in the eye.
6. Metal shrapnel or bullet.
7. Claustrophobia ("Do you have claustrophobia"). For those who answeryes, determine if they are willing to attempt the test. True claustrophobiais relatively uncommon (2-3%) . Participants with claustrophobia will know who they are, and these people will probably not be willing to attempt the test. Other may sag they are uncomfortable in small spaces, but may tolerate MRI without difficulty. It is useful to make an attempt in persons who Seem uncertain are who have mild concern. MRI information booklets or a picture of someone in the bore for a knee exammay be helpful in orienting the participant.

Patient preparation

. A satisfactory written consent from must be taken from the patientbefore entering the scanner room.
. Ask the patient to remove all metal objects
Including keys, coins, wallet, cards with magnetic straps, jewellery,hearing aid and hairpins.
. If possible provide a Chaperon for claustrophobic patients.
. Offer earplugs or headphones, possibly with music for extra comfort.
. Explain the procedure to the patient.
. Instruct the patient to keep still.
. Note the weight of the patient.Patient Positioning

Picture13 .Positioning of MRI knee

Positioning of the knee in the magnet must be reproducible from visit to visit in order to allow accurate comparison of serially acquired images. The participant should be images supine with the leg in neutral position and the patella pointing straight up rather than in slight external rotation as is commonly the routine in clinical imaging protocols. External rotation is more difficult to reproduce on serial exams and complicates image interpretation in this study. Additionally, the knee must be well immobilized in the circumferential extremity coil with foam padding.

. Feet first supine.
. Position the knee in the coil and immobilize with cushions .Givecushions under the ankle for extra comfort.
. Centre the laser beam localizer over the lower border of patella. Imaging Parameters
MRI header:

In addition to the standard information usually entered on the setup screen when starting a new participant (name, age, sex etc), three pieces of information unique to Health ABC must be entered. The participant‟s Health ABC ID (which can be obtained from the knee MRI tracking from), the Health ABC ID of the MRI technician, and the leg imaged (right and left). A diagram of the setup screen for the .....MRI center with this information in the correct location is shown below.

Proper participant setup should ensure correct positioning of the knee and sufficient participant comfort to limit motion artifacts and minimize the likelihood of participant dropouts.

All parameters should be pre-programmed into the MRI computer in order to limit potential of human error. Total examination time including10-minutes participant setup is approximately 30 minutes for both knees.

Bandwidth should be16 kHz for all sequences.

1. Axial T2- weighted fast spin echo (FSE) localizer including entirepatella.
. 2500 / 60 (or 64) (TR msec / TE msec),
.20 cm field of view (FOV) ,
.4mm /1mm (slice thickness/interslice gap),
.256×128 matrix,
.Frequency encoding anterior-posterior, phase right -left,
.16echo train length(ETL),
.1 excitation (NEX),
.(Imaging time =25sec).

2. Sagittal T2-weighted fast spin echo (FSE) including entire synovialcavity; localize the slices from sagittal to medial
.
.4217 / 60,
.14 cm FOV,
.4 mm / 0.5 mm (about 5yr 20 slices),
.256×224(or256) matrix,
. Frequency encoding anterior-posterior,
. 8 ETL,
. 2 NEX,
. No phase wrap (NP)
. Frequency-selective fat suppression,

3. Coronal T2- weighted FSE :
. 3500 / 60,
. 14 cm FOV,
. 4mm / 0.5 mm,
. 256 x 256,
. Frequency encoding medial- lateral,
. 8 ETL,
. 2 NEX,
. No phase wrap (NP) ,
. Coverage should included the entire femorotibial joint but not thepatella as shown in fig.

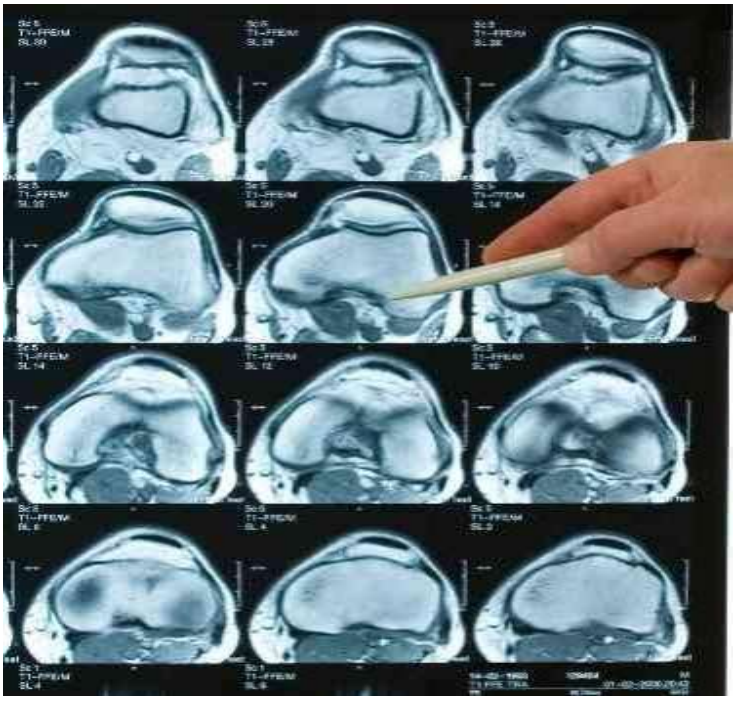
Artifacts

Fat saturation failure : It eliminates chemical – shift artifacts alongcartilage margins and is essential for detecting bone marrow edema. Fat saturation can occur over areas of irregularly shaped anatomy,such as thepatella. Usually, this artifact does not extend to the patellar cartilage, but can interfere with assessment of patellar marrow edema. Accidentalomission of the frequency- selective fat saturation pulse is a significant oversight.

Motion artifacts:participant motion artifacts can be minimized by positioning the participant comfortably using cushions and pads around the knee, and emphasizing the importance of laying still to the participant.

Filming protocol

Format: The three sequences should be filmed. Images should be printed with 3×4 format (12 images per film) with the anatomy depicted from lateral to medial (sagittal), posterior to anterior (coronal), and superior toinferior (axial). Images should be ordered from the top to the bottom and from left to the right of the film. Sequences should be filmed on a separate sheet (i.e., two different sequences should not appear on the same sheet). The first image on the top left should be the localizer showing the slice selection. Section at the periphery of the coverage that do not include any relevant anatomy need not to be filmed.



Pictures 14 . Filming Format of knee MRI

Magnification: Magnification should be the same from one examination to another for the same participant and should be documented on the MRI logsheet

Windowing and leveling

Image window and level settings should be selected as in routineclinical practice to maximize discrimination of anatomy and pathology.

Data handling on site

All completed MRIs should be sent to the MRI reading center every two weeks. It is anticipated that all exams taken over the two-week period fiton a single CD or optical disk. A complete MRI packet consists of the optical disk or CD labeled with each participant whose MRIs are included on the disk, plus individual participant packets with:

- completed MRI logsheet
- Hard copies of the MRI films (3 sequences, one per film) in a separate jacket for each participant
- A completed knee MRI Tracking Form.

