TO STUDY THE DIAGNOSTIC ACCURACY OF MRI VERSUS ARTHROSCOPY IN KNEE INJURES

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LIST OF ABBREVIATIONS

PD	Proton density
MCL	Medial Collateral Ligament
MR	Magnetic Resonance
PCL	Posterior Cruciate Ligament
MRI	Magnetic Resonance Imaging
MM	Medial Meniscus
LM	Lateral Meniscus
LCL	Lateral collateral ligament
NMR	Nuclear Magnetic Resonance
NPV	Negative Predictive Value
PPV	Positive predictive value
RF	Radiofrequency
IDK	Internal Derangement of Knee
ACL	Anterior Cruciate Ligament
STIR	Short tau inversion recovery
T	TESLA
T1	Inversion time
TR	Repetition time
TE	Time to echo
T2	Transverse relaxation

ABSTRACT

The aim of this study is to compare the diagnostic accuracy of magnetic resonance imaging (MRI) versus the arthroscopic findings in cases of ligament injuries of knee. MRI is currently available means of diagnosis in acute injured painful knee where clinical examination is non conclusive because of high negative value. The purpose of study was to correlate results of MRI in internal derangement of knee with arthroscopy findings, so as to determine the efficacy of MRI in different intraarticular knee injuries.

Aim & Objective of study

- To observe sensitivity and specificity of MRI in detecting cruciate ligament tears, confirmed subsequently with arthroscopy.

- To observe the sensitivity and specificity of MRI in detecting meniscal tears.

- To categorize discrepancies in finding of menisci and cruciate ligament between arthroscopy and MRI.

- To k now the Positive Predictive Value, Negative Predictive Value and Accuracy of MRI.

Methods Of Collection of Data

- All patients who are clinically suspected of internal derangement of knee presented in department of orthopedics will be evaluated with clinical history and MR imaging.

- A surface coil is used, MRI will be performed using a 1.5 tesla MRI scanner (Philips MRI System). Axial, coronal & sagittal T1 ,T2 ,PD & STIR images will be taken.

- Patient underwent Diagnostic arthroscopy and were further evaluated.

Result

Out of total 32 patients evaluated, most common injury were ACL and PCL injuryleast Common. Medial meniscus injury is most common than lateral. Osseous lesion & joint effusion were most common associated with injuries. On arthroscopy most of findings corelatedvery well.

Conclusion

MRI is noninvasive and reliable investigation for ligament pathologies, It helps in diagnosis of ligament injuries, thereby helping in proper management by conservative and surgical treatment. However there are a few medial meniscal injuries which go unnoticed in MRI, hence reducing its sensitivity to diagnose the injury. MRI can even give false positive results in those patients who also have medial osteochondral defects.

However one must carefully evaluate and re-evaluate before ruling out a internal derangement in a knee even when MRI shows no evidence of injury.

Keywords: Medial Meniscus (MM), Lateral Meniscus (LM), Anterior Cruciate Ligament (ACL), Posterior Cruciate Ligament (PCL), lateral collateral ligament (LCL), Medial collateral ligament (MCL).

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Trauma to the knee joint is a significant cause of morbidity in active young individuals, especially among athletes, road traffic accidents, and military and police recruits. The knee takes much stress, especially when bending. Studies have shown that the forces at the knee joint can reach three times body weight when the knee is bent during activities such as going upstairs and up to six to seven times body weight when in a full squatting position. Internal derangement of the knee refers to a variety of damaged structures that can be injured within the knee, including meniscal cartilage tears and loose bodies. Ligament tears often present with pain and instability during function. The higher the degree of tearing in the ligament, the greater the number of instability symptoms. Early detection is vital for the proper treatment of intraarticular ligaments, meniscal injury and articular cartilage to prevent further degeneration and mechanical instability by available surgical options. Internal derangement can be diagnosed by various imaging techniques.

USG ultrasonography can detect effusion of the knee. It has the advantages of being non-invasive, readily available and allowing good visualization of superficial structures. CT provides valuable information about co-existing joint effusion, chondral and osseous fractures, and CT scans locate loose bodies; however, it has disadvantages. Arthroscopy is considered the gold standard for the diagnosis of traumatic intraarticular

knee lesions, having accuracy as high as 95% to 98%. However, arthroscopy is non-invasive and costly. It requires hospitalization & anaesthesia. Initially, arthroscopy was used for the diagnosis of various knee pathology, including diagnosis of meniscal pathology, articular cartilage injury and other pathologies.

AIM OF THE STUDY

1. To compare and correlate the MRI appearances of meniscal and ligamentousinjuries with arthroscopy

2. To find out the specificity, sensitivity, positive and negative predictive values ofMRI in diagnosing different injuries.

3. To studylimitation of MRI in detecting injuries of the knee.

REVIEW OF LITERATURE

The knee is the largest joint in the body. It is a complex 'hinge' joint made up of the lower end of the femur, the upper end of the tibia and the patella, which slides in a groove on the end of the femur.

The knee joint has three components, the lateral tibio-femoral, medial tibio-femoral and patella-femoral joints. Four bands of tissue, the anterior and posterior cruciate ligaments, and the medial and lateral collateral ligaments connect the femur and the tibia and provide joint stability. Strong thigh muscles give the knee, strength and mobility. The surfaces where the femur, tibia and patella touch are covered with articular cartilage, a smooth substance thatcushions the bones and enables them to glide freely. Semicircular rings of tough fibrous-cartilage tissue called the lateral and medial menisci act as shock absorbers and the bones of the knee are surrounded by a thin, smooth tissue capsule lined by a thin synovial membrane which releases aspecial fluid that lubricates the knee, reducing friction to nearly zero in a healthy knee.It is a synovial modified hinge joint, which also permits a small degree

of rotation. In the knee joint, the femoral and tibial condyles articulate, as does the patella and patellar surface of the femur.Fibula does not contribute to the knee joint.
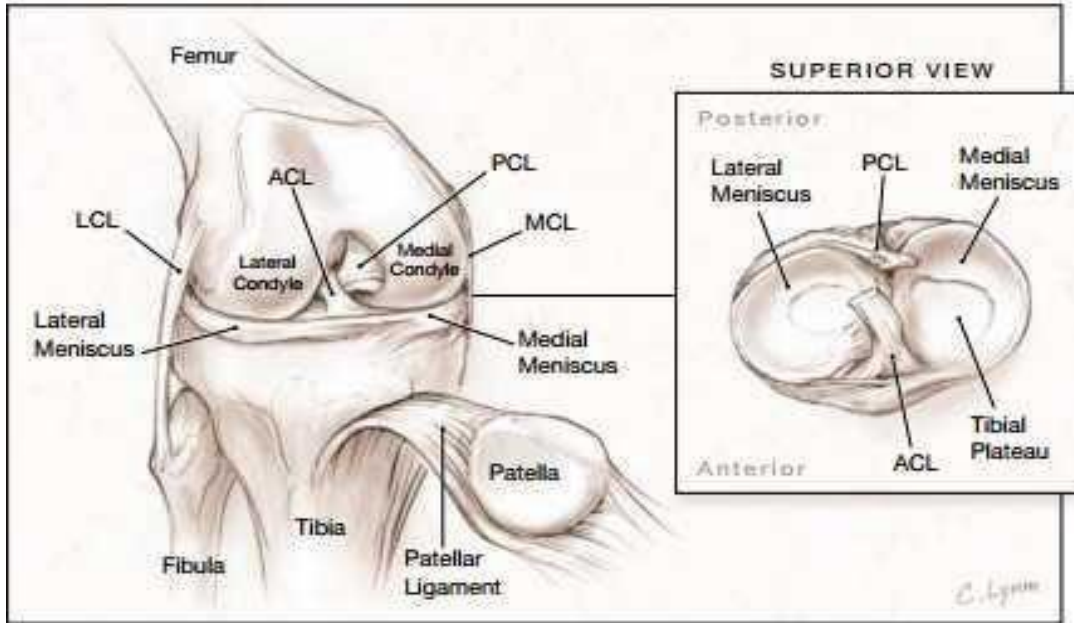
Fig 1 normal anatomy of knee [58]
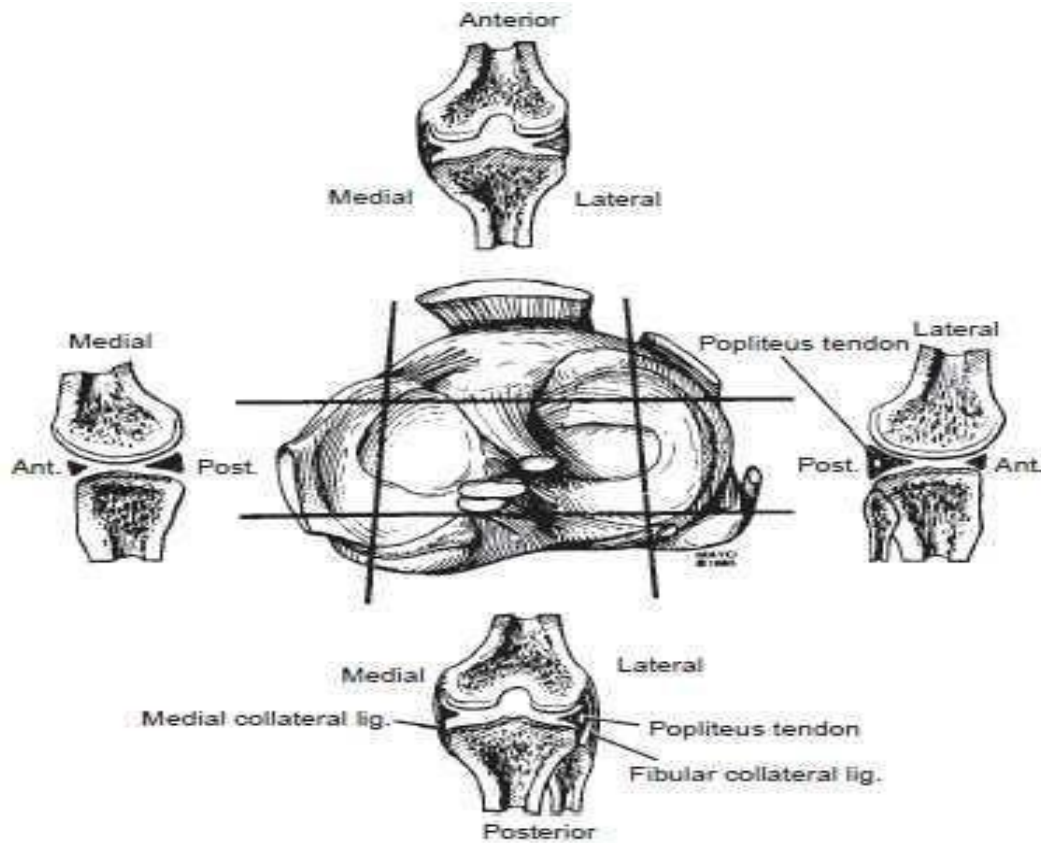
Fig 2 cross sectional anatomy of knee [42]

Fibrous capsule: It is attached superiorly to the femur about 1 cm above the articular margin with three special features. It is attached to the margins of thearticular surfaces except anteriorly, where it dips downwards. In the anterior part of the capsule there is a large opening through which the synovial membrane is continuous with the suprapatellar bursa.

This bursa extends superiorly three finger breadths above the patella between the femur and quadriceps. Posteriorly, the capsule communicates with another bursa under the medial head of gastrocnemius and often, through it, with the bursa of semimembranosus. Posterolaterally, another opening in the capsule permits the passage of the tendon of popliteus .The lateral expansions extend backwards on each side and downwards to the tibia forming medial and lateral patellar retinacula. On its deep surface, it is attached to periphery of each meniscus and connects it to adjacent margin of head of tibia; this connection is termed as coronary ligament(13).

Ligamentum patellae: It is strong, flat, ligamentous band, about 8 cm in length(13). It is the central portion of common tendon of the quadriceps femoris, which is continued from the patella to the tuberosity of the tibia. The ligamentumpatellae is related to the superficial and deep infrapatellar bursa and alsoto the infrapatellar pad of fat.

Extra capsular ligaments:

The oblique popliteal ligament: This is an expansion from the tendon of semimembranosus.It runs upwards and laterally blending with the posterior surface of the fibrous capsule. It gets attached to the intercondylar line and the lateral condyle of femur.

- The arcuate popliteal ligament: It has Y shaped fibers, the stem of which is attached to the head of fibula. The posterior limb arches medially over tendon of popliteus to be attached to theposterior border of intercondylar area of tibia. The anterior limb, which is sometimes absent, extendsto lateral epicondyle of femur where it is connected with lateral head of gastrocnemius. It is often termed short lateral ligament.

- The fibular collateral ligament: It is a strong, rounded cord, attached above, to the lateralepicondyle of the femur, immediately above the groove for the tendon of the popliteus and below, tothe head of the fibula, in front of the apex. The greater part of it is hidden by the tendon of bicepsfemoris, which embraces and is attached to the ligament. The ligament has no attachment to thelateral meniscus.

  Bursae around the Knee Joint: As many as thirteen bursae have been described around theknee joint- four anterior, four lateral and five medial [12]. These are as under;

Anterior

1. Subcutaneous prepatellar bursa

2. Subcutaneous infrapatellar bursa

3. Deep infrapatellar bursa

4. Suprapatellar bursa

Lateral

1) A bursa deep to the lateral head of gastronomies.

2) A bursa between the fibular collateral ligament and the biceps femoris.

3) A bursa between the fibular collateral ligament and the tendon of popliteus.

4) A bursa between the tendon of popliteus and the lateral condyle of tibia.

Medial

1. A bursa deep to the medial head of gastronomies

2. The anserine bursa is a complicated bursa which separates the tendons ofsartorius, gracilis and semitendinosus from one another, the tibia and from the tibialcollateral ligament.

3. A bursa deep to the tibial collateral ligament

4. A bursa deep to the semimembranosus.

5. Occasionally a bursa is present between the semimembranosus and the semitendinosus.

RELATIONS OF KNEE JOINT:

Anteriorly: Quadriceps femoris, patellar retinacula and supra patellar retinacula and suprapatellar bursa [12,13].

Posteriorly: Oblique popliteal ligament, popliteus, popliteal artery with vein posterior and tibial nerve posterior to both; lymph nodes; heads of gastrocnemius ,lower end of semimembranosus and semitendinosus[12,13].

Posteromedially: Sartorius and gracilistendons[12,13].

Posterolaterally: Biceps femoris with the common peroneal nerve on its medial side[12,13].

MOVEMENTS OF KNEE JOINT:

Flexion and extension are the principle movements at the knee. Some rotation is possible when the knee is flexed but is lost in extension. During the terminal stages of extension the large medial tibial condyle screws forwards onto the femoral condyle to lock the joint.

Conversely, the first stage of flexion is unlocking the joint, by internal rotation of the medial tibial condyle, an action performed by popliteus.

The principal muscles acting on the knee are,

Extension: Quadriceps femoris.

Flexion: Predominantly the hamstrings but also gracilis, gastrocnemius and sartorius.

Medial Rotation: Popliteus, semitendinosus and semimembranosus bring about

medial rotation of the flexed leg assisted by the sartorius and gracilis.

Lateral Rotation: Lateral rotation of the flexed leg is brought about by the biceps

femoris.

During the last 30 degrees of extension, medial rotation of the femur occurs so that the articular surfaces of femur and tibia are completely used up. This is called locking of the knee. Similarly during initial stages of flexion, lateral rotation takes place, which unlocks the knee joint. This is brought about by the action of popliteus. Locking of knee helps the knee to remain in the position of full extension without much muscular effort[13]

MRI ANATOMY AND APPEARNACE OF INJURED LIGAMENTS.

Routine MRI sequences for the evaluation of the knee vary among institutions and scanners. The knee should be imaged in all 3 planes—sagittal, coronal, and axial. At a minimum, scans should include sequences to define anatomy, edema, and cartilage.

Sequences for anatomic definition include spin-echo (SE) and fast spin- echo (FSE), proton-density (PD) sequences. Fluid-sensitive sequences, such as SE/FSE PD fat-suppressed or short tau inversion recovery (STIR), detect edema. Cartilage may be characterized by fat-suppressed FSE PD sequences; fat- suppressed, gradient-echo (GRE) sequences; or spoiled gradient, fat-suppressed sequences.

Coronal images with anatomy-defining and fluid-sensitive sequences optimally demonstrate the medial and lateral supporting structures. Additional useful information may be gleaned from sagittal and axial images of these structures.[53]

i) THE CRUCIATE LIGAMENTS[34,46,47].