Labeling the images

The following information should appear on :

1. The MRI header(so that it will appear on the printed film copy andoptical disk/ CD)
2. The film copy jacket.

- Clinical location and name
- "HABC" and participant enrollment ID for the MRI header, this information must be written in the "ID" field)
- Participant name or acrostic
- Date of MRI exam(mm/dd /yy)
- The side imaged (right or left) should be indicated on:
- the film copy by annotating the localizer scan , and the MRI header by entering " Right" or "Left" into the" Description" field.
- The MRI technician"s health ABC Staff ID # should be entered in theoperator field in the setup screen

CASE DESCRIPTION

CASE:- 1
PATIENT DETAILS

AGE / SEX :- 41Y/ M
DATE :- 14/10/21

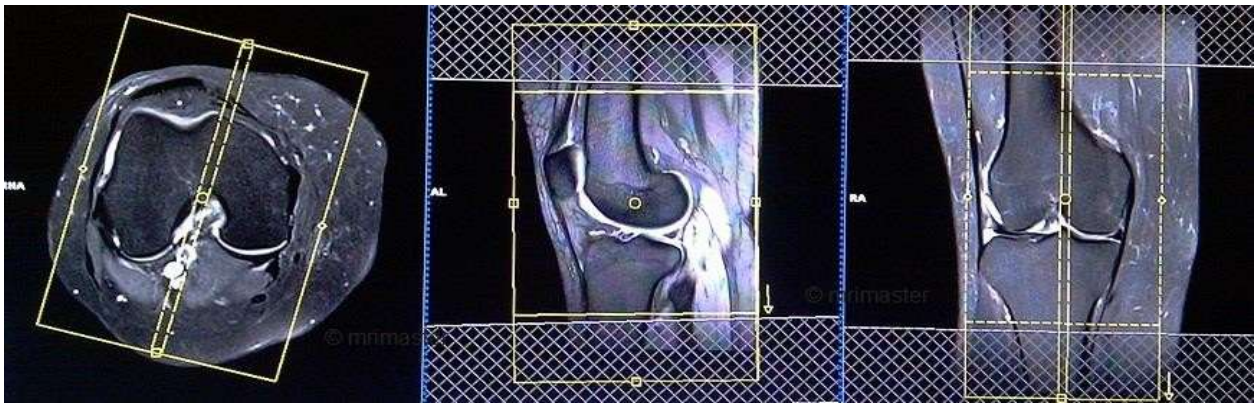
2. PATIENT HISTORY:-

* Trauma x 2year ago
* Pain in left knee x 2 years
* Difficulty in walking x 2 years
* Previous investigation report of MRI, Lateral meniscus tear with ACLtear.

MRI SEQUENCES:-
. Scanogram / Topogram
. Pd weighted
. T2 weighted Sagittal

. T2 weighted Coronal
.T1 weighted Sagittal
. STIR Sagittal

. STIR Coronal
. T2 Axial
. 3DFT (Fourier transformation)



FINDING:-

BONES FORMATION THE KNEE JOINT :

- Alignment - Normal
- Signal intensity- Normal
- Osseous abnormalities–Marginal Osteophytes seen involving tibio- femoral and patello- femoral joints. Suspicious Osteo – chondral lesion measuring 3mm in maximum transverse dimension seen in inner aspect of medial femoral condyle with no significant displacement.

ANTERIOR CRUCIATE LIGAMENT: Chronic high grade partial tearseen at femoral attachment .
POSTERIOR CRUCIATE LIGAMENT: Buckling seen.MEDIAL COLLATERAL LIGAMENT: Normal.
LATERAL COLLATERAL LIGAMENT: Normal.

MEDIAL MENISCUS: Thinning with attenuation of the body of medial meniscus seen.
LATERAL MENISCUS: Normal.

JOINT EFFUSION: Mild joint effusion seen.ARTICULAR CARTILAGE: Normal.
PARA – ARTICULAR REGION: Normal.

PATELLA : Normal.

HOFFA FAT PAD : Normal.QUADRICEPS: Normal.
POPLITEAL VESSEL : Normal.POPLITEAL TENDON: Normal.

IMPRESSION: MRI of the left knee joint demonstrate.

. CHRONIC HIGH GRADE PARTIAL TEAR OF ANTERIORCRUCIAT LIGAMENT AT FEMORAL ATTACHMENT.
. SUSPICIOUS OSTEO – CHONDRAL LASION MEASURING 3MM IN MAXIMUM TRANSVERSE DIMENSION IN INNER ASPECT OFMEDIAL FEMORAL CONDYLE WITH NO SIGNIFICANT DISPLACEMENT.
. THINNING WITH ATEENUTION OF BODY MEDIAL . MENISCUS ANY TEAR.

. MILD JOINT EFFUSION.
. EARL DEGENERATIVE OSTEOARTHRITIS OF KNEE JOINT.

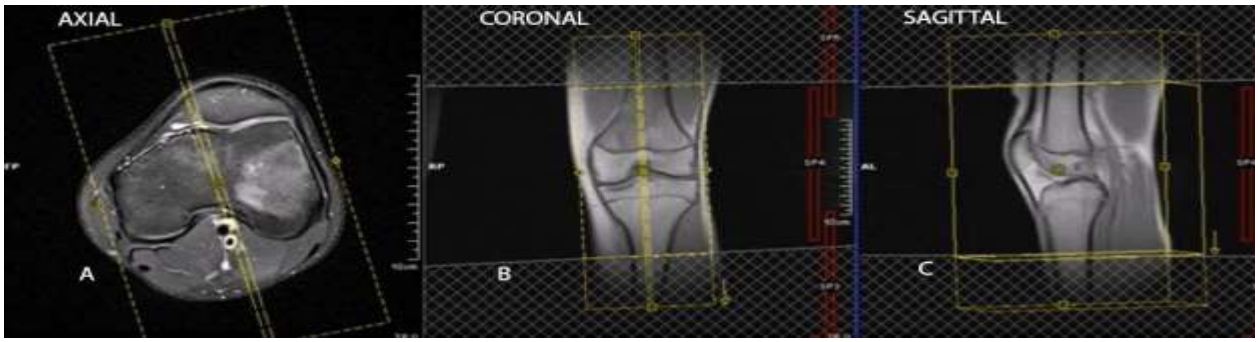
CASE: - 2

1. PATIENT DETAILS:-

DATE :- 12/10/21
AGE / SEX :- 55Y/ M

PATIENT HISTORY: -
*Trauma x2 years ago
*Pain in right knee x 2 years
*Swelling in both lower limb x 2 years

MRI SEQUENCES:-
.Scanogram
.PD weighted
.T2-weighted sagittal
.T1-weighted sagittal
.STIR Sagittal
.T2-weighted coronal
.STIR coronal
.T2-weighted axial



FINDINGS :-

BONES FORMING THE KNEE JOINT:
Alignment-Normal,
Signal intensity &osseous abnormality- **A focal area of altered signalintensity (hyper on.....STIR) noted at tibial plateau ?marrow oedema.**

ANTERIOR CRUCIATE LIGAMENT:**partial tear is noted** POSTERIOR CRUCIATE LIGAMENT: **Buckling at tibial attachmentis noted.**
MEDIAL COLLATERAL LIGAMENT: Normal. LATERAL COLLATERAL LIGAMENT: Normal.
MEDIAL MENISCUS: **anterior tear of medial meniscus is noted.**
LATERAL MENISCUS: **mucoid degeneration is noted.**
JOINT EFFUSION: **joint effusion with suprapatellar extension isnoted.**
ARTICULAR CARTILAGE: Normal to the extent visualized.PARA-ARTICULAR REGION: Normal.
PATELLA :Normal. HOFFA FAT PAD: Normal.QUADRICEPS: Normal.
POPLITEAL VESSELS: Normal.POPLITEAL TENDON: Normal.

IMPRESSION:

MRI OF THE RIGHT KNEE JOINT DEMONSTRATES:

. PARTIAL TEAR OF ANTERIOR CRUCIAT LIGAMENT WITH BULKING OF POSTERIOR CRUCIATE LIGAMENT AS DESCRIBED.
. MEDIAL MENISCUS TEAR WITH MUCOID DEGENERATION OF LATERAL MENISCUS AS DESCRIBED.
. JOINT EFFUSION WITH SUPRAPATELLAR EXTENSION.

CASE :- 3

PATIENT DETAILS:-

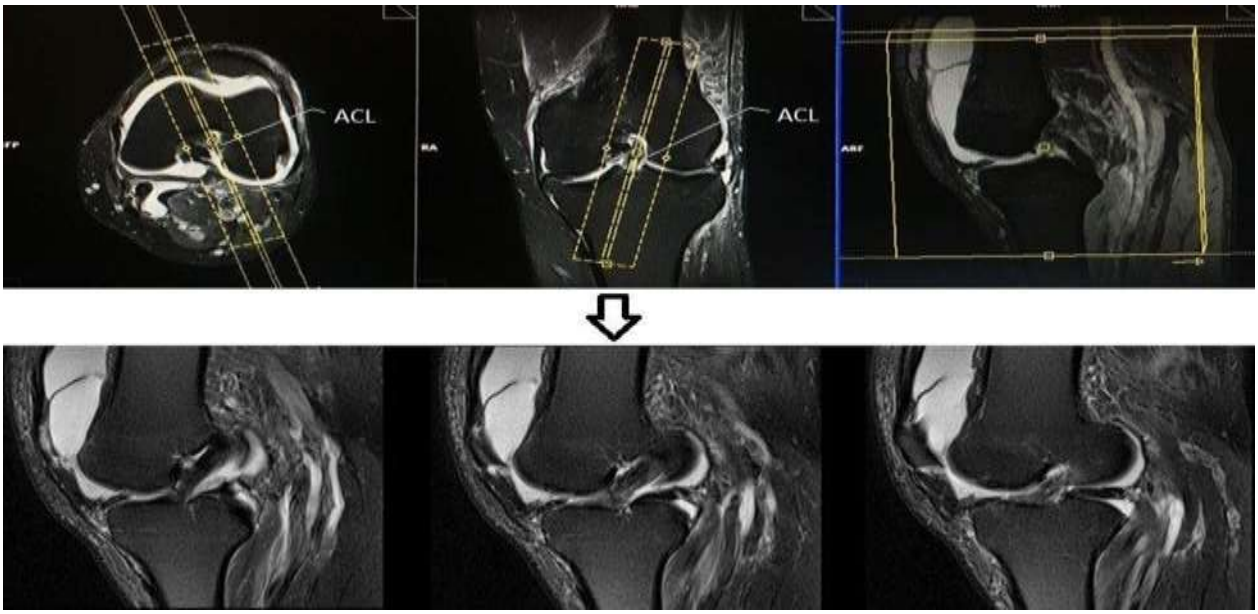
AGE :- 37Y/F
DATE :- 01 /12/21

PATIENT HISTORY:-

- Right Knee pain x 1 year
- Swelling at knee joint
- Difficulty in walking

MRI SEQUENCES:-

- T1 weighted Spin echo
- T2 weighted fast spin echo
- PD weighted fast spin echo
- Fast STIR gradient echo sequences
- T2 weighted gradient echo sequences



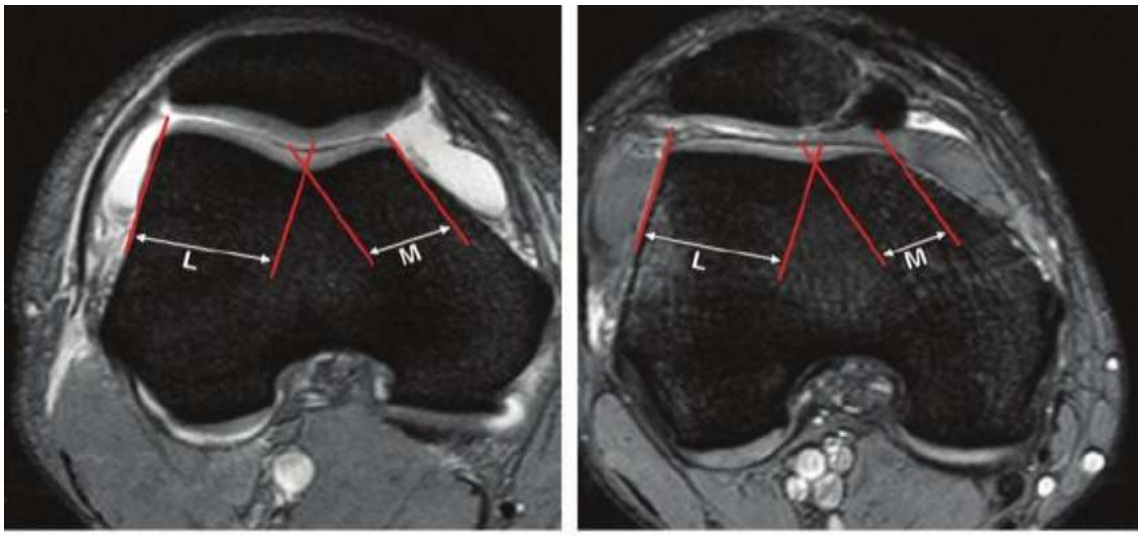
FINDINGS:-

There is a lateral dislocation of patella and mid lateral and anteriortranslation of tibia over femur.

Small osteochondral defect is seen in the inferior aspect of medialpatellar facet.

Small ill-defined area of marrow oedema / contusion is seen anterolateral aspect of lateral femoral condyle.

Grade I intrasubstance signal is seen in posterior horn of medialmeniscus.



a. b.

IMPRESSION:-

Mild trochlear facet asymmetry noted.

Moderate knee joint and suprapatellar effusion noted.