Anterior Cruciate Ligament is a attached to posteromedial aspect of lateral femoral condyle, it extend inferiorly and medially to anterior tibial intercondylar region it inserts between anterior attachments of menisci.its function is prevent anterior displacement of tibia and posterior displacement of femur. The ACL is 11-12 mm thick and appears straight and taut without angulation.On MRI appears intermediate to hypointense.ACL best seen on saggital images.

Most common mechanism of injury to anterior cruciate ligament is external rotation of femur on a fixed tibia with a valgus force. Other less common mechanisms include hyperextension, internal rotation with maximal extension or anterior translation of tibia produced by a direct force against the back of calf. Clinically the patients present with hemarthrosis and an audible pop at the time of injury. The anterior cruciate ligament has limited healing capacity possibly related to heterogeneity of collagen fibers or fibroblast function within a synovial environment. Acute rupture of the ACL ranges from low grade, partial thickness to full thickness and are located most commonly in the mid- to proximal aspect of the ligament. ACL tears occur up to eight times more commonly in females than in males Indertalwaret al., 1998. A torn ACL fiber has increased T2-weighted signal and an abnormal contour. In some full-thickness tears, an amorphous mass replaces the discrete ACL fibers. Fluid can fill the gap between the fibers of a full-thickness tear. The location of

the tear can be described as proximal, midsubstance, distal, or involving the femoral or tibial attachment.

On MR imaging there are both direct and indirect signs of anterior cruciate ligament injury. The direct signs include **Inder talwar et al.,[71]**

i. Discontinuity of the fibers of anterior cruciate ligament

ii. An abnormal contour of anterior cruciate ligament.

The indirect signs include **Inder talwar et al.,[71]**

The knee John Haaga 5th edition 2009 [75]

Angulation of the posterior cruciate ligament of less than 105 degree,

i. Anterior tibial translation exceeding 6mm

ii. Overhanging posterior horn of the lateral meniscus by 2.5mm

iii. Deep lateral femoral notch exceeding 2 mm in depth

iv. Segond fracture of the lateral tibia involving the middle portion of the lateral fibrous capsule at the meniscofemoral attachment

v. Chip fracture of the posterior tibia

vi. Rotary bone contusion pattern.

vii. Irregularity of the free concave edge of Hoffa's fat pad suggestive of synovitis.

Jamal Yaqoob *et al,,* 2015 [48]

The arthroscopic characterization of partial tear is variable and ranges from the presence of some interrupted fibers to a sub totally ruptured ACL. In this study they adopted the approach used by Rubin et al.,.that is to distinguish complete ACL tear from the rest. Therefore a complete ACL tear on MRI was seen in 11 patients (20%) Discontinuity and non-visualization of ACL fibres were considered predictors of a complete ACL tear. Only 5% of ACL tears were identified in isolation, while15%

were associated with meniscal tears. ACL tear with midsubstance hyperintense signal was seen in 5 patients (9.2%) while non-visualization of the ACL was identified in 6 patients (11%). They found sagittal T2- weighted images evaluating ACL abnormality with great degree of accuracy, while coronal T2-weighted and PD sequences were helpful in the evaluation of the proximal and distal ACL

attachment sites.

In patients with ACL tear subtle peripheral tears may be present in both lateral and medial menisci which should be carefully looked for on imaging, especially posterior horn of medial meniscus. The specificity decreases if a tear is diagnosed when there are only equivocal or probable findings on MRI because these findings usually do not represent a tear at arthroscopic examination.

Amreenbariet al.,2014 Dec [49] Out of total 230 patients, ACL tear was most common finding affecting 172 patients (74.8%). According to them diagnosis ofpartial tears of ACL may not be accurate due tooverlying synovial reaction.Anterior tibial subluxation was found in 82 patients, with 34 patients categorized under grade 1and 48 patients showed a subluxation of grade 2 or more.

Patients with complete ACL tear showed grade 2 or higher ATS, thus suggesting that significant ATS is existent with complete ACL tears. In a study done by Chan et al.,., [16], the presence of torn ACL was established on the basis of measurements of the position of the lateral tibial plateau relative to the lateral femoral condyle on a saggital image. Proper use of this sign requires little experience yet it provides sensitivity for identifying complete ACL tear.

F. Rayan *et al,,* 2007 [72]

The objective was to compare and correlate clinical, MRI, and arthroscopic

findings in the diagnosis of anterior cruciate ligament (ACL) injuries.Out of 26 cases where ACL was found damaged on MRI scan, 22 cases had arthroscopic evidence of ACL injury (84.6%)MRI scan has much better negative predictive value than positive predictive value in anterior cruciate ligament injury diagnosis. When clinical signs and symptoms are inconclusive, performing an MRI scan is likely to be more beneficial in avoiding unnecessary arthroscopic surgery.

Ketan Gupta *et al,,* **2013**[(50)]

Case of ACL study shows MRI has very good sensitivity (100%) which may be due to fact that ACL is relatively easy structure to see on MRI and because of ACL injuries are most common injuries in internal derangement of knee , radiologists are very keen to see whether ACL is injured or not. So there are less chances of interobserver errors in case of ACL injuries.

There was not a single false negative case of ACL in this study.

This study found that the accuracy of the MRI scan in diagnosing internal derangement of knee in decreasing order of ACL, PCL, MM and LM. The routine use of MRI scan to confirm diagnosis is not indicated, as the positive predictive value of the scan is low for all lesions. In the presence of positive clinical signs, proceeding to arthroscopy is recommended. The negative predictive value of a scan was found to be high for all structures of the knee joint and hence a 'normal' scan can be used to exclude pathology, thus sparing patients from expensive and unnecessary surgery and also freeing up valuable theatre time. In this scenario the accurate and careful clinical examination remains the primary necessity in diagnosing internal derangement of knee. From this study, we believe that routine interaction of arthroscopist and radiologist with retrograde introspection about the diagnosis should be encouraged, Inthe everyday practice, based on clinical examination that comes first, surgeons decide whether he

must proceed to further laboratory tests, MRI, conservative or surgical treatment. In India routine use of MRI for diagnosing every knee injury is not acceptable considering the cost effectiveness of treatment. So in patients with obviousclinical diagnosis by experienced orthopaedic surgeon and role of MRI is debatable. **Dr D S SHETTY *et al,,* [83]** The main indication of MRI is in assessment ligament injuries. However it is useful in demonstrating other knee joint abnormalities involving articular cartilage, bone marrow, synovium, patellofemoral joint and adjacent soft tissue.ACL tear accounted for the major number of cases (36.5%)Hyperintensity in the ligament was noted in 28 cases, discontinuity in 10 cases and nonvisualization of ACL was seen in six cases.In this study ACL tear was the commonest condition accounting for 42 patients (36.5%). Mid substance tear in the form of hyperintensity was noted in 30 patients (71.4%). Hyperintensity in the ligament was seen in 28 patients (61.9%) and discontinuity in 10 patients (23.8%). Sixpatients (14.3%) with ACL tear showed non-visualisation of ACL. Secondary signs such as PCL buckling, anterior tibial displacement, uncovered meniscus sign and bone contusions assisted in diagnosis in indeterminate case. Associated meniscal tear was seen in 32 patients (76.2) and PD and T2WI revealed abnormality with great degree of accuracy.

John Haaga. *et al,,* [75]

Posterior cruciate ligament is intracapsular and extrasynovial. Posterior cruciate ligament originates at lateral aspect of medial femoral condyle, crosses the anterior cruciate ligament and attaches to posterior intercondylar portion of tibia.posterior cruciate ligament is central stabilizer of knee, resisting posterior displacement of tibia when knee is flexed. The PCL is generally 15-20 mm thick, uniformly hypo intense (black), more curved than the ACL and is in shape of hockey stick appearance when knee is extended on saggital images[47.]

The PCL is injured by three mechanisms.[36]

1. Knee hyperextension

2. Kneehyperflexion.

3. Posterior displacement of tibia with knee flexed.

The PCL most commonly tears at the mid portion of the ligament. PCL injuries have a high association with other injuries. Trabecular microfractures, or bone bruises are seen associated commonly. PCL tears are also associated with posterolateral corner injuries **Sonin *et al,,* 1995 [32]**

Posterior cruciate ligament; normal and abnormal injury pattern.Acute tear of PCL are usually manifested by thickening of middle portion of ligament with increased signal intensity on both T1WI and T2WI. The mass like quality that an acutely torn ACL exhibits is not seen in acute PCL tear.Also, unlike acute ACL tears, continuity of ligament is maintained in PCL with acute trauma.

Chronic tears of the PCL are difficult to diagnose and image. Because most PCL injuries heal without surgery, the ligament will form fibrous scar in the place of normal ligament. This scar generally has the same signal intensity of native tissue. Secondary signs such as a lax ligament or persistent increased signal may helpdiagnose chronic PCL tears

JP Singh *et al,,* 2004[6] in there study 10 patients of PCL tears were detected accurately both by MRI and Arthroscopy. The use of MRI to identify PCL tears has proven to be extremely accurate. This might be expected in light of the fact that the PCL is usually very easily visualized as a homogenous, continuous low-signal structure. Several studies have reported sensitivity, specificity, accuracy, positive predictive value and negative predictive value to be 99-100%. In this study too the sensitivity, specificity, accuracy, positive predictive value and negative predictive value was 100%.

Gupta MK *et al,,*jan 2014 [51]

MRI showed tears of PCL in 14 cases, out of which only 13 cases showed tears during arthroscopy. MRI showed no tears of PCL in rest 26 cases, out of which tears was found in one during arthroscopy.

These tears were within the vascularized red zone of the meniscus. It ispossible that these MRI findings that had the appearance of a tear were healed tears. This area can also be difficult to visualize at arthroscopy, so it is also possible that meniscal tears were present in these areas but were not seen during arthroscopy. Timing of MRI may also be an issue. A substantial delay between injury and MRI may allow the meniscus to heal, but intrameniscal signal may persist, leading to false positive MRI reading. Similarly a delay between MRI and arthroscopic evaluation could allow healing and a false positive result- 17, In the present study, all subjects were symptomatic and MRI was done on average of 10 days before arthroscopic procedure.

Manoj MK *et al,,*January 2014[46]

PCL is usually very easily visualised as a homogenous, continuous low signal structure in MRI all PCL tears were accurately detected and the same confirmed in arthroscopy.

Posterior Cruciate Ligament No of tears identified by Arthroscopy : 4 No of tears identified by MRI : 4 Accuracy of MRI in diagnosing PCL injuries : 100%

MRI should be done in all patients suspected of ligamentous injury, thus preventing unwanted arthroscopies. The orthopedic surgeon must be able to associate thefindings on MRI in the decision making before and during arthroscopy. When onemenisci or ligament is injured, always look diligently for other derangements. whichis producing definite mechanical symptoms will need arthroscopic surgery whateveris shown on MRI.

Jamal Yaqoob *et al,,*2015 [48]

PCL tear was identified in only 2 patients (3.7%) appearing as hyperintense signal in one patient and ligament discontinuity in the other patient. PCL is difficult to visualize during arthroscopy with intact ACL, and in such cases physical examination is often performed under cover of anesthesia to determine rupture of PCL. MRI findings preceding arthroscopic evaluation are often helpful in PCL evaluation.22 In our study PCL rupture was identified in both patients by arthroscopy.

THE COLLATERAL LIGAMENTS

MEDIAL COLLATERAL LIGAMENTS [52,53, 75]

The anterior vertical component and the posterior oblique component of the MCL are depicted consistently on coronal T1-weighted or SE/FSE T2-weighted sequences. As seen on the image below, the MCL is seen as a thin, taut, well-defined, low T1/T2-signal structure extending from the medial femoral epicondyle to themedial tibialmetaphysis.Surrounded by high T1-weighted signal – fibrofatty tissue throughout its full extent, the MCL is parallel to and closely applied to the medial femoral epicondyle and medial tibial metaphysis. The anterior vertical or superficial component is best visualized at the level of the intercondylar notch in the vicinity of the distal insertion of the ACL.
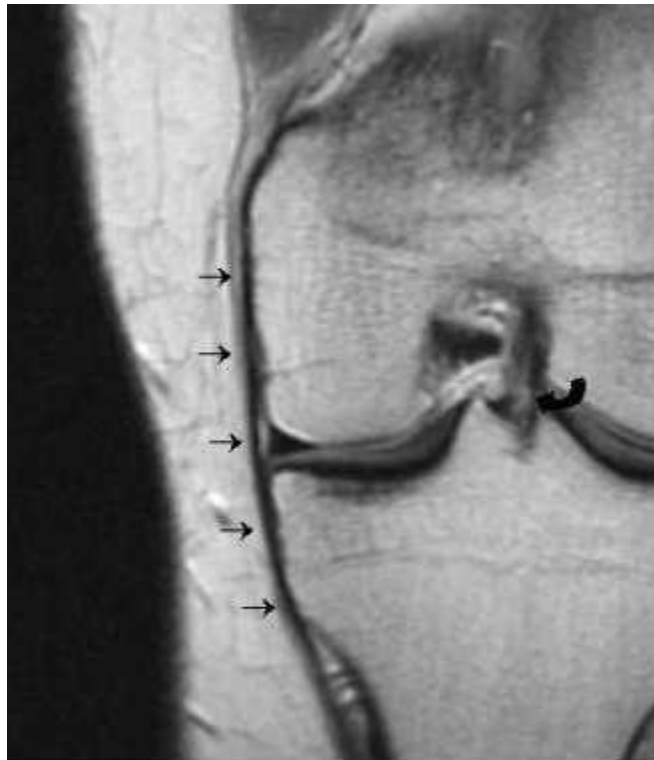
Fig 3 Proton density coronal image shows the anterior vertical portion of the medial collateral ligament as a thin, taut, well-defined, low-signal structure extending from the medial femoral epicondyle to the medial tibial metaphysis (straight arrows). Distal insertion of the anterior cruciate ligament is visualized (curved arrow)[53.]

Medial collateral ligament are usually caused by valgus stress and are often associated with other derangements. The combination of ACL tear, MCL tear and medial meniscus tear occurs with valgus stress to knee while foot is fixed on ground and is also known as "unhappy triad" or O donoghue's triad.

The traditional classification of MCL tear is to grade the damage as first through third degree sprain/ tear injuries.

Grade I Lesions are defined as signal intensity superficial to MCL representingedema, withintact MCL fibres.

Grade II lesions in which fluid signal extend partially through MCL, although some fibres remain intact.

Grade III lesions with complete discontinuity of MCL fibres seen along with surrounding edema consistent with a complete rupture[54.]

A chronic MCL tear is seen as an ill-defined, thickened ligament with low T1-weighted and T2-weighted signals.

Lateral collateral ligament (LCL)

The lateral supporting structures are seen on posterior coronal and far lateral sagittal T1-weighted or SE/FSE T2-weighted sequences. The arcuatepopliteofibular and fabello-fibular ligaments are visualized. Because of its posterior course, the entire LCL rarely is visualized on a single coronal image. Specialized coronal oblique (parallel to typical course of normal LCL) and sagittal, 1-mm, 3-dimensional, volume-rendered sequences depict the LCL and posterior lateral corner (PLC) structures particularly well. The LCL is seen as a thin, taut, well-defined, low – T1/T2-signal structure extending laterally and posteriorly from the lateral femoral epicondyle to the fibular head.

An acute LCL tear is seen as a serpiginous or lax ligament with discontinuous fibers (or avulsed fibular head), often without significant thickening of the ligament. As previously discussed, LCL tears rarely are isolated, and an LCL tear becomes more likely as associated PCL and cruciate ligament injuries increase in severity.

Fig 4 The lateral collateral ligament is lax and its fibers are interrupted at its origin (white arrow) on this coronal fast spin-echo T2-weighted image. Note theassociated anterior cruciate tear (black arrow)[53].

A chronic LCL tear (seen below) appears as a thickened, low – T1/T2- weighted signal ligament.

Almost all tears of LCL are associated postero-lateral corners of knee. The injuries include damage to structures within the region of LCL, such as capsule, the biceps femoris and the popliteus, as well as to structures else where in the knee, such as cruciate ligaments or lateral tibial rim (segond fractures) [47, 53]

The Menisci: The sagittal plane is most important plane in assessing the menisci, with coronal plane providing supportive rather than new information and the axial plane increasing the accuracyof the sagittal and coronal planes when combined. In general, sagittal images optimally show anterior and posterior horns of the medial and the lateral menisci, coronal images help in evaluating the Meniscal bodies and thin axial sections provide an additional view of menisci and their free edges[25,30].