CASE – 4

PATIENT DETAILS-:

AGE/ SEX :- 28Y/M
DATE :- 20/02/22

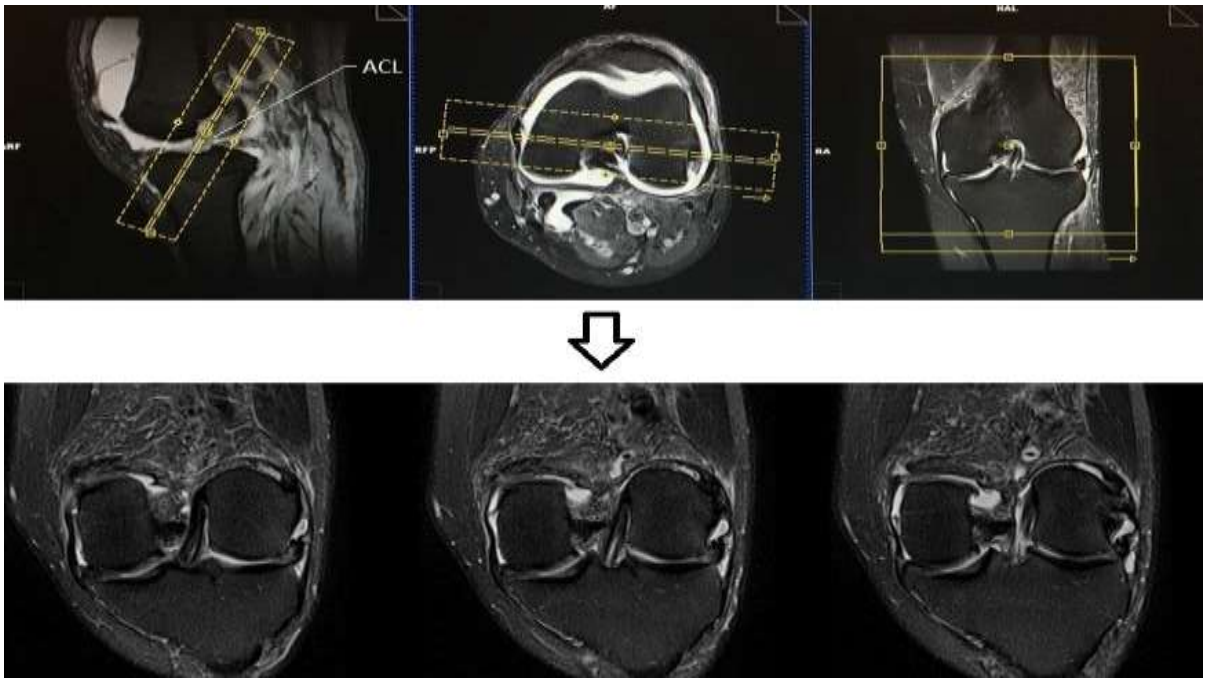
HISTORY:-

H/OTrauma

Knee pain Tenderness, swelling, bruising
Inability to bear weight or take any pressure on the inquired legDifficulty moving the joint
Stiffness

MRI SEQUENCES :-

- T2 Axial
- T1 Sagittal
- T1 Coronal
- TSE PD
- STIR



FINDINGS:-

Mild synovial effusion with supra patellar extension is seen.

Linear hyperintensity not reaching up to articular surface is seen inanterior horn of lateral meniscus.

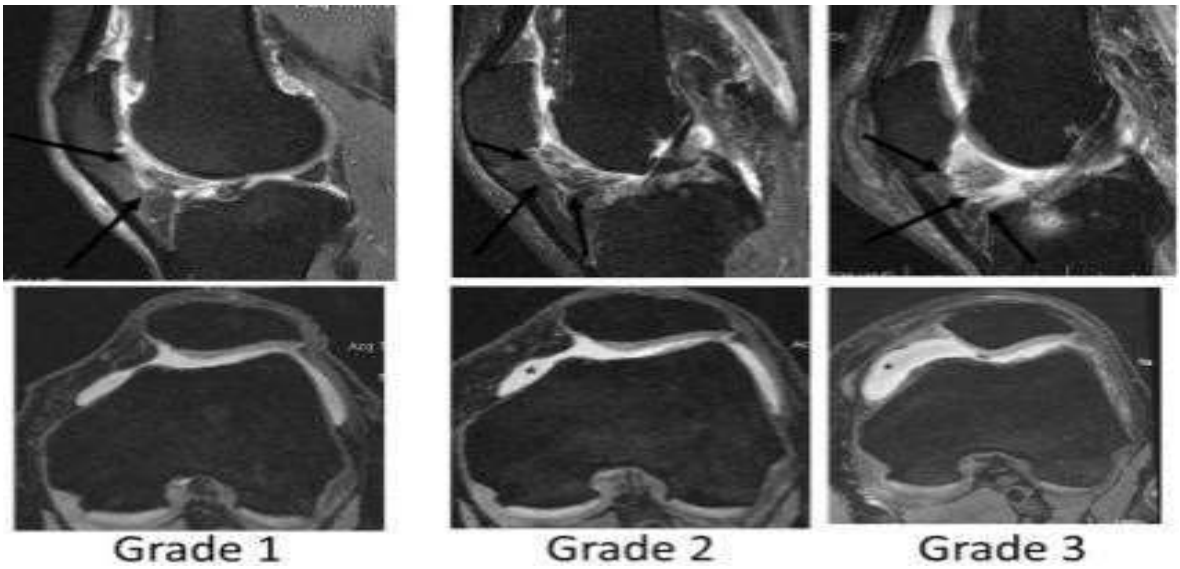
Both posterior horns of medial as well as lateral menisci are normal inMR morphology and signal intensity.

Mild fluid is noted along the insertion site of popliteus tendon. However,no discontinuity or tear of fibers is seen.

Bone marrow oedema is noted in head of fibula – contusion.

Pariarticular musculotendinous attachments and Vascular flow voids areunremarkable

Few enlarge lymphnodes are seen in popliteal Fossa region, largestmeasuring 10x11 mm in size



IMPRESSION:-

Mild SYNOVIAL EFFUSION WITH SUPRA PATELLAR EXTENSION.

GRADE -2 LINEAR HYPERINTENSE SIGNAL IN ANTERIORHORN OF LATERAL MENISCUS.

CONTUSION IN HEAD OF FIBULA.

CASE – 5

PATIENT DETAILS:-

AGE/SEX:- 41Y/M
DATE :- 23/02/22

PATIENT HISTORY:-

1. Knee pain
2. Swelling
3. Stiffness
4. Difficulty in rotating the joint

MRI SEQUENCES:-

- TSE T2 Axial
- T1 Sagittal
- TSE PD Sagittal
- T2 Sagittal
- T1 Coronal
- STIR Coronal

FINDINGS:-

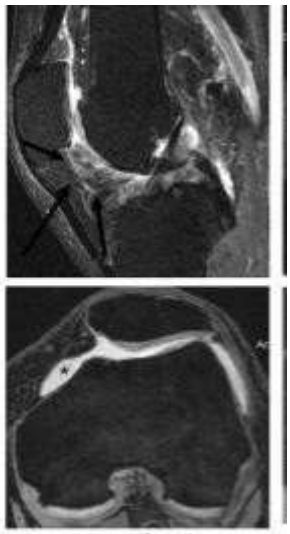
. Femoral attachment site of anterior cruciate is not visualized to complete ACL tear.

Linear hyperintense signal are noted involving lateral femoral condyle, lateral tibial meniscus not extending up to the articular surface, grade -2 medial meniscal changes.

PDFS hyperintense signals are noted involving lateral femoral condyle, lateral plateau and intercondylar region of tibia contusion.

Hyperintense signal with fibrillation are noted involving the fibular collateral ligament- likely sprain.

Moderate synovial effusion with suprapatellar extension is seen.



Grade 2

IMPRESSION:-

NEAR COMPLETE TO COMPLETE ANTERIOR CRUCIAT LIGAMENT TEAR.

GRADE- 2 MEDIAL MENISCAL CHANGES.

CONTUSION INVOLVING LATERAL FEMORAL CONDYLE, LATERAL TIBIAL PLATEAU AND INTERCONDYLARREGION OF TIBIA.

HYPERINTENSE SIGNAL WITH FIBRILLATION INVOLVING THE FIBULAR COLLATERAL LIGAMENT-LIKELY SPRAIN.

MARROW OEDEMA / CONTUSION WITHIN THE HOFFAS PAD OF FAT AND SUBCUTANEOUS AROUND LEFT KNEEJOINT.

MODERATE SYNOVIAL EFFUSION WITH SUPRAPATELLAR EXTENSION.

CASE – 6

PATIENT DETAILS:-

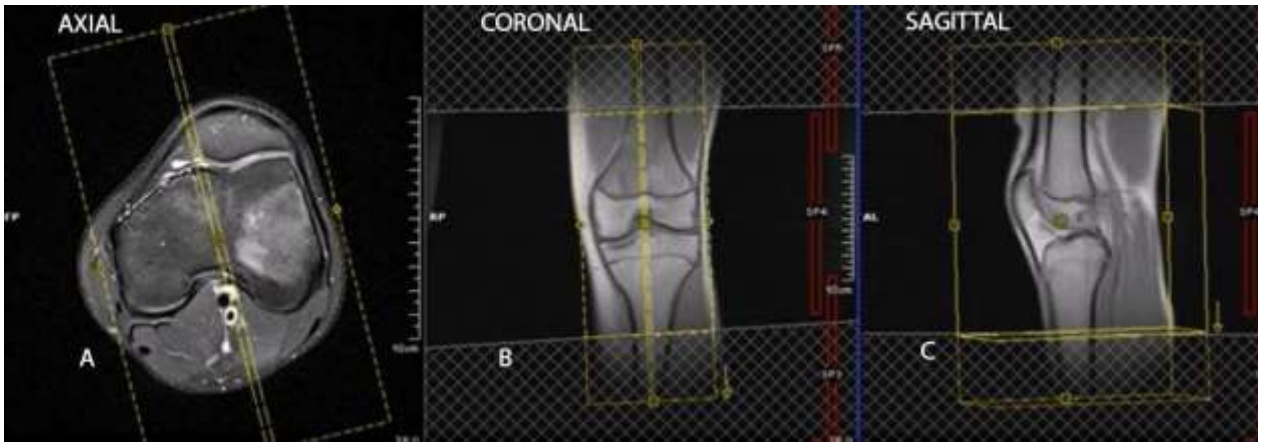
AGE/ SEX :- 25Y/M
DATE :- 23/02/22

PATIENT HISTORY:-

1. A loud pop or a “popping” sensation in the knee.
2. Severe pain
3. Rapid swelling
4. Loss of range of motion

MRI SEQUENCE:-

- TSE T2 AXIAL
- T1 Sagittal
- TSE PD Sagittal
- T2 Sagittal
- T1 Coronal
- STIR Coronal



FINDINGS:-

Thinning with intrasubstance hyperintense signal are seen involving the anterior cruciate ligament with involvement of more than 50 percent of it‟s fibers – consistent with grade – 2 ACL changes / partial tear.

Subtle intrasubstance hyperintense signal are noted involving the posterior horn of medial meniscus not extending up toarticular surface, grade – 1 medial meniscal changes.

Hyperintense signal with fibrillation are seen involving the medial patello- femoral ligament, sprain.

Moderate synovial effusion with suprapatellar extension is seen.

IMPRESSION:-

GRADE- 2 ANTERIOR CRUCIAT LIGAMENT CHANGES / PARTIAL TEAR.

GRADE-1 MEDIAL MENISCAL CHANGES.

SPRAIN INVOLVING THE MEDIAL PATELLO- FEMORAL LIGAMENT.

MODERATE SYNOVIAL EFFUSION WITH SUPRAPATELLAREXTENSION.

CASE –7

PATIENT DETAILS:-

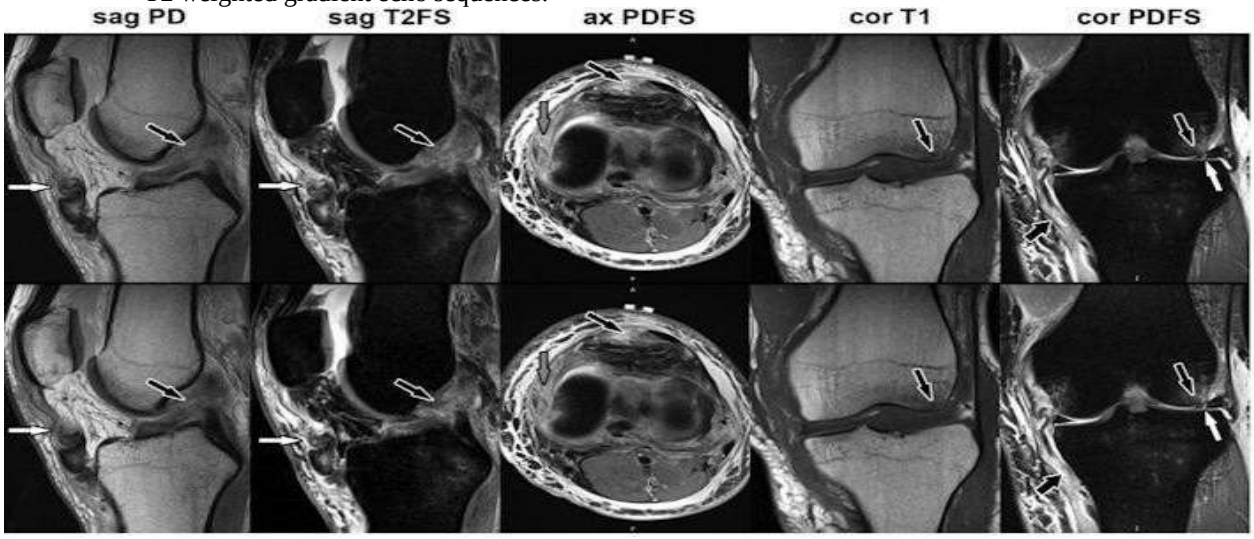
AGE/SEX :- 30 Y/M
DATE :- 27/11/21

PATIENT HISTORY:-

1. Knee pain
2. Stiffness
3. Tenderness 4.Loss of flexibility
5. Grating sensation6.Bone spurs

MRI SEQUENCES:-

- T1 weighted Spin echo Sagittal Plane.
- T1 weighted Spin echo coronal plane
- T1 weighted Spin echo transverse plane.
- T2 weighted spin echo sequence
- PD weighted fast spin echo sequence.
- Fast STIR.
- T2 weighted gradient echo sequences.



FINDINGS :-

There is complete full thickness of tear of anterior cruciate ligament. Moderate anterior translation is seen of tibia over femur and mild
„buckling is seen of posterior cruciate ligament, which shows no intrinsic abnormality.

Grade lll bucket-handle tear is seen of body of medial meniscus. Theflap fragment is displaced anterosuperiorly over its anterior horn.

Grade lll Oblique tear is seen of posterior horn of lateral meniscus.