Sagittal image: The anterior and the posterior horns of menisci appear as isosceles triangles.

The posterior horn of medial meniscus is twice the size of anterior horn. The

anterior and posterior horns of lateral meniscus are of same size. The posterior horn of either menisci should never appear smaller than the anterior horn. On both sides, the menisci appear as flat bands. On lateral side, the more central the slices take on bowtie configuration because of smaller radius of curvature.

Coronal images: Mid portion of the knee produce best images of bodies of both menisci.

They appear triangular and slightly larger laterally than medially. The capsular attachment on the medial side is incorporated in the tibial and medial 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 horns appear as flat bands. On lateral cross sections, the popliteal tendon courses upward and laterally at 45 degrees. More anteriorly, the anterior horn of lateral meniscus appears as a band like structure. The anterior horn of medial meniscus extends more anteriorly than lateral meniscus [25,30.]

The medial and lateral menisci, the transverse ligament, and the meniscofemoral ligament appear homogenously dark on all pulse sequences. The vascular and avascular zones cannot be distinguished on MRI. The vascularized zone does not demonstrate enhancement withintravenous gadolinium.

TR Madhusudhanet *et al,,2008* [57]

Data from 565 knee arthroscopies performed between 2002 and 2005. Patients were categorised into three groups on objective clinical assessment:

Those who were positive for either meniscal or cruciate ligament injury [group 1]Both meniscal and cruciate ligament injury [group 2] Those with highly suggestive symptoms and with negative clinical signs [group 3].

MRI was requested for confirmation of diagnosis and for additional

information in all thesepatients. Two experienced radiologists reported MRI films. Clinical and MRI findings were compared with Arthroscopy as the gold standard.A thorough clinical examination performed by a skilled examiner more accurately correlated at Arthroscopy. MRI added no information in Group 1 patients, valuable information in Group 2 and equivocal in group 3 patients. A negative MRI did not prevent an arthroscopy. In this study, specificity positive and negative predictive values were more favourable for clinical examination though MRI was more sensitive for meniscal injuries.

De smet and mukherjee *et al,,* 2008 Clinical, MRI and arthroscopic findings with associated with failure to diagnose a lateral meniscus tear on knee MRI performed the study to determine why lateral meniscus tears are missed on MRI.36 of189 lateral meniscus tears found at arthroscopy were not diagnosed on original MR interpretation, In recent study sensitivity of 79% for lateral meniscus tear.Because failing to diagnose a lateral meniscal tear did not correlate with failure to diagnose amedical meniscal tear, poor quality MR examination due to patient size or motionare not likely to account for some of missed tears.

Lateral meniscal tear are more likely to be missed if tear involves only one third of meniscus or posterior horn.Longitudinal peripheral tear of posterior horn weremost commanly missed tears that could be seen in retrospect

Amreen abdul bari *et al,,*[49].

MRI of 230 patients with 71 arthroscopic co-relation.Sensitivity, specificity, PPV and NPV was calculated for ACL it was 87.87, PCL 81.57.MM 93.54, 87.50, LM 77.77, 81.81. MRI is helpful in diagnosing meniscal and cruciate ligament injuries, arthroscopy still remains gold standard for definitive diagnosis.

Ketan Gupta *et al,,*[50]

Positive predictive value and negative predictive value of ACL was 60% and 100%, Of PCLwas 30% and 82%, Of MM was 38% and 100% and of LM is 28% and77% respectively. Routine use of MRI scan to confirm diagnosis is not indicated, as the positive predictive value of the scan is low for all lesions. In the presence of positive clinical signs, proceeding to arthroscopy is recommended. The negative predictive value of a scan was found to be high for all structures of the knee joint and hence a 'normal'scan can be used to exclude pathology. Reporting of MRI is dependent on the technician and the Radiologist. It has a long learning curve

Ruth Crawford *et al,,* [78]

MRI is highly accurate in diagnosing meniscal and ACL tears. It is the most appropriate screening tool for therapeutic arthroscopy. It is preferable to diagnostic arthroscopy in most patients because it is faster. From the review, it is clear that the diagnostic performance results of MRI differ for the medial and lateral meniscus and the ACL, although all were above 85% accuracy. The diagnosis of meniscal tears was more difficult due to small peripheral tears. The improved results in the diagnosis of ACL tears in response to 30° flexion and in particular in response to 55° flexion were based on the fact that the anterior cruciate ligament moved further away from the intercondylar roof with increased knee flexion.MR Imaging of the knee at 55° of flexion and less at 30° of flexion allow an improved diagnosis of injuries to the anterior cruciate ligament as compared to MRI examinations at extension. The diagnosis of meniscal injuries, however, was not superior at either flexion positions compared to commonly performed examinations at knee extension.

Manoj MK *et al,,* [46]

This was a prospective study of 80 patients to compare and correlate the MRI appearances of meniscal and ligamentous injuries and its various types with arthroscopy. Out of the 80 patients 35(43.75%) showed ACL injury, 23(28.75%)

showed medial meniscus tear, 11(13.75%) showed lateral meniscus tear, 4 (5%) showed PCL injury, 4(5%) showed MCL injury and 3(3.75%) showed LCL tear. MRI is a very useful non-invasive modality having high sensitivity and specificity in detecting IDK. MRI can be considered at par with arthroscopy in the diagnosis of meniscaland cruciateligament tears. Is MRI Essential Prior to Arthroscopic Management of Internal Derangement of the Knee?

Khan R.A *et al,,* 2010 [34]

This study was designed to compare the accuracy of clinical examination and MRI by arthroscopic examination in patients with knee meniscal and ACL injuries.If clinical diagnosis could be as accurate as MRI, the need for this expensive and time consuming investigation could be avoided.

In case of meniscal injuries, clinical examination had sensitivity of 91%, specificity of 22%,positive predictive value of 73%, negative predictive value of 50% and accuracy of 70% and MRI had sensitivity of 94%, specificity of 9%, positive predictive value of 64%, negative predictive value of 50% and accuracy of 63%.

The accuracy of diagnosis of meniscal and ACL injuries by clinical examination and MRI were arthroscopically compared and found to be fairly matched .It is suggested that routine use of MRI just to confirm the clinical diagnosis of these injuries should be reconsidered.

D. J. DANDY *et al,,*[11] The accuracy of the clinical diagnosis of meniscal tears is about 75% to 80%, compared with 88% to 90% for MRI. For lesions of articular cartilage, both the sensitivity and accuracy of MRI are low.MRI is a considerable advance and may well preserve patients from unnecessary operations. A knee whichis producing definite mechanical symptoms will need arthroscopic surgery whatever is shown on MRI.If there are no mechanical symptoms MRI may be indicated to exclude any treatable pathology.

Surgeons who are less expert in this specialist field are well advised to request MRI in preference to arthroscopy for a doubtful case, but those who are confident about their management of knee disorders may need neither. MRI is very useful but,as was once said of arthroscopy, it is no substitute for clinical acumen.

THE MENISCI

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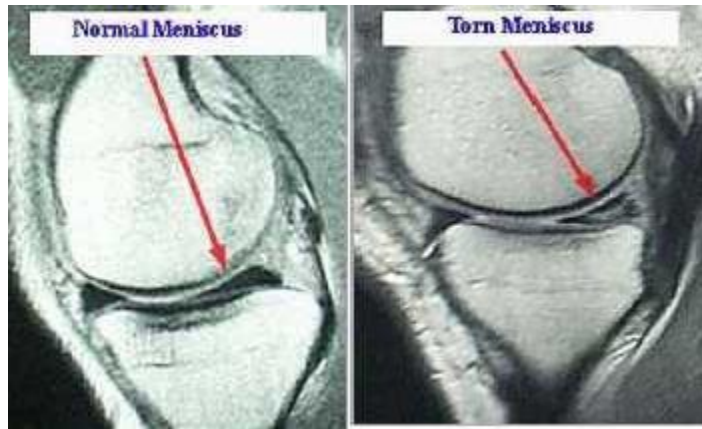
FIG 5 Magnetic resonance imaging scan showing a normal meniscus & torn meniscus.

Abnormal shearing forces may be generated during compression and rotation of knee resulting in meniscal damage. The rotation of femur on a fixed tibia during flexion and extension places the menisci at risk for injury. Clinical signs of meniscal injury include joint pain along the joint line, giving way, clicking, locking of knee in fixed flexion and effusions.

Before embarking upon the pathological states, it is worthwhile considering normal anatomic variants which should not be mistaken for pathological conditions[42].

NORMAL MENISCAL VARIANTS:

The Discoid Meniscus: It is a congenital anomaly found usually in lateral meniscus. It has a reported incidence of 0.4 to 16.6%[43] . A meniscus is said to be discoid if there is continuity between anterior and posterior side [bow tie appearance] on five or more contiguous 3mm sagittal MRI section. It presents with symptoms of

joint line tenderness, ''snapping'', and locking of the knee. The three types of discoid lateral meniscus are complete, incomplete, and the Wrisberg variant. Someinvestigators include a ring-shaped meniscus's a fourth type. The complete and incomplete types have a firm, normal posterior tibial attachment and are stable.

Symptomatic patients who have these types of discoid menisci usually are treated with a partial meniscectomy. In contrast, the Wrisberg variant has no posterior coronary or capsular attachments and increased T2signal is present between the meniscus and the capsule, simulating a peripheral tear or a fascicular injury. The Wrisberg variant has the most notable symptoms, with a ''snapping' sensation occurring when the posterior horn moves across the femoral condyle during flexion and extension.

A discoid medial meniscus is much less common, with the incidence reported to be 0.12% to0.6%.On MR, the diagnosis of a discoid meniscus is suggested by identifying either meniscal tissue on three continuous sagittal 5-mm-thick slices, or a meniscal body on coronal images greater than 15 mm wide or extending into the intercondylar notch The discoid meniscus has an increased incidence of tears and degeneration, likely caused by its abnormal shape, resulting in increased stress on the meniscus. Intrasubstance ''grade 2'' signal, or abnormal signal not extending to an articular surface, is noted in 24%of discoid menisci and is more common in complete discoid `menisci. Typically, this abnormal signal is not considered clinically significant. However, in thepopulation with discoid menisci, some investigators report that this Intrasubstance signal may be significant clinically[25,44].

Meniscal Ossicles: They are reported in 0.15% of patients and are thought to be eitherdevelopmental or posttraumatic. These small, ossific foci are found typically in the posterior horn of the medial meniscus and are associated with meniscal tears. They can be symptomatic, or associated with pain and a sensation of locking, clinically simulating a torn meniscus with a flap component. The ossicle follows the signal of bone marrow on MRI[25,44].

Meniscal flounce: It is a wavy appearance along the free edge of the meniscus. Previously, meniscal flounce was thought to be identified only at arthroscopy, in the presence of joint fluid in the setting of an ACL or medial collateral ligament (MCL) tear. However, a flounce can be seen without a ligament injury. Recently, the Meniscal flounce has been identified with MR imaging when the knee is in 10 degreesof flexion.. The flounce can appear truncated on coronal images and can simulate a tear or degeneration. The incidence at MR is reported to be from 0.2% to 6%. A flounce-like appearance can be seen with meniscal Tears[25,44].

Meniscal Extrusion: It is measured from the outer meniscal edge to the proximal tibial margin. Extrusion of the medial meniscus more than 3 mm is considered abnormal. This degree of extrusion can be seen in patients who have advanced Meniscal degeneration, and various types of meniscal tears. Although extrusion of the anterior horn or body of the lateral meniscus sometimes is considered a normal variant, others consider extrusion of the lateral meniscus more than 1 mm to be abnormal[45].

MENISCAL TEARS

The cause of meniscal tears can be divided into two categories.

    a. Increased force on a normal meniscus, usually resulting in longitudinal or radial tears, and

b. Normal forces on a degenerative meniscus, usually producing horizontal tears in the posterior half of the meniscus.

Tears are more common in the medial meniscus, possibly because the medial meniscus is less mobile, and it bears more force during weight bearing than the lateral meniscus, with 56% of tears involving the posterior horn of the medial meniscus. Tears isolated to the anterior two thirds of the meniscus are uncommon, representing only 2% of medial and 16% of lateral meniscal tears[42.]

Lateral meniscal tears are more common in younger patients (under 30 years old), who have a higher incidence of tears related to sporting events than do older patients. It is likely that this is related to the higher incidence of concomitant ACL tears in this population.

Diagnostic Criteria:

Two criteria for diagnosing a meniscal tear are commonly used[4]

i. An intrasubstance area of intermediate or high signal intensity that unequivocally extendsto the articular surface,

ii. Abnormal meniscal morphology

Intrasubstance signal: It is graded as follows:

Grade 1: Intrameniscal high signal intensity of irregular or globular appearance that is confined within the meniscus and does not extend to the articular surface.

Grade 2: The signal is linear and does not intersect the inferior or superior articular surface. It may, however, contact the capsular margin at the posterior aspect of the meniscus.

Grade 3: Tears characterized by linear high or intermediate signal intensity that extends to the superior and/or inferior articular surface.

Grade 4: It is sometimes added to indicate a complex tear with multiple components or fragmentation.

Both grade 1 and grade 2 lesions do not represent a tear, but indicate mucinous and mucoidintrasubstance degenerative change and are usually encountered after the third or fourth decade. In children and adolescents, prominent vasularity may resemble grade 1 or grade 2 lesions.

Abnormal Meniscal morphology:

Morphologic changes of the meniscus associated with meniscal tears include blunting of tip of the inner free meniscal edges of the meniscus, displacement of a portion of the meniscus, interrupted appearance of the meniscus and abnormal size of a segment of the meniscus is detached (a bucket handle tear), the remaining peripheral portion appears small and often truncated. The displaced portion usually lies within the intercondylar notch beneath the PCL.

Coronal views are helpful in further identifying such displaced fragments. An abrupt change in contour of the meniscus,known as the 'notch' sign, is an important indicator of a meniscal tear. Although the normalmeniscal flounce can simulate it, the presence of abnormal intrameniscal signal makes the notchsign a more definite indicator of a meniscal tear[46].

Classification of tears:

1. Horizontal tears

2. Vertical tears

3. Complex tears

1.Horizontal Tears: Horizontal tears are parallel to the tibial plateau and divide the meniscus into upper and lower segments. The Cleavage type extends to the apex and divides the menisci into upper and lower halves. They are referred to as 'fish mouth'

tears. In the Non cleavage type, tear extends to the superior and inferior articular surface of the meniscus.

Horizontal tears are most common within the posterior horn of the medial meniscus. Linear horizontally oriented grade II signal intensity is sometimes mistaken for complete horizontal tears[44.]

2. Vertical Tears:

They are perpendicular to the tibial plateau, A vertical longitudinal tear occurs between the circumferential collagen fibers parallel to the long axis of the meniscus. Longitudinal tears can be obliquely oriented, but are not parallel to the tibial plateau. Vertical grade III signal intensity located within the peripheral third of the meniscus is considered a peripheral longitudinal tear A vertical radial tear occurs perpendicular to the circumferential collagen fibers and long axis of the meniscus. Radial tears are also known as free edge tears because they involve inner edge of the meniscus. MR images obtained perpendicular to the orientation of radial tear easily demonstrates tearas a small gap or cleft in the meniscus (Cleft sign), which sometimes can be observed to move across the meniscus on successive images (Margin Cleft sign). If the orientation of the imaging plane is in the same direction as a full thickness radial tear, a section through the same plane of the tear will demonstrate the absent meniscus or high signal intensity not representative of meniscus because of volume averaging, which results in the so called Ghost sign. A partial thickness radial tear will demonstrate blunting or abrupt truncation of the apex of the meniscus (truncated triangle sign). The term parrot beak tear has been frequently used to describe a vertical radial tear at the inner edge of the meniscus that curves obliquely across the circumferential collagen fibers[44.]