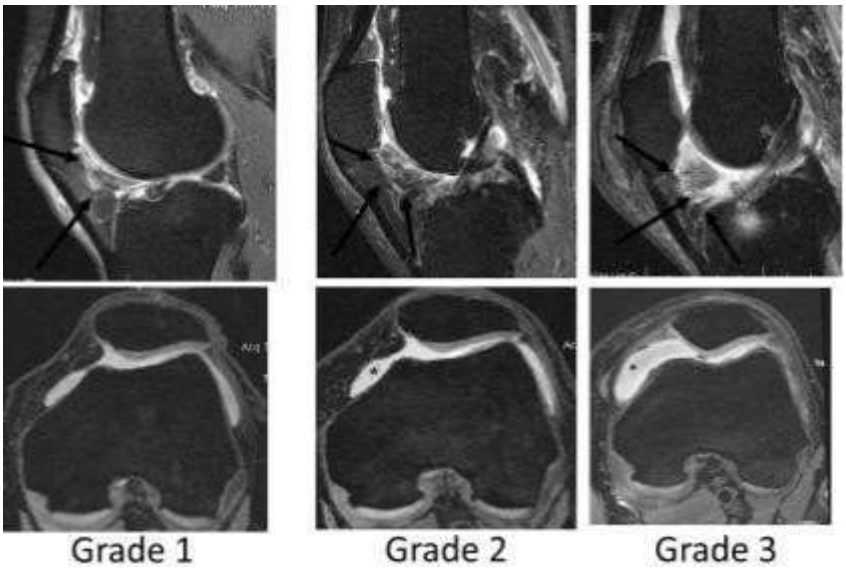
Mild fluid is seen along medial collateral ligament, without any intrinsic abnormality, suggestive of grade I sprain.

Mild osteophytic spurring is seen of the articular margins of femur ,tibia and patella and there is evidence of spiking of tibial spines. Mild reduction of medial femorotibial joint space noted.
Low grade loss of articular surface cartilage along with degenerative subchondral marrow oedema are seen along the weight bearing articular surfaces of medial femoral condyle and medial tibial plateau a d medial patellar facet, suggestive of grade l/ll chondromalacia.

A small loculated septated cystic lesion is seen in the popliteal fossa, in between the tendons of medial head of gastrocnemius and semimembranosus / semitendinosis, which seems to communicate with the knee joint space and most likely represents a popliteal cyst . It measures approximately cms in maximum anterior-posterior x transversex craniocaudal dimensions.

Mild to moderate knee joint and suprapatellar effusion noted.

Patellar tendon is normal in the thickness and signal intensity. Rest ofthe visualized bones appear normal. Lateral collateral ligament appears normal.



IMPRESSION :-

. Complete full thickness tear of anterior cruciate ligament associated with moderate translation of tibia over femur and mild buckling ofposterior cruciate ligament, which shows no intrinsic abnormality.

. Grade lll bucket-handle tear of body of medial meniscus. The flap fragment is displaced anterosuperiorly over its anterior horn.

.Grade lll oblique tear of posterior horn of lateral meniscus.

.Grade I sprain of medial collateral ligament .

. Degenerative osteoarthritic changes in the form of mild osteophytic spurring of the articular margins of femur, tibia and patella, spiking of tibial spines, and mild reduction of femorotibial joint space and grade l/ll chondromalacia along the weight bearing articular surfaces of medialfemoral condyle and medial tibial plateau and medial patellar facet.

. A small loculated septated popliteal cyst.

. Mild to knee joint and suprapatellar effusion.

CASE – 8

PATIENT DETAILS:-

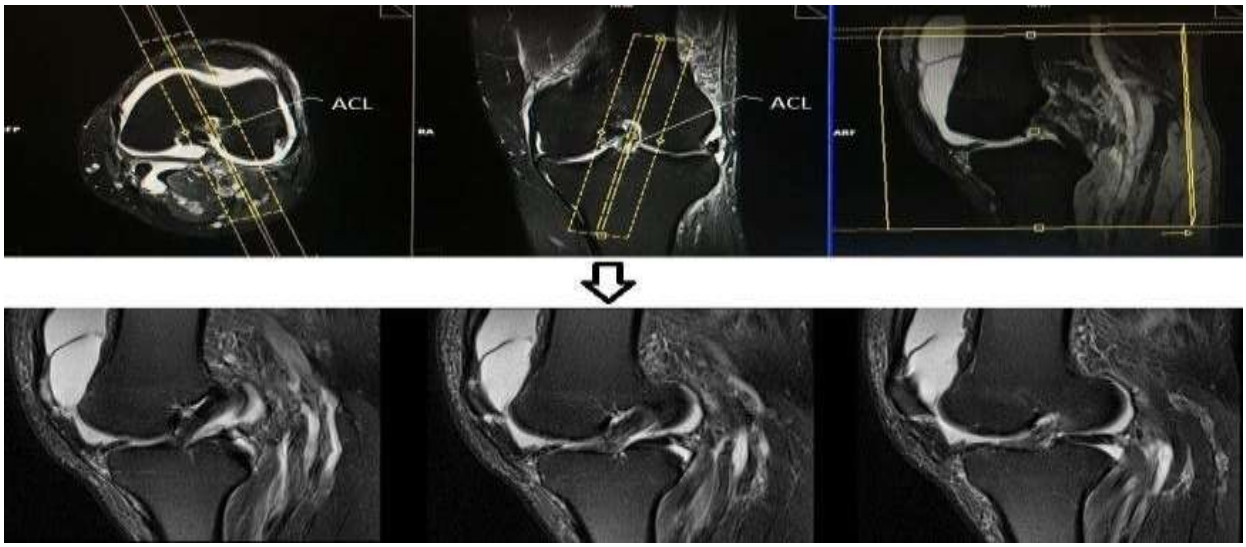
AGE/SEX :- 60Y/M
DATE:- 26/11/21

PATIENT HISTORY:-

1. Dull, achy pain
2. Swelling or redness
3. Warmth
4. Loss or reduction in motion

MRI SEQUENCES:-

- T1 weighted Spin echo Sagittal Plane
- T1 weighted Spin echo coronal plane
- T1 weighted Spin echo transverse plane
- T2 PD weighted fast spin echo
- Fast STIR
- T2 weighted gradient echo



FINDINGS:-

There is partial tear of midsubstance of anterior cruciate ligament.

Mild buckling is seen of posterior cruciate ligament, without Any intrinsic abnormality.

Mild anterior translation is seen of tibia over femur.

Grade lll horizontal tear is seen of body of medial meniscus

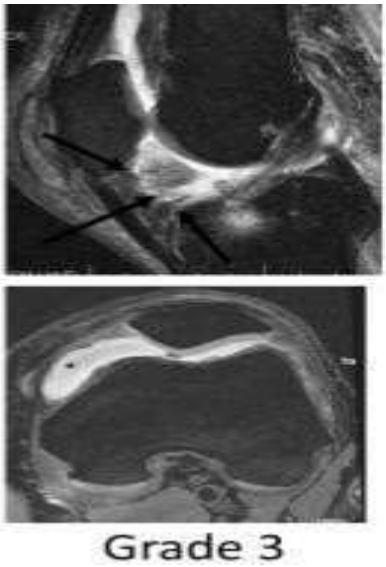
Mild fluid is seen along medial collateral ligament,without any intrinsic abnormality, suggestive of grade I sprain.

Mild osteophytic spurring is seen of the articular margins of femur, tibia and patella and there is evidence of spiking of tibial spines. Mild reduction of medial femorotibial joint space noted.

Mild knee joint and suprapatellar effusion noted.