Root tears: They are full thickness radial tears at the central tibial attachment sites of the menisci &are called the root ligaments. .A root tear is reportedly difficult tear to

diagnose because meniscaltissue is noted only on one side of the tear. The diagnosis is easier to make medially because of theclose anatomic relationship between posterior horn of the meniscus and the tibial attachment of the PCL. Normally, on 3-mm sagittal images, the meniscus should be seen on the image medial to thePCL attachment; otherwise, a root tear is suspected and the coronal images can confirm. Lateralmeniscal root tears are diagnosed when posterior horn of the lateral meniscus does not cover the most medial aspect of posterior lateral tibial plateau on at least one coronal image[44].
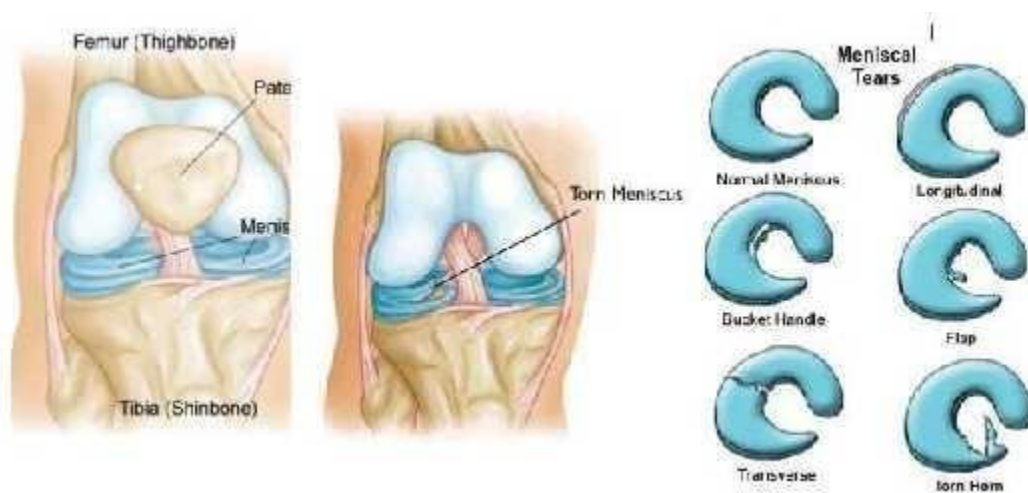
Fig 6 shows normal meniscus in coronal anterior and posterior & meniscalinjuries.

Bucket-handle tears: These are displaced longitudinal tears. The displaced in a fragment often has the appearance of a handle, and the remaining peripheral segment attached to the tibial resembles a bucket – hence the name. Confirmation of this tear is mandatory and can be made by identification of displaced fragment. The most reliable sign is the finding of a displaced fragment of meniscus in the intercondylar notch, which can be better seen on coronal images. 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. These tears may also result in the flipped meniscus sign, double delta sign, or double anterior horn sign, in which the displaced meniscal segment of the posterior horn is

located anterior to, on top of posterior to the anterior horn. Helpful clues in these cases include non visualization of the posterior horn of the meniscus, the

appearance of a larger anterior horn than posterior horn, or an anteriorhorn taller than

6mm[4,44].

Flap Tears: A flap tear or a displaced flap tear is a term that is used often to describe a shortsegment, horizontal meniscal tear with fragments either displaced into the notch or into the superioror inferior gutters. Flap tears are the most common type of meniscal tears and may developfollowing only minimal meniscal trauma of the degenerative meniscus from chronic shear stress. They involve the inner one third to

one half of the meniscus with a superior or inferior leaf extensionthat creates the flap[(46)].

3. **Complex tears:** They either have two or more tear configurations or are not

categorized easilyinto a certain type of tear[46].

MRI grading of meniscal tears and degenerations:

A grading system based on the signal abnormality correlated with histopathological abnormalities has been developed to understand the significance of increased signal intensity patterns in meniscal abnormalities[4,44].

Grade I: Non-articular focal or globular intrasubstance increased signal intensity in the nonarticular portion of the meniscus.

Grade II: Horizontal linear intrasubstance increased signal intensity usually extends from the capsular periphery but does not involve an articular surface.

Grade III: Region of abnormal signal intensity extends or communicates to at least one of the articular surfaces.

MENISCAL CYST

A meniscal cyst is a fluid-filled structure adjacent to a meniscus, which appears as intermediate signal intensity mass on T1-weighted images and hyperintense on T2-

weighted images, sometimes lobulated or septated. Meniscal cysts are strongly associated with a horizontal cleavage tear of the meniscus and often a connecting neck between the tear and the cyst can be visualized. The cysts may become fairly large, which is thought to be caused by a ball valve mechanism. They can become symptomatic usually on the medial side, since they may impress on the medial collateral[4,44].
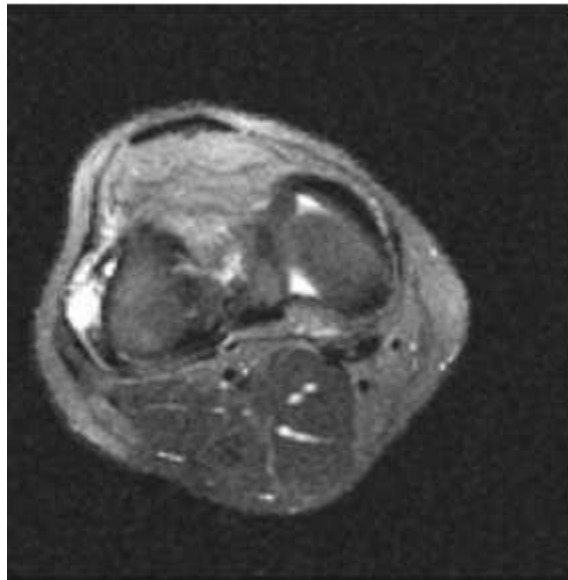
FIG 7 Hyperintense cystic lesion in medial meniscus.

MENISOCAPSULAR SEPERATION

Meniscocapsular separation occurs when the meniscus detaches from the capsular attachments,which is more common medially and usually is associated with other injuries.

Meniscocapsular separation is evaluated best on coronal and sagittal T1- or proton density– weighted sequences for anatomy, and fat-saturated T2-weighted or STIR sequences for pathology. Signs that have been described in meniscocapsular separation include displacement of the meniscus relative to the tibial margin, extension of the tear into the superior or inferior corner of the peripheral meniscus, and an

irregular outer margin of the meniscus body on coronal images. Additional signs include increased distance between the meniscus and the MCL, or fluid betweenthe meniscus and the MCL. Overall, the presence of perimeniscal fluid and an irregular meniscal outline are the best predictors of meniscocapsularseparation[4,44].

IV) EXTENSOR MECHANISM AND PATELLAR TENDON

The extensor mechanism of the knee consists of the quadriceps muscle group, quadriceps tendon,patella, patellar retinaculum, patellar ligament, and adjacent soft tissues. Injuries to the extensor mechanism are common and consist of chronic degenerative injuries, overuse injuries, and acute trauma. Overuse injuries typically are seen in high performance athletes, most commonly in sports requiring long distance running or jumping. Cumulative micro trauma produced by repetitive kneeflexion and extension results in focal inflammation[47].

Acute traumatic injuries occur secondary to direct blunt trauma or excessive tension applied to the extensor mechanism through quadriceps contraction. Patellar fractures are the most common traumatic injury of the knee extensor mechanism[47] Patellar tendinopathy Patellar injuries can result from chronic overuse injuries or as a result of acute trauma. Patellar tendonosis, or 'jumper's knee' results from chronic overload on the patellar tendon because of strain from the quadriceps muscle group. Chronic overload results in microtears and focal degeneration,which is characterized histologically by pseudocyst formation, increased fibrocartilage, and myxomatous and hyaline metaplasia. Patellar tendonosis frequently is seen in participants in sports associated with jumping and is associated with mal-alignment[48,49].

MRI findings consist of focal thickening of the proximal patellar tendon, with increased signal on T1-weighted and T2-weighted images. Edema in the paratenon, infrapatellar fat pad, and subcutaneous adipose tissue is associated with acute patellar

tendonitis, which is defined as symptoms of less than 2-week duration and patellar tendon tears. Acute patellar tendonitis is associated with increased intrasubstance signal on T1-weighted and T2-weighted images without tendon thickening[49].

Patellar tendon tears

They may be partial or complete, and most frequently occur in the proximal inferior patellar tendon.A patellar sleeve fracture represents a cartilaginous avulsion from the lower pole of the patella and isoften associated with patellar tendon tears. With complete inferior patellar tendon tears, the patellaretracts proximally as a result of the pull of the superior patellar tendon[5,49].

MRI shows discontinuity of the tendon, demonstrated on fluid-sensitive sagittal T2-weighted andSTIR images. MRI findings in partial patellar tendon tears can resemble acute patellar tendonitis.Correlation with a history of acute trauma is useful for specific diagnosis[5,49].

Quadriceps tendon tear

A tear of the quadriceps tendon is the second most common acute injury to the extensor mechanism. Injury to the quadriceps mechanism (rectus femoris, vastus medialis, vastus intermedius, vastus lateralis, and quadriceps tendon) may be the result of acute trauma caused by rapid deceleration ,such as running when the foot is planted, or it may be caused by chronic micro-trauma. In elderly patients or patients who have gout, diabetes, connective tissue diseases, or other systemic conditions, minor trauma may result in quadriceps injury.

MRI is useful in differentiating complete from partial quadriceps tendon tears. With complete tears, discontinuity of the tendon with associated retraction of the proximal remnant usually is visualized best using T2-weighted images. Often, an associated hematoma is seen with heterogeneous signal intensity on T1-weighted

images.

Myotendinous strain

Myotendinous strain is a common injury in athletes. The most commonly injured muscles are fusiform muscles that cross two joints. In these muscles, high tensile stress develops when the muscle is forced to lengthen during active contraction, a process termed eccentric contraction. Because the rectus femoris muscle is the only component of the quadriceps muscle group that crosses two joints, it is the most common site for myotendinous strain injuries in the knee extensor mechanism[49].

MRI findings of strain injuries consist of focal edema centered on the central tendon of the rectus femoris. The presence of a focal hematoma is indicative of a partial myotendinous tear. Complete myotendinous tears often are recognized clinically, and these patients less frequently undergo MRI[(49).]

V) OSSEOUS AND OSTEOCHONDRAL LESIONS

Bone bruise or marrow edema pattern. Bone bruises or marrow edema may be identified with numerous conditions, including trauma, infection, and osteoporosis. Bone bruises related to trauma may be caused by a direct blow, articular compression forces, or avulsion injuries. The extent of marrow edema tends to be more dramatic with compression or direct trauma, compared with avulsion injuries.

Typically, bone bruises are not visible on radiographs. However, these injuries are detected easily on MR images using T1- weighted sequences and either short T1 inversion recovery (STIR) or fat-suppressed T2-weighted sequences. Specific edema patterns are also useful in predicting the mechanism of injury and the associated ligament, tendon, or meniscal involvement [49].

Tibial plateau fractures

Subtle tibial plateau fractures are overlooked easily on radiographs. The only finding may be a lipohemarthrosis, which can be detected on the cross table lateral

radiograph. Displaced tibial plateau fractures are detected easily on radiographs. However, further imaging with CT or MR imaging is required to evaluate fragment position and associated soft-tissue injuries.

CT is adequate for the evaluation of fracture position, articular step-off, and separation of fragments. MR imaging, especially with subtle fractures, can assess the bony injury and associated ligament and meniscal injury more easily [49].

Segond and reverse Segond fractures

The Segond fracture is a small, avulsion fracture proximal and posterior to the insertion of the iliotibial band on Gerdy's tubercle. The avulsion may occur with

internal rotation and the knee flexed, or with internal rotation and varus stress. The fracture is caused by avulsion of the meniscotibial portion of the middle third of

the lateral capsular ligament, with possible associated fractures ofthe fibular head or Gerdy's tubercle. In the case of severe varus stress, such as in a motor vehicleaccident, the entire lateral ligament complex may be disrupted.

Segond fractures have a high incidence of anterior cruciate ligament tears and meniscal injury. MR imaging is ideal for the detection of osseous, meniscal, and ligament injuries. The reverse Segond fracture, much less common, is a medial avulsion of the deep medial collateral ligament attachment on the tibia. The mechanism of injury is felt to be valgus stress with external rotation and is associated with disruption of the posterior cruciate ligament and peripheral medial meniscus tears. When this avulsion is detected on radiographs, MR imaging should be performed toEvaluate the associated ligament and meniscal injuries[49].

Osteochondral lesions

Osteochondral lesions in the knee may be acute or chronic. Acute lesions result from impaction, or rotational or shearing forces. The fracture may involve only

cartilage, or cartilage and underlying bone. The fracture line is parallel to the joint line, unlike more conventional fractures that enter the joint vertically or obliquely. Fractures may be impacted, elevated partially or displaced completely and free in the joint [49].

When imaging osteochondral lesions, radiographs may be useful, but detection and appropriate classification are accomplished more effectively with MR imaging usingT1- and T2-weighted or STIR sequences. The axial and sagittal planes are most useful for femoral lesions. Lesions that are minimal (softening, fibrillation, or fissuring) show abnormal signal intensity without elevation or separation. MRsigns of unstable lesions include a high signal intensity line between the native bone and the osteochondral fragment, focal defects, articular fracture, and adjacent subchondral cysts[49]

Spontaneous osteonecrosis of the knee:

Spontaneous osteonecrosis of the knee (SONK): Spontaneous osteonecrosis of the knee was considered classically a condition of vascular insufficiency, leading to bone infarction of the weight bearing surface of the femoral condyle. The condition was seen in older adults. The condition almost always was unilateral and involved most commonly the medial femoral condyle. growing base of knowledge in the literature suggests that a subchondral insufficiency fracture leads to focal

osteonecrosis. Similar features have been described in the medial tibial plateau as well[49].

CLINICAL FINDINGS

Examination [43]

The most common knee complaints typically involve the patellofemoral joint. The knee takes a lot of stress. The higher the degree of tearing in the ligament, the greater the amount of instability symptoms. The knee serves as an important transmission between the ankle and the hip. As such, knee injuries are among the most common complaints encountered in sports medicine.

Palpation

During the examination, it is important to feel the anatomical structures of the knee to see if they have been injured. Damaged structures around the knee are typically tender to direct pressure. Such structures include the joint surfaces of the knee cap, the femur, the tibia, and the muscles and tendons around the knee. Patellar mobility is determined by passive medial and lateral movement. The patella can by divided into quadrants. A patella is considered to be hypomobile when it moves less than one quadrant on medial or lateral glide. A hypermobile patella is illustrated by a glide of more than two quadrants (one half of patellar width). Any tilting or rotation of the patella when it is pushed medially or laterally should also be noted. If the medial structures are too tight, the patella will tilt up when pushed laterally. If the lateral structures are too tight, the patella will tilt up when pushed medially.

Range of Motion

Hyperextension may occur, especially in women (Range 0° to 15°). A goniometer is a useful joint angle measuring tool that can be used to measure range of motion. The greater trochanter (hip reference), lateral joint line (knee), and lateral malleolus (ankle) are typically used as reference landmarks to check for the range of motion of the knee.

Examination of the range of motion at the knee is most easily performed with the patient in lying position. Full knee flexion is considered to be approximately 135° (Range 120-150°). Worrisome signs while testing range of motion include a "locked" knee,which lacks full extension when compared to the contralateral side. This suggests internal derangement may be present, such as a large meniscus tear, a ligament tear, or a loose body/bone chip. Another concering sign is the inability to extend the knee against gravity while in the lying position. This is indicative of an injury to the extensor mechanism of the knee. Examples include a quadriceps tendon tear, a patellar fracture, or an injury to the patellar tendon.

Anterior Drawer

Description: The Anterior Drawer test examines for any tearing or laxity of the anterior cruciate ligament (ACL).

Maneuver: Have the patient lying on their back with their knee bent as close to 90° as possible, with the foot resting on the table. Place both hands behind tibia and pull the tibiaforward, using a force between 15-20 lbs. The test can also test be performed with the foot externally rotated (turned out) to 15°.

Positive Findings: Increased anterior movement of the tibia on the injured side compared tothe non-injured side is considered to be a positive test. Up to 3 mm of

forward movement of the tibia is considered normal. The Grading for the test is as

follows: Grade 1 = 5 mm, Grade 2 = 5 to 10 mm,

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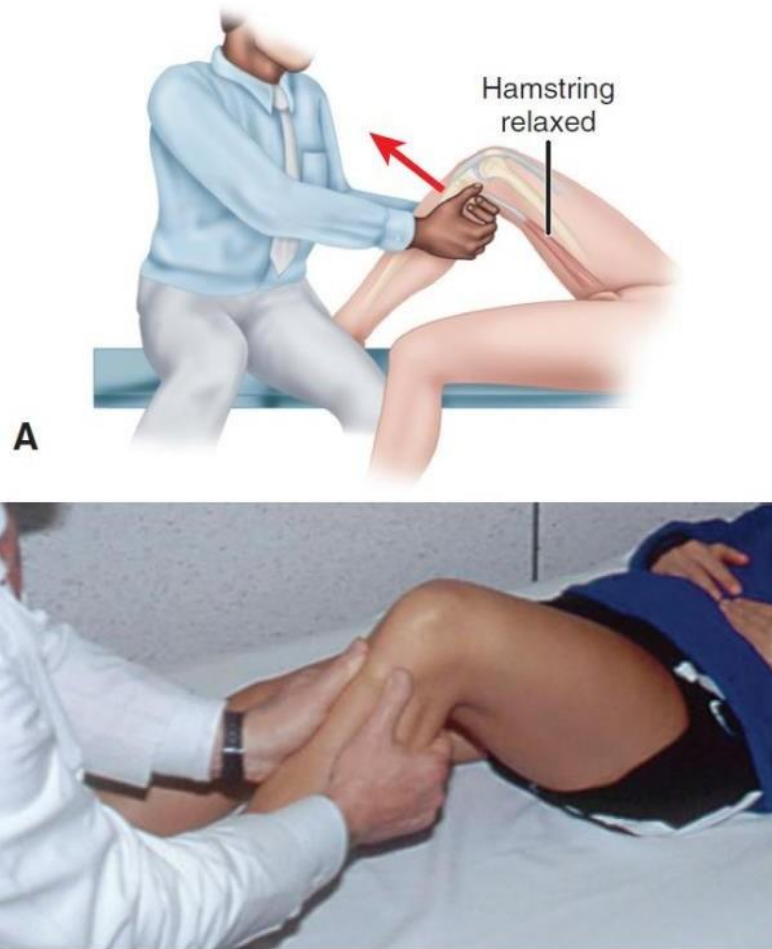
Figure 8 : Anterior Drawer Test

Lachman test:

In an acutely painful knee, the anterior drawer test is impossible to perform since 90

degrees of flexion is not possible. The Lachman test might be used in this situation. The

patient lies supine, with the leg in mild external rotation and the knee in a 15-degree

flexion range of total extension. The femur is made steady with one hand while the

proximal section of the tibia is pushed forward and translated anteriorly with the other. The thumb of the hand grasping the proximal tibia should be on the anteromedial joint edge. The presence of a soft terminal point on the anterior translation of the tibia suggests anterior cruciate ligament damage.In the diagnosis of anterior cruciate ligament damage, the Lachman test is more sensitive than the anterior drawer test.

Figure 9 : Lachman Test

Valgus Test

Description: The valgus stress test checks for medial joint laxity, which usually represents an injury to the medial collateral ligament (MCL).

Maneuver: Have patient lie on their back. Position one hand at the joint line on the outer part of the knee. Have the other hand fixed on the ankle of the affected side. Flex the knee between 20° and 30° and apply a medial or valgus force to the knee. Approximately, 15 to 20 lbs of force should be applied during the test. In order to test the MCL, as well as the posterior medial capsule, the test can be repeated at 0° with

the knee in full extension.

Positive Findings: A positive test demonstrates increased medial joint laxity compared to the unaffected side. A Grading system from 1 to 3 can be used which is

based on the amount of joint space opening (Grade 1 = 5 mm, Grade 2 = 5 to 10 mm, Grade 3 > 10 mm).
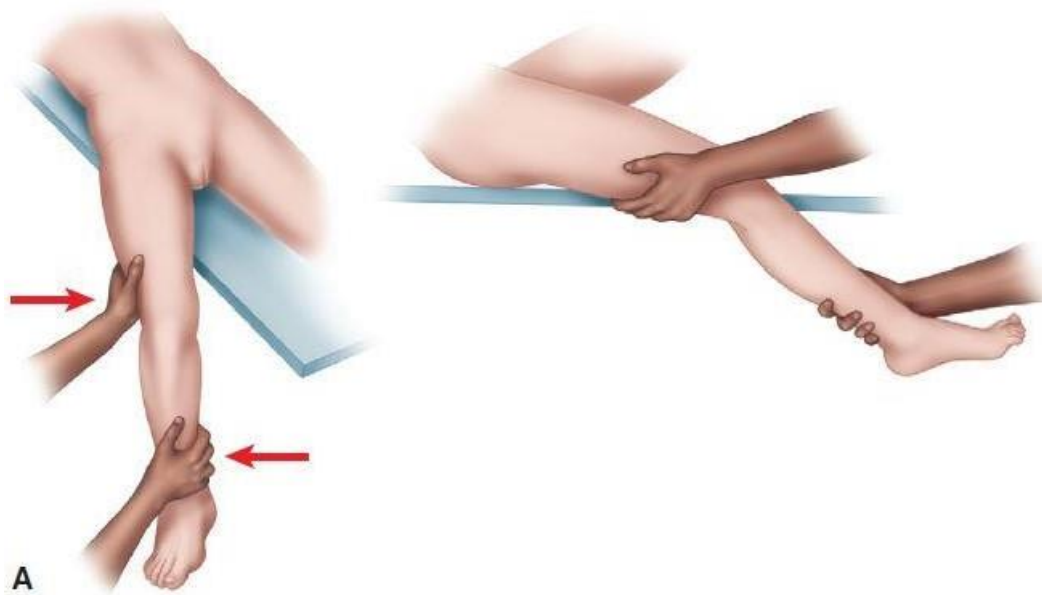
Figure10 : Valgus Stress Test

Varus Test

Description: The varus stress test checks for joint laxity on the outside of the knee, which usually represents an injury to the lateral collateral ligament (LCL).

Maneuver: With the patient lying on their back, position one hand at the joint line on the outer part of the knee. Fix the other hand on the ankle of the affected side. Flex the knee between 20° and 30° and apply a lateral or varus force to the knee. This can be done either by reaching over the top of the knee, or by approaching the patient from the inside aspect of the knee with the leg off to the side. Approximately, 15 to20 lbs of force should be applied during the test. The test can also be repeated at 0° with the knee in full extension.

Figure 11:   Varus Stress Test

McMurray's Test

Description: This test checks for meniscal tears and other internal derangement in the knee.

Maneuver: With the patient supine, and their hip and knee bent to 90°, grasp the heel in one hand. Place the other hand over the knee, with the thumb and fingers on the joint line. Gently rotate the tibia with the heel internally rotated with a mild valgus force (for the lateral compartment) and externally rotated with a mild varus force (for the medial compartment).

Alternate View:

Positive Findings: Painful clicking along the joint line or any pain over the joint line that reproduces the patient's symptoms is considered to be a positive test.

Figure 12 : McMurray's Test

Apley's Grinding Test:

There exist two phases to the Apley test for posterior meniscus injuries. The patient must lie prone and bend the knee to 90 degrees in both sections. The examiner then grabs the patient's foot and tells them to relax. The examiner stabilises the patient's thigh by applying downward pressure from the examiner's own knee while pushing the patient's foot upward to distract the patient's knee during the distraction section of the test. This component of the exam is uncomfortable when ligaments are ruptured.After that, the examiner alternately externally and internally rotates the patient's foot before moving on to the compression test, which involves squeezing the knee while rotating it alternately externally and internally. During the compression test, discomfort in the medial joint line (generally caused by external rotation) indicates a medial meniscus tear, whereas pain in the lateral joint line (usually caused by internal rotation) indicates a lateral meniscus tear.
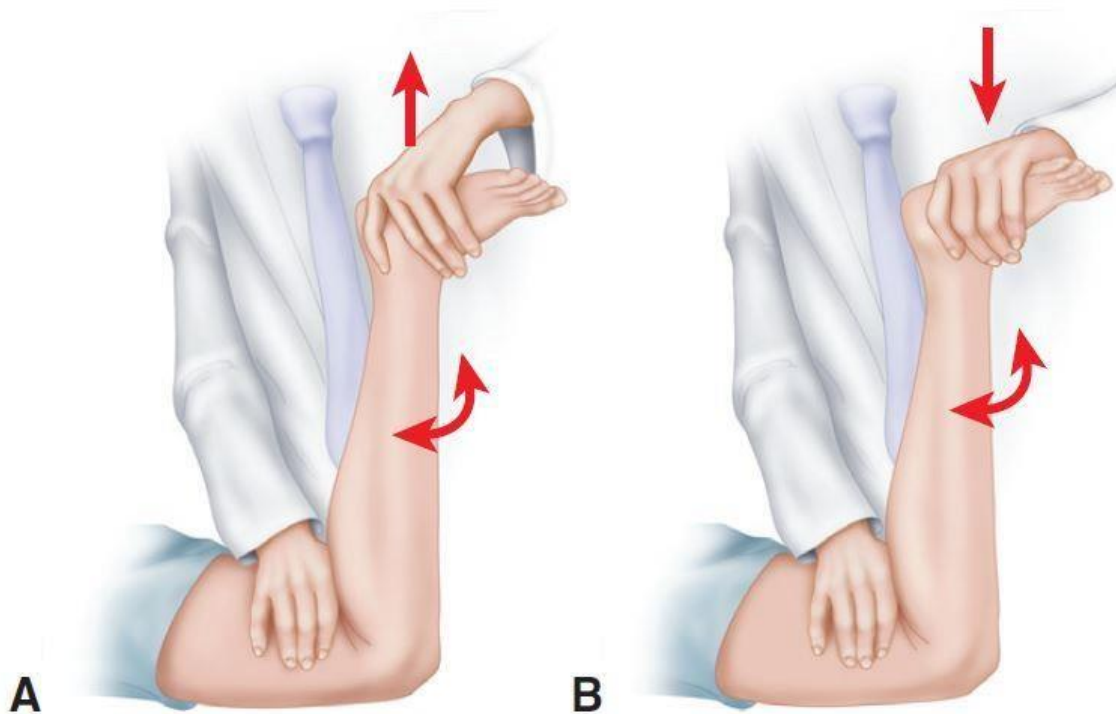
Figure 13 : Apley's Griding Test

Knee protocol MRI

☐ Fast spin echo PD and T2W in saggital plane (meniscal and cartilage).

☐ STIR sequence in coronal plane (marrow)

☐ T1W coronal images.

☐ T2W axial images.

Coils : Slightly externally rotate the foot by about 10-15 degrees to stretch the

anterior cruciate ligament.

Pack some cushions around the knee to help it stay motion-free. A small

cushion under the ankle helps to keep the leg straight.
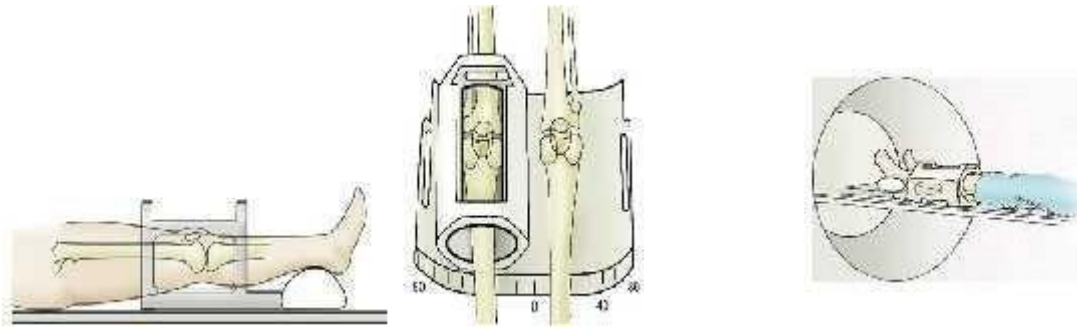
Fig 14 Shows MRI knee coil

Slice thickness 3 mm

Series 1: Axial Proton Density

Enter left or right offset corresponding to distance from centerline of magnet. Then scan.

Right knee:	**offset**	**R 75**
Left knee:	**offset**	**L 75**

Series 2: Sagittal Proton Density

☐ Oblique to the intercondylar notch

☐ Include all of medial and lateral menisci. Subcutaneous fat medial and lateral to knee joint may be excluded. If more slices are required, increase TR.

Series 3: Coronal Proton Density

☐ Oblique perpendicular to series 2.

☐ If more slices are required, increase TR.

☐ Keep TR > 3000 and ETL < 16

☐ If there is bone abnormality or soft tissue mass then it may be necessary to increase FOV.

Series 4: Coronal T2 Fat Sat (same as series 3 above)

Series 4: Coronal T2 Fat Sat (same as series 3 above)

<u>Knee Arthroscopy</u>

In arthroscopy, appropriate lighting, joint distension, and portal location for the introduction of the arthroscope and auxiliary equipment are critical. Because poor portal placement makes it difficult to visualise the joint and handle the instruments within it, precise placement is necessary. When an arthroscope is inserted into a poorly positioned portal, not only may the joint be hurt, but also the device.

Before joint distension, the portal entry locations should be properly noted. The figures of the patella and its tendon, medial and lateral joint lines, and posterior contours of the lateral and medial femoral condyles are delineated.

To guarantee proper portal placement, the surgeon must demarkate the portals and landmarks prior and after distension.

In a research by Stetsin and Templin, it was discovered that knee arthroscopy with two portals resulted in faster rehabilitation and return to activity than arthroscopy with three portals. This was owing to the fact that the vastus medialis obliqus was broken by using three portals.

<u>Standard portals:</u>

Standard portals that are included are,

1. antero-lateral

2. antero-medial

3. supero-lateral

4. postero-medial

Anterolateral portal :

The surgeons' preferred portal for diagnostic arthroscopy is this one.The PCL and the anterior part of the lateral meniscus are the only structures not visible. This portal is placed one centimetre above the lateral joint line and one centimetre below the patellar tendon.A millimetre distant from the inferior pole of the patella, the portal should be positioned. If the port is positioned too close to the joint line, the anterior horn of the lateral meniscus may be damaged. The scope penetrates the fat pad when the port is put too close to the patella tendon, making viewing and manoeuvring difficult.

Anteromedial portal:

This portal is primarily used for lateral compartment visualisation and probe palpation of medial and compartment components. One centimetre above the medial joint line, one centimetre distal to the inferior pole of the patella, and one centimetre medial to the patellar tendon is where the portal is located. Percutaneously implanting a spiral needle that can be viewed via the anterolateral portal can limit the exact placement of the portal.

Posteromedial portal :

This portal is located in a tiny triangular region that is bounded by the femoral condyle and tibia's posteromedial borders. Before the joint is distended, this triangle is palpated with the knee at 90 degrees of flexion. A 30 degree angled arthroscope implanted through this portal can see the structures in the posteromedial compartment. This portal lies 1centimetre superior to the posteromedial joint line and 1centimetre posterior to the femoral condyle's posteromedial edge. This section is mostly utilised to treat diseases of the menisci's posterior horn and posterior loose bodies that cannot be reached

through the anterior portals.

Superolateral portal :

This is primarily used to visualise the patellofemoral joint's dynamics, such as patellar tracking and patellar congruity, as the knee moves from extension to flexion. This portal located 2.5cm above the patella's superolateral border and 2.5cm lateral to the quadriceps tendon.

Optional portals:

Posterolateral portal, Proximal mid-patellar lateral and medial portals, Accessory far medial and lateral portal, and Central transpatellar tendon (Gillquist) portal are among the optional portals.