Patellar tendon is seen in the thickness and signal intensity.

The lateral collateral ligament and lateral meniscus appear normal.



IMPRESSION:-

Partial tear of midsubstance of anterior cruciate ligament associatedwith mild buckling of posterior cruciate ligament, which shows no intrinsic abnormality and mild anterior translation of tibia over femur.

Grade lll horizontal tear of body of medial meniscus.Grade I sprain medial collateral ligament.
Mild knee joint and suprapatellar effusion.

A Moderate sized loculated septated popliteal cyst.

CASE – 9

PATIENT DETAILS:-

AGE/SEX :- 28Y/M
DATE:- 13/02/22

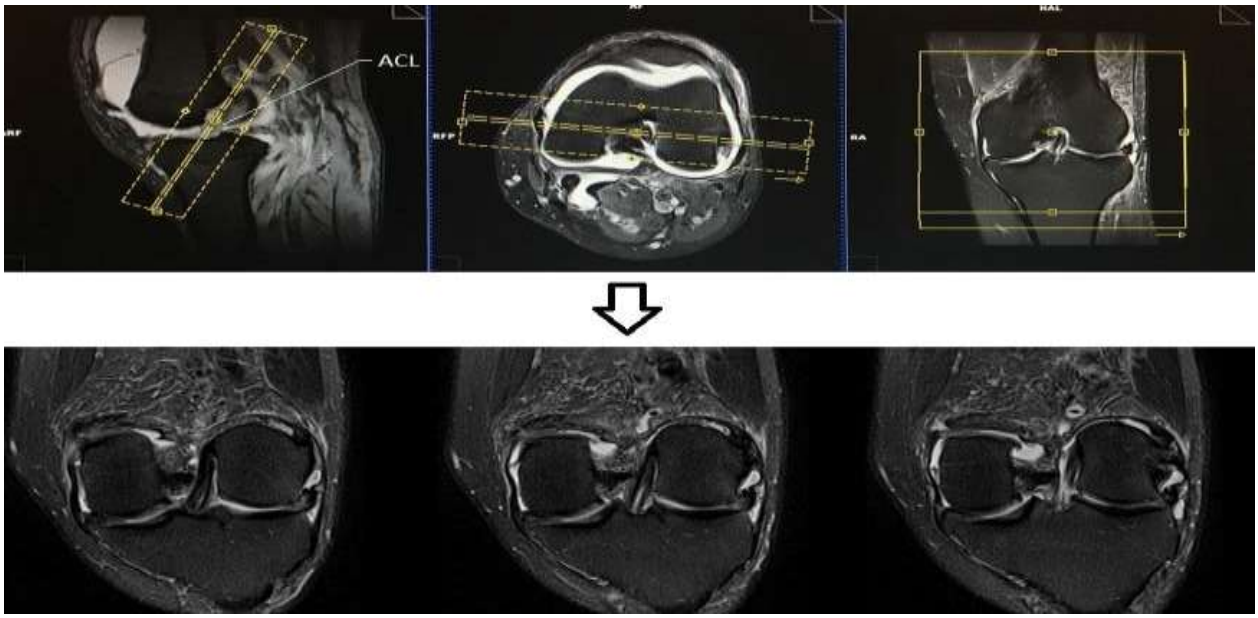
PATIENT HISTORY:-

- History of post Operative patient
- Knee pain
- Swelling and Stiffness
- Catching or locking
- Instability

- Pain in the back of knee with deep
- squatting

MRI SEQUENCES:-

- T2 Axial
- T1 Sagittal
- T2 Sagittal
- PD Sagittal
- T1 Coronal
- STIR Coronal



FINDINGS:-

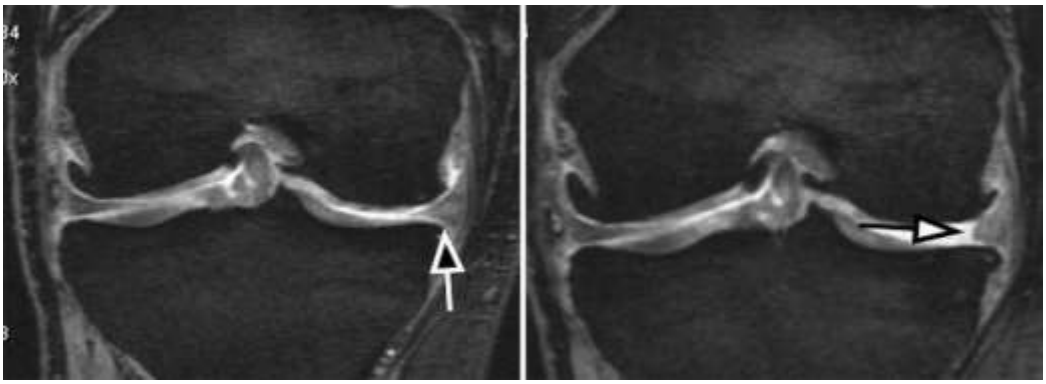
The femoral tunnel appears normal. The inferior portion of the tunnel is located at the intersection of the Blumensaat line with posterior femoral cortex line. The intra-articular portion of the tunnel is located at the superiolateral posterior margin of the intercondylar notch.

The ACL graft shows normal signal intensity. No evidence of tear is observed. The posterior cruciate ligament appears normal.

Grade ll horizontal and lateral collateral ligament are normal seen. QUADRICEPS tendon and patellar ligament are normal.

Degenerative maceration with grade ll signal intensity change are alsonoted involving the posterior horn of the medial meniscus.

The posterior cruciate ligament appears normal.Minimal joint effusion is observed.



IMPRESSION:-

Normal post operative anatomy of the femoral and tibial tunnel aswell as the ACL graft.

Grade ll horizontal signal intensity changes involving the body andposterior horn of the lateral meniscus.

Degenerative maceration with grade ll signal intensity changes involving the posterior horn of the medial meniscus.

Minimal joint effusion.

CASE – 10

PATIENT DETAILS:-

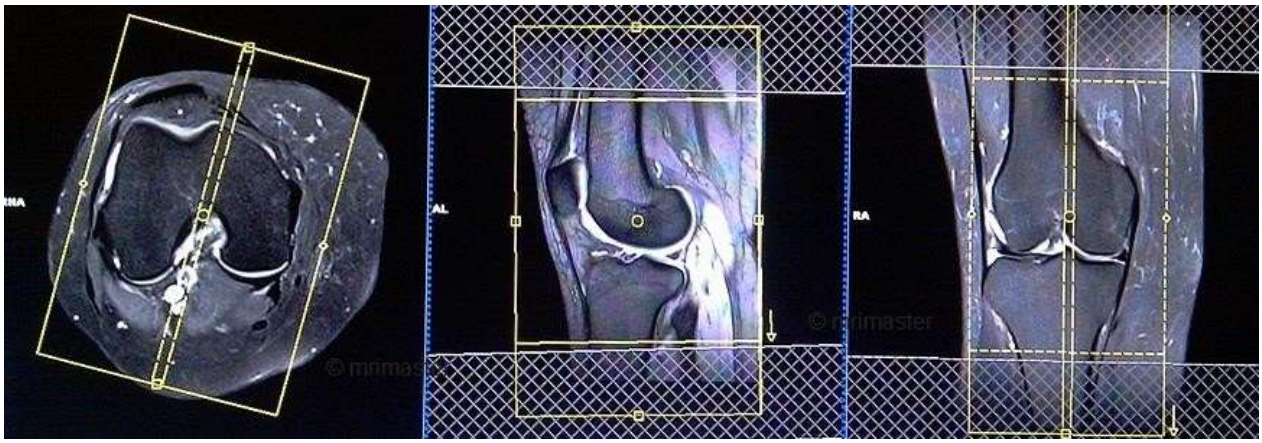
AGE/SEX:- 27Y/M
DATE :- 16/02/22

PATIENT HISTORY:-

- Buckling, Catching or locking of the knee
- popping or cracking in the knee
- Stiffness or swelling of the knee
- Pain after extended sitting.