Under anesthesia examination and patient positioning:

All of the patients in our research were operated on while supine and under spinal anaesthetic. The Posterior drawer test, Anterior drawer test, Pivot Shift test, and Lachman test were all performed under anaesthetic. A pneumatic tourniquet is applied and positioned in the upper thigh after soft padding. Scrubbing , Painting and draping of the injured limb is done upto the ankle from the tourniquet. The patient is supine, with the knee joint set back from the distal breakpoint of a standard operating table. A well-fitting leg brace is used to support the unaffected limb. A prophylactic antibiotic, usually 1 gramme of ceftriaxone, is given before the tourniquet is inflated. Before inflating the tourniquet, the arm is held upright to exsanguinate it.
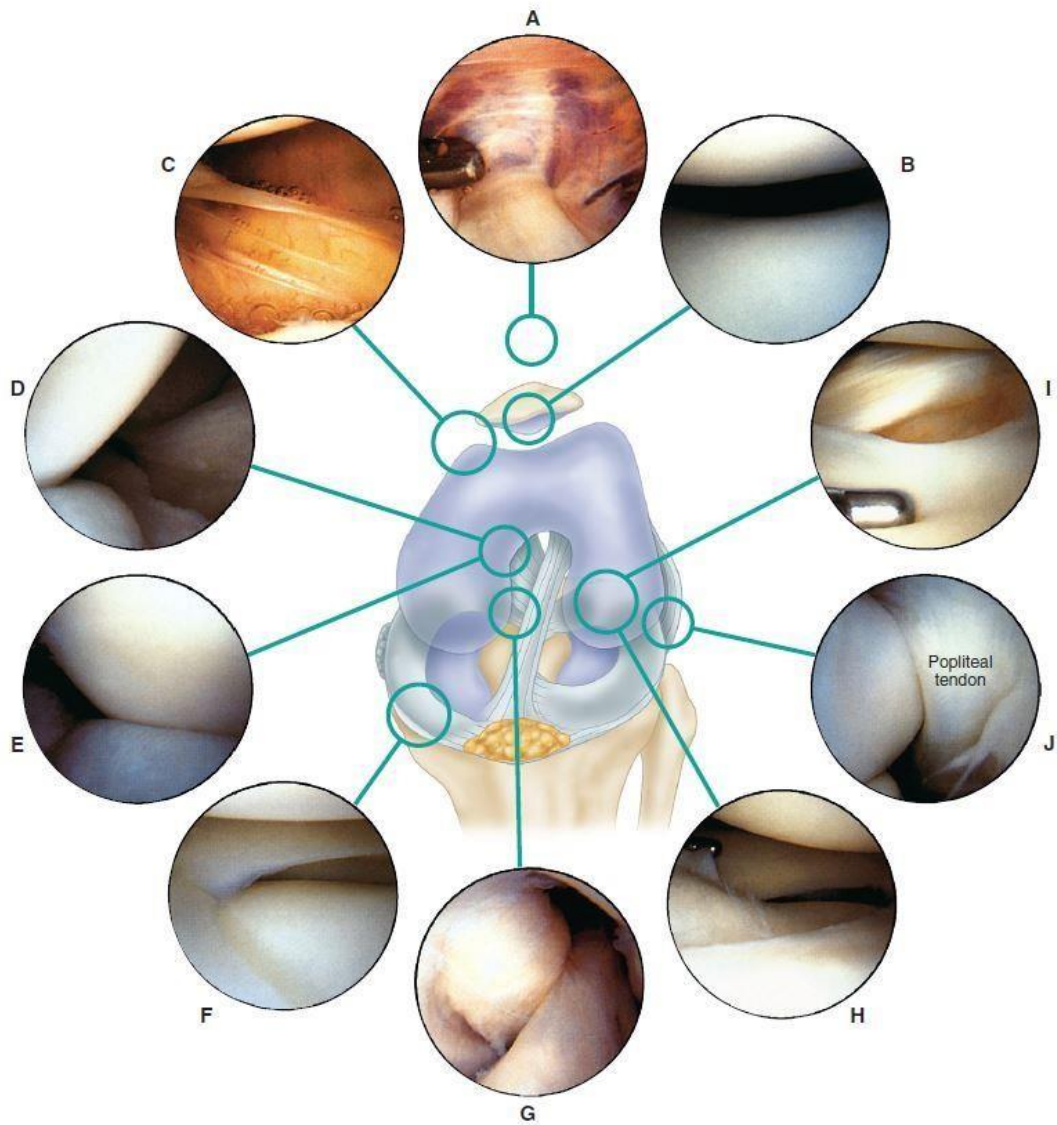
Figure 15 :Showing various structure of knee when viewed arthroscopically through various portals during diagnostic arthroscopy

METHODOLOGGY

SUBJECTS:

The objective of present study is to determine accuracy, sensitivity, specificity and concordance of findings of MRI and correlating with arthroscopy in our hospital establishment. Our hospital is 700 bedded tertiary care hospital where daily 10-15 trauma

cases are admitted.

Source of Data:

All cases referred from orthopedic department of shri B M PATIL MEDICAL COLLEGE,VIJAYAPUR for evaluation of traumatic knee.

INCLUSION CRITERIA[80]

- Patients who had recent knee injuries (within 2 months) to either or both knee joints.
- Patients who had their ligamentous reconstructive surgery within 3 months of preoperative MRI of knee
- Patients undergoing arthroscopic surgeries for meniscus, acl or pcl based on mri.
- Age group of over 18 years

EXCLUSION CRITERIA

- Knee injuries other than internal derangement.

- Patients with contraindication to MRI like intracerebral aneurysmal clips, cardiac pacemaker, metallic foreign body in eye, implants in middle ear.

- Patients who underwent multiple ligamental reconstructions in knee injuries.

- Patient not willing for surgery

- Patients over 55 years

- Patients who rfused undergo the surgery

STUDY SAMPLE

32 cases of internal derangement of knee will be evaluated with MRI and arthroscopy to asses diagnostic accuracy.

METHOD

Each patient of knee injury will be evaluated clinically for evidence internal derangement knee by clinical test.

- These patients were subjected to MRI
- And Diagnostic Arthroscopy

Each MRI was performed using the MR protocol of 1.5 TESLA G SIGMA EXPLORE, 16 CHANNELS. T1 & T2 weighed sequences were done on coronal and sagital planes MR films were be read by a senior radiologist. The status of menisci, cruciate ligament, cartilage and subchondral bone were registered. `

Study will be evaluated for:

Joint effusion	:	Present/Absent
Anterior Cruciate Ligament tear	:	Present/Absent
Partial/Complete		
Posterior Cruciate Ligament tear	:	Present/Absent,
Partial/Complete		
Medial Collateral Ligament tear	:	Present/Absent
Grade- 1/2/3		
Lateral Collateral Ligament tear	:	Present/Absent
Grade- 1/2/3		
Medial Meniscal Tear	:	Present/Absent
Location & Type		
Lateral Meniscal Tear	:	Present/Absent
Location & Type		
Osseous /Osteochondral lesions	:	Present/Absent

Arthroscopy:

Instruments used for surgery:

Arthroscopic anterior cruciate ligament restoration necessitates a large number of specialised devices. Arthroscopic system is composedof :

1. T-V monitor

2. Camera

3. Fibre optic light source cable

4. Arthroscope

5. Shaver system with hand piece

6. Tourniquet – pneumatic.
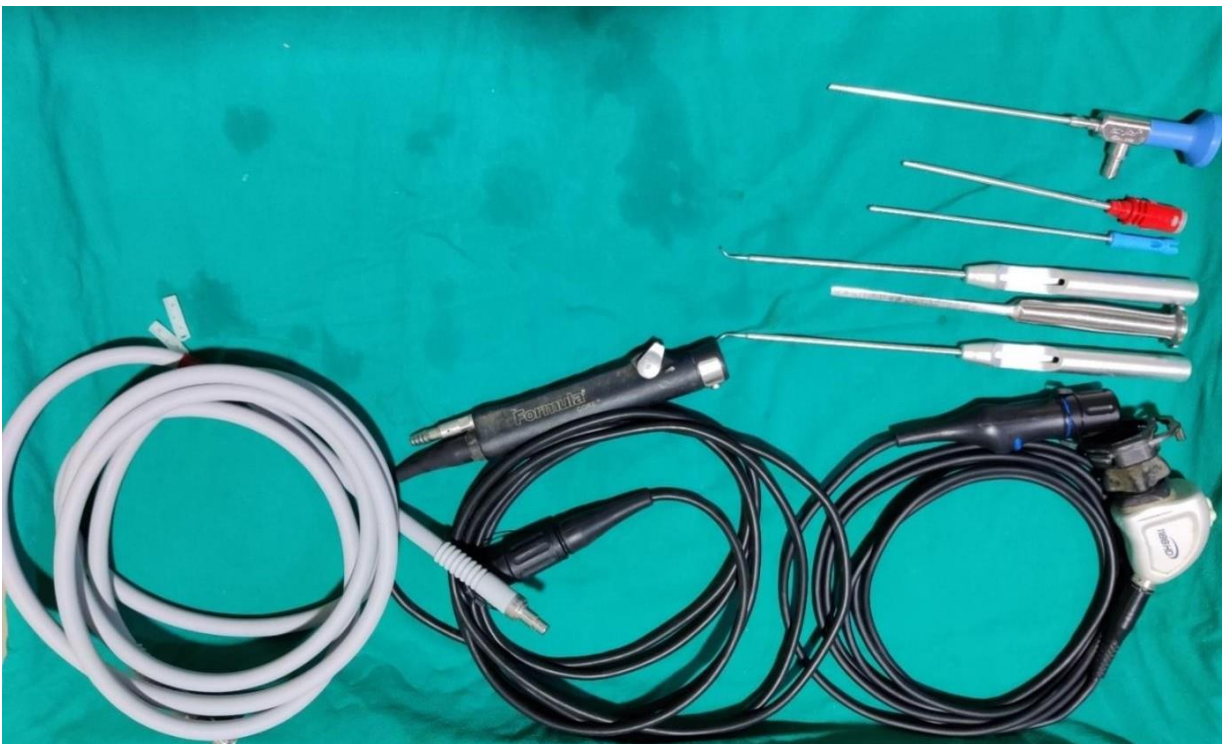
Figure 16 : Instrument tray showing instruments used in the arthroscopy

Diagnostic Arthroscopy:

The scope is inserted by the anterolateral port in 90 degrees of knee flexion, and the knee is inspected in the following order:

A. Supra-patellar pouch

B. Patello-femoral articulation

C. Normal medial para-patellar plica

D. Postero-medial compartment

E. Posteromedial compartment when seen through posteromedial portal, which ismade after completion of routine examination if complete posteromedial view isunsatisfactory

F. Medial meniscus and medial compartment

G. Cruciate ligament with fatty synovium covering PCL

H. Lateral meniscus and lateral compartment

I. View of posterior horn of lateral meniscus and popliteal tendon through hiatus

Arthroscopic views were obtainedfrom standard anteromedial and anterolateral portals.

Findings of MRI of the Knee are well correlated with the arthroscopic findings in patients of trauma to the Knee
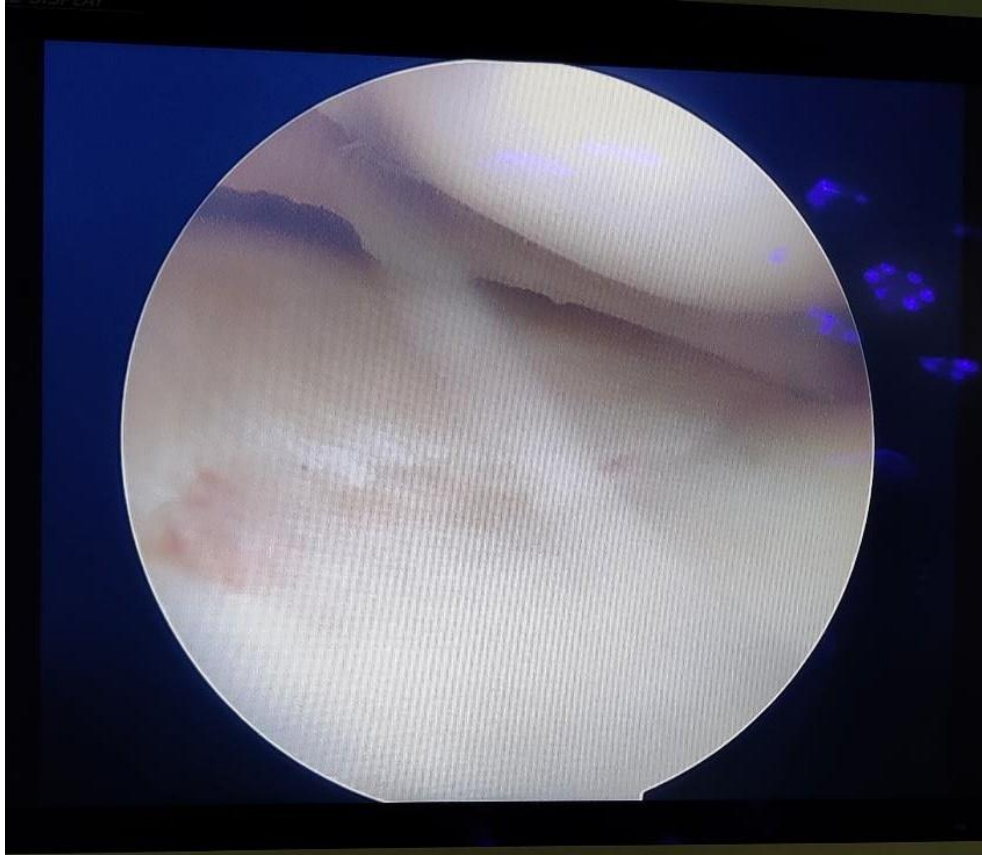
Fig 17 : Clinical picture shows an intact medial meniscus visualized during arthroscopy

Fig 18 : Arthroscopy equipments.

Fig 19 : MRI Gantry

RESULTS

1) Age wise distribution

Age(Years)	No. of Patients	Percentage
< 30	9	28.1
30 - 39	15	46.9
40 - 49	5	15.6
50+	3	9.4
Total	32	100.0

Table 1: Age wise distribution
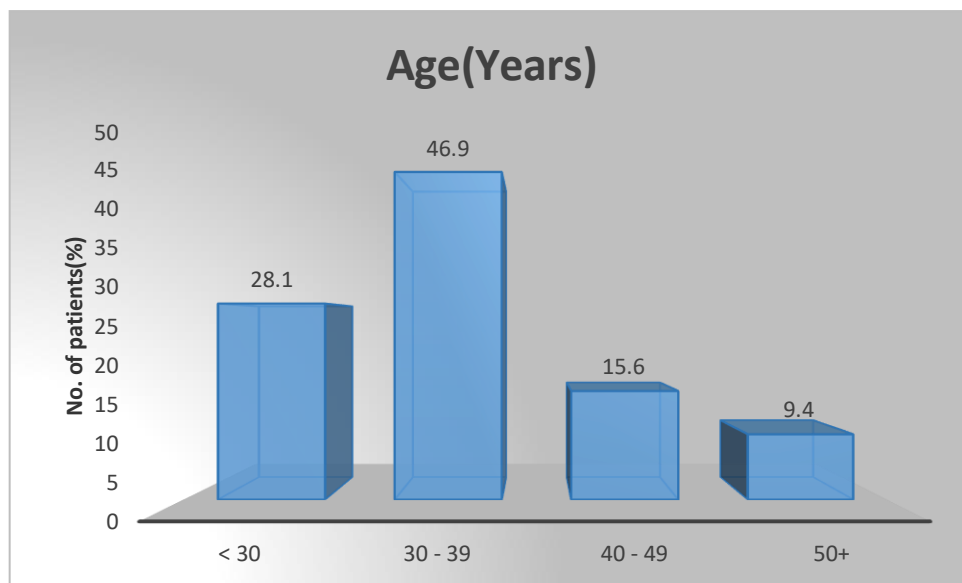
Fig 20 shows age wise distribution of various ligament injury in correlation of MRI with arthroscopy.

2) Sex wise distribution of patients

Gender	No. of Patients	Percentage
Female	13	40.6
Male	19	59.4
Total	32	100.0

Table 2: Sex wise distribution of patients
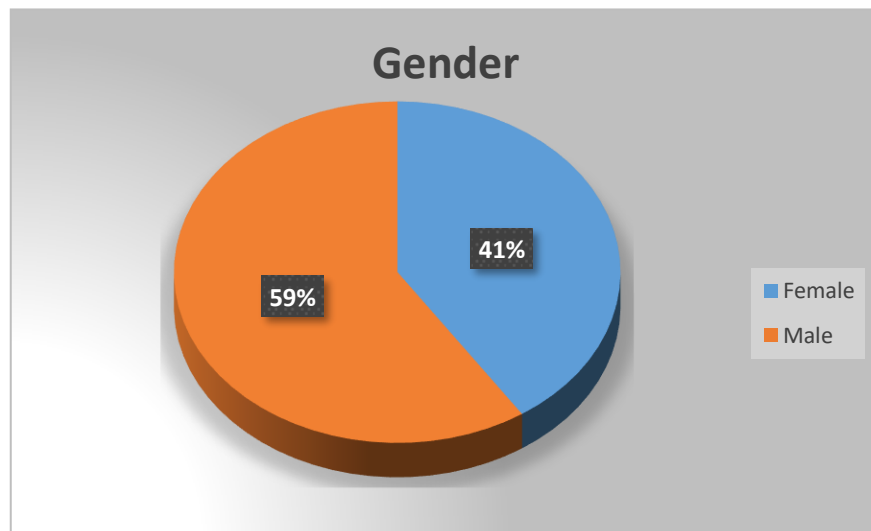
Fig 21 shows gender wise distribution in patients

2) Sex wise distribution of patients

3) Mode of Injury

Mode of Injury	Number	Percent
Others	8	25.0
RTA	7	21.9
Self-fall	6	18.8
Sports injury	11	34.4
Total	32	100

Table 3 : Mode of injury in various patients
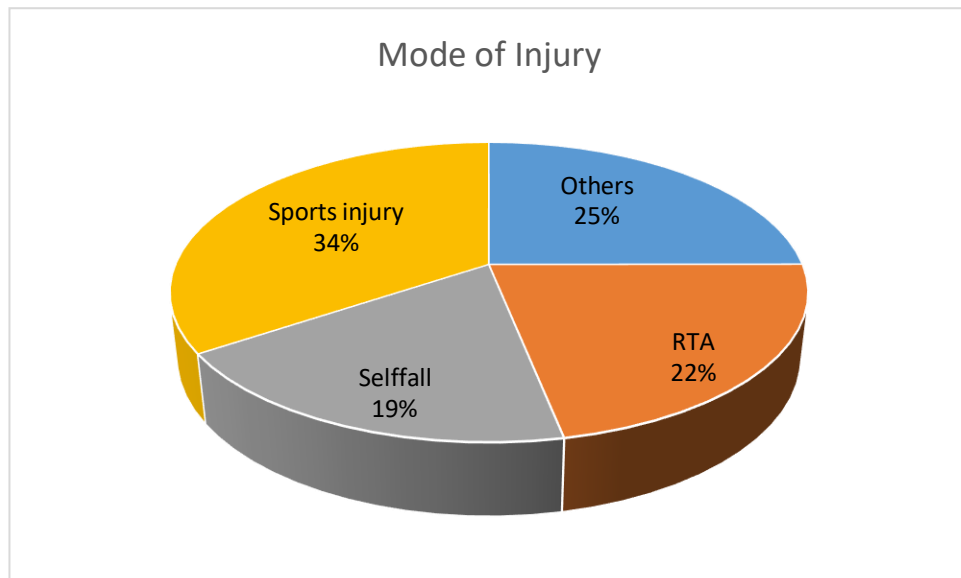
Fig 22 : Pie diagram showing mode of injury in various patients

4) Presenting symptoms of patients

Presenting symptoms	Number
Instability	2
Knee pain	17
knee pain and instability	4
Knee pain and locking	2
Knee pain and swelling	6
Swelling, locking and instability	1
Total	32

Table 4 - Presenting symptoms of patients
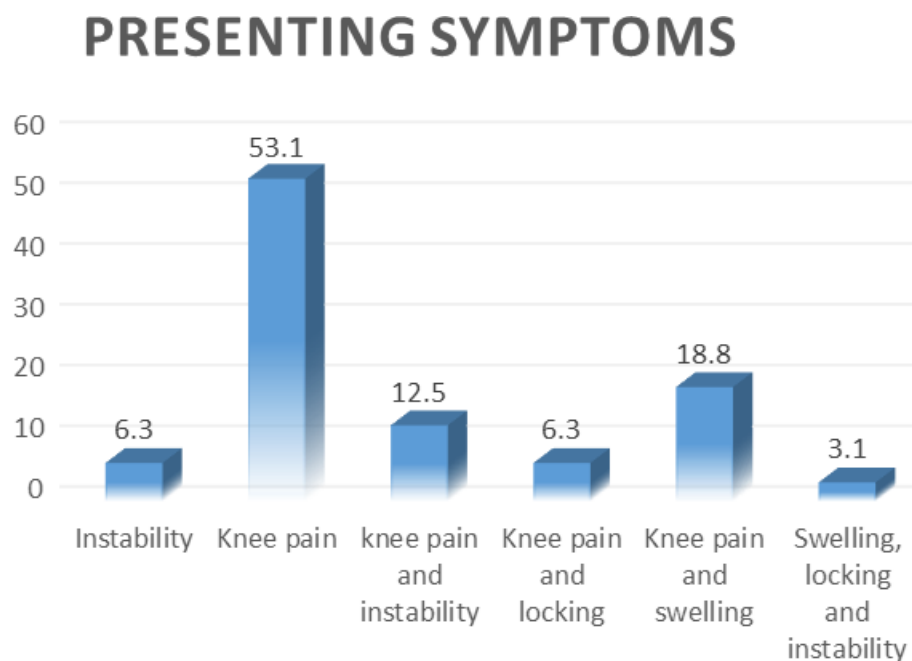
Fig 22 - Bar diagram showing presenting symptoms of patients

5) **Duration of the injury**

Duration of injury(weeks)	Frequency	Percent
1	9	28.1
2	11	34.4
3	10	31.3
5	1	3.1
10	1	3.1
Total	32	100

Table 5 : Shows duration since the injury
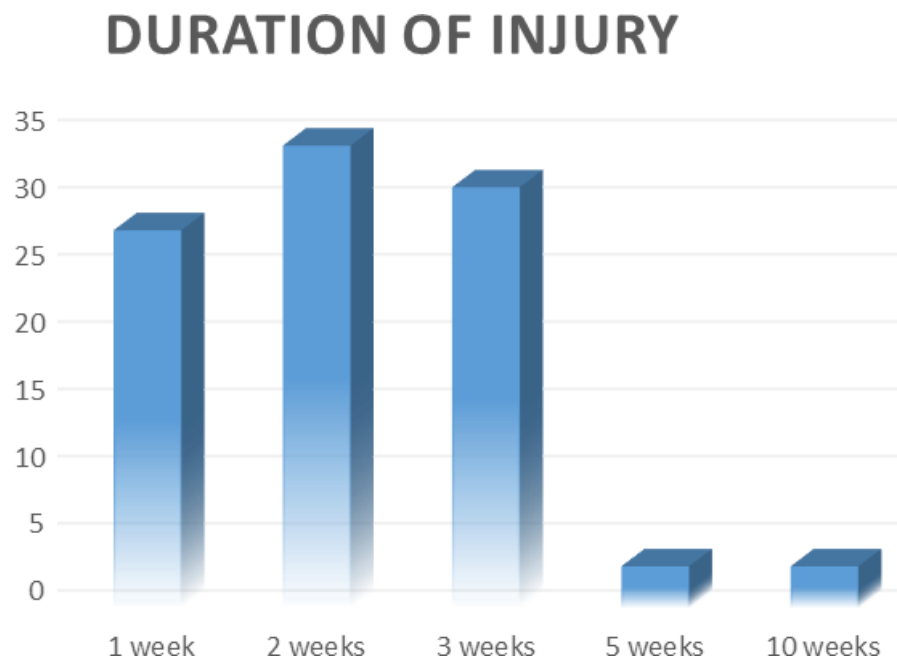
Fig 23 : Bar diagram shows duration since the injury

6) Osteochondral lesions

Oseous /osteochondral lesions	Patients	Percent
No	21	65.6
parameniscal cyst	1	3.1
Yes	10	31.3

Table 6 : Osteochonfral Lesions
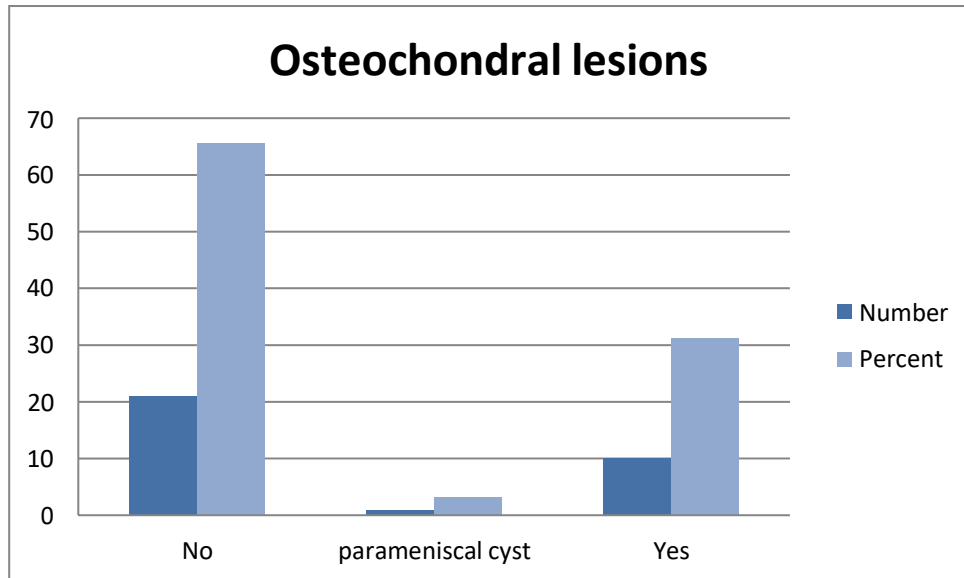
Fig 24 : Bar diagram showing patients who have osteochondral lesions

7) Joint effusion

Joint effusion	Frequency	Percent
No	12	37.5
Yes	20	62.5
Total	32	100.0

Table 7 : Shows patients who had joint effusion
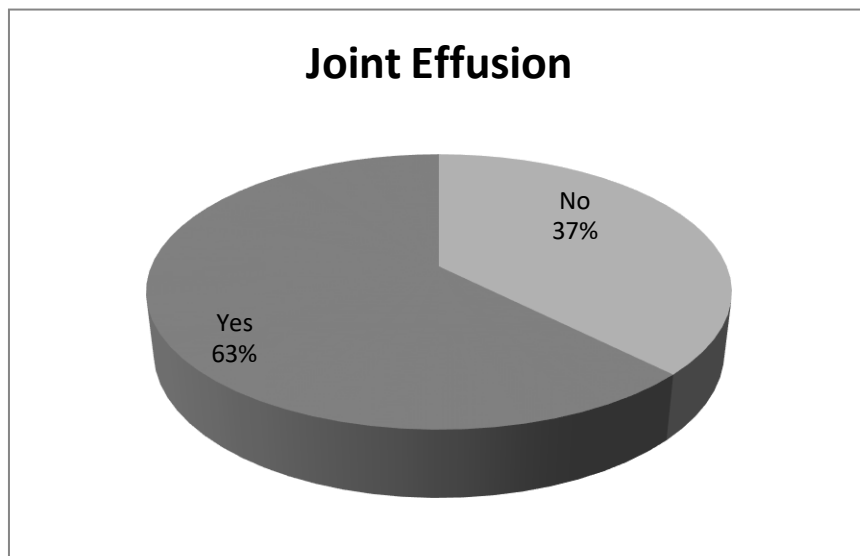
Fig 25 : Pie diagram shows patients who had joint effusion

Statistical analysis was used to calculate sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV), accuracy in order to assess the reliability of the Arthroscopy and MRI results. To evaluate the sensitivity, specificity and accuracy of MRI, the findings at arthroscopy were taken to be the true diagnosis. Sensitivity was calculated from the number of true positive results divided by the sum of the true positive results and the false negative results. Specificity was calculated from the number of true negative results divided by the sum of the true negative results and the false positive results. Positive predictive value was calculated by true positive divided by sum of true and false positive results multiplied by 100. Negative predictive value was calculated by true negative divided by sum of true and false negative results multiplied by 100. Accuracy was calculated from the sum of the true positive and the true negative results divided by the total number of patients who underwent arthroscopy. The data was analysed using SPSS 17.26 version. The following were the results of the study.

Arthroscopic findings

Longitudinal tears were the most common type of medial meniscal tears seen followed by bucket handle tears. Longitudinal tears were the most common type of lateral meniscal tear followed by radial tears. Isolated ACL tears were seen in 13 patients, ACL + Medial Meniscus tears were seen in 8 patients, isolated Medial Meniscus tears were seen in 3 patients and isolated Lateral Meniscus tears were seen in 02 patients. Osteochondral defects were noted in 09 patients.

1) Correlation of MRI findings with Arthroscopic Examination of Medial Meniscal tears:

MRI MM	Arthroscopy			Chi square test	P value
	Yes	No	Total		
Yes	8	1	9		
%	57.1%	5.6%	28.1%	10.367	0.001
No	6	17	23		
%	42.9%	94.4%	71.9%		
Total	14	18	32		
%	100.0%	100.0%	100.0%		
Statistically significant					

Table 8 : Correlation of MRI findings with Arthroscopic Examination of Medial Meniscal tears

Statistic	Value
Sensitivity	57.14%
Specificity	94.44%
Positive Predictive Value (*)	88.89%
Negative Predictive Value (*)	73.91%
Accuracy (*)	78.12%

Table 9 : Shows Sensitivity, specificity, PPV, NPV and accuracy of medial meniscus tears

The Sensitivity was 57%, Specificity was 94%, Positive Predictive Value was 88%, Negative Predictive value was 73% and Accuracy was 78%

2) Correlation of MRI findings with Arthroscopic Examination of Lateral Meniscal tears:

MRI LM	Arthroscopy			Chi square test	P value
	Yes	No	Total		
Yes	7	0	7	26.880	0.001
%	87.5%	0.0%	21.9%		
No	1	24	25		
%	12.5%	100.0%	78.1%		
Total	8	24	32		
%	100.0%	100.0%	100.0%		
Statistically significant					

Fig 10 : Correlation of MRI findings with Arthroscopic Examination of Lateral Meniscal tears

Statistic	Value
Sensitivity	87.50%
Specificity	100.00%
Positive Predictive Value (*)	100.00%
Negative Predictive Value (*)	96.00%
Accuracy (*)	96.88%

Table 11 : Shows Sensitivity, specificity, PPV, NPV and accuracy of lateral meniscus tears
The Sensitivity was 87%, Specificity was 100%, Positive Predictive Value was 100%, Negative Predictive value was 96% and Accuracy was 96%.

3) **Correlation of MRI findings with Arthroscopic Examination of ACL tears:**

MRI ACL	Arthroscopy			Chi square test	P value
	Yes	No	Total		
Yes	22	1	23	18.602	0.001
%	91.7%	12.5%	71.9%		
No	2	7	9		
%	8.3%	87.5%	28.1%		
Total	24	8	32		
%	100.0%	100.0%	100.0%		
Statistically significant					

Table 12 : Correlation of MRI findings with Arthroscopic Examination of ACL tears

Statistic	Value
Sensitivity	91.67%
Specificity	87.50%
Positive Predictive Value (*)	95.65%
Negative Predictive Value (*)	77.78%
Accuracy (*)	90.62%

Table 13 : Shows Sensitivity, specificity, PPV, NPV and accuracy of ACL tears

The Sensitivity was 91%, Specificity was 87%, Positive Predictive Value was 77%, Negative Predictive value was 77% and Accuracy was 90% .

4) Comparison of MRI findings for ACL, Medial Meniscus and Lateral Meniscus

RESULTS	SENSITIVITY	SPECIFICITY	Ppv	Npv	ACCURACY
ACL	91.67%	87.50%	99.5%	77.78%	90%
MM	57.14%	94.44%	88.89%	73.91%	78.12%
LM	87.5%	100%	100%	96%	96.88%

Table 14 : Comparison of MRI findings for ACL, Medial Meniscus and Lateral Meniscus
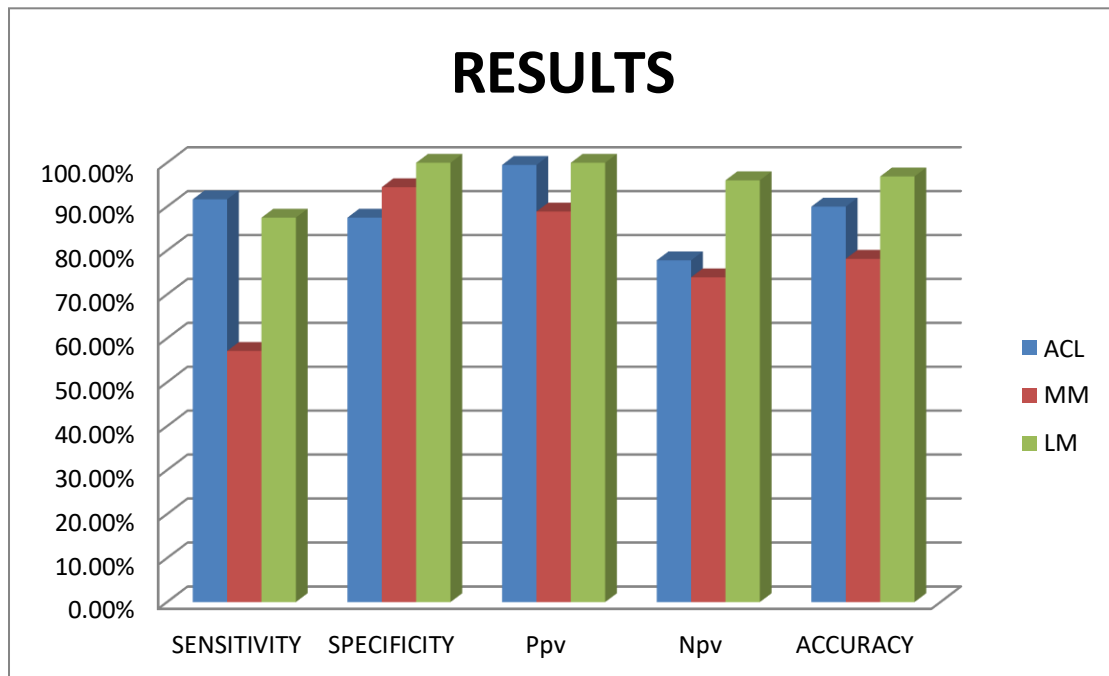
Fig 26 : Bar diagram showing comparison of MRI findings for ACL, Medial Meniscus and Lateral Meniscus

DISCUSSION

The role of MRI has steadily increased and is now investigation of choice for internal derangement of knee. It is also being used for pre and post operative evaluation. It is a non invasive technique that that does not require contrast administration and is not operator dependent. Complete evaluation of internal structures of the knee is not possible with modalities like radiography, arthrography and ultrasonography. Even with arthroscophy lesions such as peripheral meniscal tears, inferior surface tears and osteochondrans dessicans without articular damage are most commonly detected.