MRI SEQUENCES:-

- T2 Axial
- T1 Sagittal
- T1 TSE PD Sagittal
- T1 Coronal
- STI coronal



FINDINGS:-

There is evidence of mild to moderate medial femoral subluxation.Malunited fracture of proximal tibial epimetaphysis is noted . Secondary degenerative changes are noted involving the medial as well as lateral tibiofemoral joint with reduce joint space, articular cartilage erosion, subarticular cystic changes and marrow oedema.

65Maceration with grade I signal intensity changes are also noted involving the medial meniscus as well as lateral meniscus.

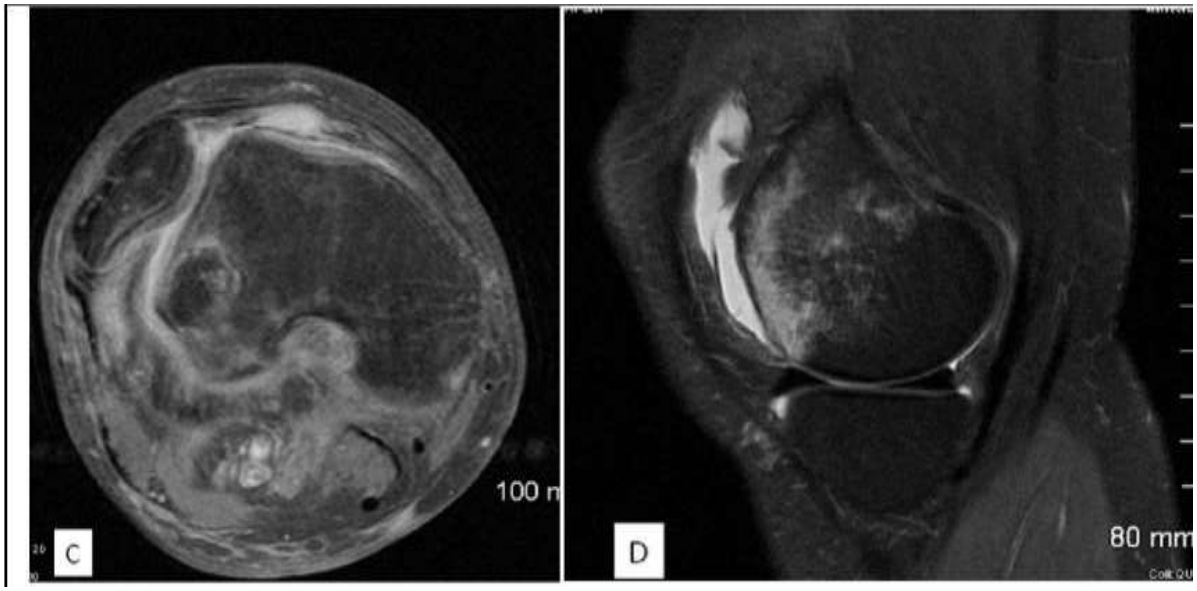
Both the anterior and posterior horns of medial as well as lateral menisciotherwise are normal in MR morphology and signal intensity.

Anterior cruciate, posterior cruciate, medial collateral and lateral collateral ligaments are normal in morphology, signal intensity and outline. No obvious ligamentous tear is seen.

Quadriceps tendon and patellar ligament are normal.

Periarticular musculotendinous attachments and vascular flow voids are unremarkable.

Both the medial and lateral retinaculae are normal, the articular cartilageis normal in signal intensity with no evidence of any chondromalacia.



IMPRESSION:-

. Mild to moderate medial femoral subluxation.

.Malunited fracture of proximal tibial epimetaphysis.

.Secondary degenerative changes involving the medial as well aslateral tibio-femoral joints.

. Maceration with grade I changes involving the medial meniscus aswell as lateral meniscus.

RESULTS

In our study, MRI examination was performed on 50 patients with the complaints of knee injury. Regarding the most common age group, the affected were between 21 and 39 and this is explained by the fact that this age group being the most active group, from 50 patients examined in this study, 42 patients (76%)were males, and 8 of them were females. Of them,36(76%) had ACL tears, 3(6%)had PCL tears, 17(34%)had medial meniscus tears, and 11(22%) had lateral meniscus injuries.

DISCUSSION

Imaging of the knee presents a special challenge because of its complex structure. A variety of imaging modalities are currently used to evaluate knee abnormalities. These modalities include standard radiography, computed tomography, MRI, and arthrography. MRI has revolutionized knee imaging. It has been compared by various studies between MR and arthroscopic findings.
These studies validate the role of MRI in the clinical arena, especially for the evaluation of knee injuries.

The study population consisted in the age group of 16- 61 years. A maximum number of patients who underwent MRI of the knee for injuries belonged to the age group of 18- 28 years. Out of total 50 patients, ACL tear was the most common finding affecting 38 patients (76%), and among which, 30(79%)had complete tear and 8 patients (21%) had partial tear, followed by MM tear in 17(34%) and LM tear seen in 11 patients (22%).The concluded ACL tears to be more common than other ligamentous injuries

There was a preponderance of MM over LM in our study which was again correlated with the study done by Singh et al. Out of 173 they found 57(32.9%) patients showed LM tear.

Sensitivity, specificity and accuracy of MRI in detecting ACL tear was reported to be 98.7%,98.9% and 98.8% respectively in a study by Singh et al.

PCL injuries are less common than ACL injuries, and reported rates varyfrom 3% to 20%. Thee PCL being a stronger ligament has a low Incidence of tears. The sensitivity, specificity and accuracy of MRI in

identifying PCL tear is 100% which similar to a study in which the accuracy of MRI in detecting PCL tears is 100%.

MRI of the knee has been found to be highly accurate in the diagnosis ofmeniscal tears. All the medial meniscal tears are associated with ACL tears in the present study.

CONCLUSION

. Ligamentous and meniscal injuries occur frequently in patients with trauma to the knee. It is noted that MM and ACL are more commonly torn when compared to PCL and LM. While ACL and medial collateral ligament tear show predilection toward MM tear, lateral collateral ligament tear showed a strong relationship with LM tear.
. MRI is highly sensitive and accurate at the identification of both anterior cruciate ligament and PCL tears.
The diagnostic yield is increased with appropriate use of sequences and proper analysis of images in all planes.
. Misinterpretation are more likely to happen in the case of partial ACL tear where it can be missed or it canbe over diagnosed on MRI.
. Description of the type of ACL and PCL tears helped the orthopedic surgeons as a conservative approach was indicated in partial tears whilea reconstruction was indicated in a complete tear.

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