AGE OF PATIENT.

Manoj MK et al 2014 [46] **,** A total 40 cases with age ranged between 15-61 years. 12.5

% were below 20 years, 63.7% were between 21-40 years, 18.75% were between 41- 60 years. More than 60 years 5%. The mean age was 30 years and the maximum number of patients affected belongs to the age group of 21-40 years. which is correlating our study with clinical history, They found mean age group of younger generation with acute history such as road traffic accident and sports injury.

Gupta R et al 2015 studied [51] Role of MRI in delineation of internal derangement of knee in trauma patients in there study a total of 44 patients with 37 males and 7 females. Males comprised of 84.1% and females

comprised of 15.9% of the total study group. Male patients exceeded the

number of female patients in all the age groups. The age group ranged from 20 to 60

years with mean age being 32.2 years. 20-30 year was the commonest age group in there study. They also found knee injuries are common in mainly in younger generation and active individuals. Even in our study we found mean age of injuries are from 30-40 yrs (54.3%) which is very well correlating.

Bashir Ahmed Mir 2015 [59] in there study there weretotal of 50 patients were included in the study in the age group of 18 to 50 years with a mean age of 38.5 years.Out of 50 patients in our study, 35(70%) were males and 15(30%) were females. Left knee was predominantly involved in 64% of the cases with 36% involvement of right knee for all pathologies diagnosed on arthroscopy, in our study also we found similar fings with mean age 30-40 yrs which is similar to this study.

Ali Akbar esmaili jah *et al,,* 2005 [45], They conducted a prospective, single blind study, to compare diagnostic accuracy of clinical examination with MRI findings in assessing patients with acute traumatic internal derangement of

the knee. A total of 57 males (81.4%) and 13 females (18.6%), ranging in age from 17 to 51 years (mean = 27.9). The right knee was involved in thirty cases (42.9%) and the left knee in 40 (57.1%). Most of cases in there study were non-professional sports injury in 55 patients, a motor car accident in 10 patients and a fall in 5 patients, however in contradiction we found most of cases were due to sports and recruits and road traffic accident injuries, our study mean age is correlating with study.

Rajpal Yadav *et al,,* **2013** [76] they conducted study on Role of MRI in evaluation of painful knee. A total of 50 patients and mean age of patients in this study was 36.70±

13.14. The maximum numbers of patients were seen in 40-50 years age group, which is contradicting our study since in our study we found mean age group ranging from 30-40 and patients presented with acute history of trauma, however rajpalyadav studied patients of traumatic origin or non traumatic origin like infection or inflammation. Since old aged patients presents with nontraumatic cases with we have excluded in ourstudy. Analysis of demographic characteristics shows that in this present study of 50 patients, 17 were females (34%) and 33 were males (66%). This isbecause males are generally more active than females and travel a lot. Hence their knees are exposed to more wear and tear. Also they are at more risk of injury.

Madhusudan et al 2008 [57] A total of 109 patients with 68 males and 41 female patients in the age group of 18–70 years with a mean age of 52 yrs. Patients in groups 1 and 2 were in the age group of 18 and 50 years and group 3 consisted of 62 patients in the age group of 51–70 years. There were three identified groups: Those who were clinically positive for meniscal or cruciate ligament injury [group 1], combined meniscal and cruciate ligament injury [group 2], and patients with highly suggestive symptoms but with negative clinical tests [group 3]. 82 patients in the study had treatment in the form of a knee support device or physiotherapy prescribed by their general practitioner before their first visit to the orthopaedic consultation. Our protocol of study included only patients of acute trauma on visit to orthopaedic OPD most of

patients were positive for clinical tests since most patients presented with acute trauma.

Liem 1. Bui-Mansfield *et al*,, In this study. The male-to-female ratio was 9: 1, and the

mean age was 31 years old, These demographics reflect a military population. In our study we found many of our patients from police training school,

vijayapura these patients were managed conservatively for 2 weeks, however later on surgery were planned.

Rakesh Gujjar *et al,,* **2015** [76] They found knee injuries represent roughly 6% of all acute injuries treated at emergency department and between 27% and 48% of these have been reported to be sports related in their study, in there study found that mean age was 2 weeks. Acute injuries were taken immediately for surgery within 1 week, and patients with non-sports injured patients were given 2-3 weeks of time for conservative management in our study.

In our study included around 33 patients suspected having internal derangement of knee. Maximum were young and middle aged group mean age from 30-40 yrs (54.3%) with below studies quoted shows mean age group is younger age due to trauma and sports injury.

MODE OF INJURY

Gupta R *et al,,* **2015** [51] The common mechanism of injury noted was road traffic accident with 20 patients (45.5% of the total population) followed by sports related injuries with 13 patients (29.5% of the total population) Forty of these patients presented with pain, 23 patients presented with painful swelling of the knee, and the remaining 22 patients presented with leg instability.

A. **A. ESMAILI JAH et al 2005** [45] They found mechanism of trauma was a non- professional sports injury in 55 patients, a motor car accident in 10 patients and a fall in 5 patients. In our study we found 20 patients of non professional sports injury and 10 cases of road traffic accidents and 3 cases of police recruits due to sports injuries.

B. **Rakesh Gujjar** *et al,,* **2015**[76] They found knee injuries represent roughly 6% of all acute injuries treated at emergency department and between 27% and 48% of these have been reported to be sports related in their study. In our study we found most of injury due to non professional injury, road traffic accident & sports injury.

A total of 33 patients presented in OPD. Out of these injuries patient presented with various mode of injury, Some were due to sports injury, road traffic accidents, some were police recruits from police training centre, Vijayapur.

DURATION OF INJURY

TR Madhusudhan *et al,,* **2008** [57]

Arthroscopy is inevitable considering the load in the National Health

Service (NHS) , however waiting time for the MRI from the point of definite clinical diagnosis was 3–7 weeks [average 4.1 weeks] and the waiting time for arthroscopy following the MRI was a further 5–8 weeks [average 5.8 weeks]. 32 patients were examined directly by the orthopaedic team following an acute episode and the rest were seen by the emergency medicine department at the time of injury to be followed by Orthopaedic

consultation, In our study most of injuries were due to acute injury & sports person and recruits, since patient was given appointment for MRI and arthroscopy, mean duration was from 1-4 weeks (54.27%), and however due to loadof patients most of patients were given 2 weeks of appointment for arthroscopy & fewpatient were managed conservatively initially and later advised surgery.

Peleg Ben-Galim, MD et al 2006 [68] The interval between MRI and arthroscopic surgery had to be no longer than 3 months. Soldiers included in our study were those excused from physical activity between MRI and arthroscopy. In our study fewpatients were given time for rest from physical activity, police recruits are given excuse of 3 weeks, patient with partial tear were managed conservatively

Solomon et al 2003 [58] stated "While most meniscal or ligamentous knee injuries heal with non-operative treatments, a subset should be treated with

arthroscopic or open surgery". We believe that our clinical protocol including a second examination after 3 weeks of splinting can reduce the number of unnecessary MRI's or arthroscopic procedures, and should be particularly considered when the patient is not a professional sportsman, or is willing to wait for three weeks. However, in case of a high clinical suspicion of osteochondral damage and/or bony lesion, early MRI, or arthroscopy may be required.

William Rodriguez, Jr 2008 [61] in there study found The mechanism of injury was dashboard type in 35%, fall on a flexed knee (blow to the anterior proximal tibia) withthe foot plantar-flexed in 24%, and hyperextension in 12% of cases. Hyperflexion

injury has been described as a less-common mechanism of PCL injury. Sports-related PCL injuries are significantly more likely to be isolated and more likely to be diagnosed in the acute phase, similarly in our study showed mode of injury due to dash board injury and sports related injury were noted in 3 cases.

In our study patient presented with different age of injuries with mean week/duration of injury 1 to 4 weeks(52%), due to most of injury were due to acute internal derangement of knee, so most of the patients present in acute stage with associated injury. These patients under went clinical examination

and MRI followed by arthroscopy on appointment.

ANTERIOR CRUCIATE LIGAMENT

Monoj k *et al,,* **2014** [46] studied 98% in mid substance and 100% in femoral &tibial attachment out of total cases of 35. Most common sign of ACL Injury in MRI was hyperintensity. A critical review of false positive and false negative findings in MRI showed 1 false positive and 1 false negative case. False positive case had bothprimary and secondary findings. Cause of primary finding was non visualisation of ACL and the causes for the secondary findings is unclear; they may have reflected the physiological ligamentous laxity. In the false negative case that had a partial tear as seen in arthroscopy the MR image showed a linear band of intact fibers normally oriented in expected location of the ACL. Studies have show that MR imaging haslow sensitivity (40- 75%) but moderate to high specificity (62- 94%) in diagnosis of partial tears

Singh et al.2004 [6] Out of 78 patients of ACL tears, 53 patients (67.94%) had mid substance tears, 15 patients (19.23%) had tears at the femoral attachment and 10(12.8%) at the tibial attachment were detected, on MRI. In our study, the most common tear location was at mid-substance. On Arthroscopy, mid

substance tears were seen in 52 patients (66.67%), femoral attachment tears in 15 cases (19.23%) and tibial attachment tears in 11 patients (14.1%) were detected. In there hyper intensity inthe ligament as the most common sign which was seen in 52 patients (66.67%), 16(20.51%) patients showed discontinuity and 10(12.82%) patients showed non visualization of ACL, Our study midsubstance tear of ACL had similar findings.

Laxman Prasad Ahirwar *et al,,* 2013 [66] Out of 100 patients of IDK. Out of 32 ACL tear, 25 (78%) were classified as complete tear and 7 (22%) as partial tear. 11(34.3%) of ACL tears were located in proximal segment, 17 (53.2%) in mid substance and 4 (12.5%) in distal segment of ligament. Arthroscopy was performed in 31 patients. Preoperative MRI reported ACL tear in 14, and 13 patients proven as tear on arthroscopy. 1 was normal on arthroscopy (false positive) and 1 case which were normal on MRI found to be torn on arthroscopy (false negative). MRI abnormal signal intensity was seen within the ligament with intact fibers. Mean while in our study had a similar findings on MRI findings of abnormal hyperintense signal in mid substance partial tear of ACL tear. On arthroscopy had a false negative case.

Anton M Allen M.D et al 2014 [65] **.** Meanwhile ACL ligament showed hyperintense signal in one of cases in midsubatance tear of ACL tear similarly in this study , they studied two manifestation in partial tear (1) an anteriorly angled ACL stump or (2) a heterogeneous variable-signal nodule projecting anteriorly from the ACL. Histologic

evaluation of the nodules has revealed disorganized ACL fibers, fibrosis, inflammation, and hemorrhage, they came to conculsion as MRI adds some value in the evaluation and management of partial tears, and positive MRI findings should not be ignored, even in the setting of a negative Lachman test. In most cases. Partial ACL tears are evolving. Factors favoring conservative treatment include advanced age, a normal or near-normal Lachman result, low athletic demands, and less than 50% involvement of the ACL fibers on arthroscopy. Most young and highly active patients,patients with a clearly abnormal Lachman result, and patients with greater than 50% or posterolateral band involvement on arthroscopy are best treated with ACL reconstruction. Similarly our showed a false negative cases. On discusiion with orthopaedic surgeon we went ahead with arthroscope for further evaluation.

In our study we found hyperintensity as most common in mid substance tear and few cases showed discontinuity of femoral and tibial attachment. Out of total 33 cases, ACL tear was common finding affecting total of 18 cases (54%) with injuries commonly seen in mid substance 10 cases (30.03%), 3 & 5 cases in respective femoral and tibial attachment where detected on MRI and showingone case negative on arthroscopy due to mid substance tears (27.2%). Due to hyperintense signals on partial tear which is corealting to studies.

POSTERIOR CRUCIATE LIGAMENT.

JP singh et al 2014 [6]

The PCL is usually very easily visualized as a homogenous, continuous low- signal structure which is noted on various sequences. In therestudy a total of 10 cases of PCL injury, on arthroscopy correlation were 100% positive predictive value. In our study results are similar to JP Singh et al due to easy visibility of PCL and homogenous structure.

Laxman Prasad Ahirwar *et al,,* 2013 [66] ,Out of 7 PCL tear, 3(42.8%) were classifiedas complete ligament tear, 1 (14.4%) as partial ligament tear and 3(42.8%) tibial avulsion (Fig. 4). Arthroscopy was performed in 31 patients. Preoperative MRI revealed posterior cruciate ligament tears in 2 patients, both of them found torn on arthroscopy. The PPV, NPV, sensitivity, specificity and accuracy in our study for detecting PCL tears were 100%.

Michael R Aiello et al 2015 [60] The sensitivity and specificity of MRI in making the diagnosis of PCL tears is high. Sensitivity has been reported to be as high as 100% & associated injury were about 14%, in our study we

reported sensitivity of 100% whichis similar to this study and no cases were 3 (9.09%) which is less has compared to thisstudy.

William Rodriguez, Jr *et al,,* **2008** [61] in this study PCL usually is injured as a result of a stretching deformation, similarly in our study 2 cases resulted due to fall and one case with dash board injury. Whereby the ligament maintains continuity as a thickened structure, rather than frank rupture. Apparent ligamentous continuity was seen in 62%

of our cases of surgically proven tears. Abnormally increased signal intensity within the PCL on proton-density images is highly suggestive of PCL tear and was seen in all of the patients in this study who had a surgical diagnosis of PCL tear. With use of sagittal T2-weighted images, a 7-mm or greater anteroposterior measurement of the vertical portion of the PCL can be considered evidence of a torn PCL with a high degree of certainty. With above mentioned sequences our diagnosing ability has improved and we measured PCL ligament thickness.

Mensical injury.

Manoj k et al 2014 [46] in there study only grade 3 tears were compared as grade 1 / 2 do not reach upto the articular surface and hence invisible to arthroscopic surface evaluation. Out of 80 patients 23 (28.75%) showed medial meniscal and 11 patients (13.75%) showed lateral meniscal tears on MRI. 18 patients (78.95%) had posterior horn tear and 5 patients (21.05%)

had anterior horn tear of medial meniscus. On arthroscopy posterior horn tears were seen in 17 patients (73.91%), anterior horn tears in 4 patients (17.4%) and middle one third tears in 2 patients. (8.7%). In our study we had similar findings 4 cases with posterior horn tear and 2 cases withanterior horn tear in medial meniscus & Lateral meniscus injury counting to total of 2 cases (6.06%) with each in anterior horn and posterior horn respectively.

Singh et al 2004 [51] In this study detection of Lateral Meniscal tears the sensitivity, specificity and accuracy was 87%, 99.29% and 97.11%. The accuracy of MRI in identifying medial meniscal tear has been reported to range from 72%-98%, with sensitivity of 77%-97.5% and a specificity of 37%-100%.The occurrence of the false positive meniscal tears at MRI imaging has been noted earlier. There are explanations

for this apparent discrepancy between findings at MR Imaging and arthroscopy.

Misinterpretation of normal anatomy like Meniscofemoral ligaments etc.

The presence of intrasubstance tears which are not seen on arthroscopy.

The operator dependence of Arthroscopy. The presence of loose bodies. Out of 57 Medial Menisci tears, there were two false positive (3.51%) and twofalse negative (3.51%) observations. In our study, the 2 false positive MRI involved the posterior horn of the meniscus. The exact cause of the false positives in detection of tears of the posterior horn of the medial meniscus in our study was not apparent. It may be attributed to the presence of intra-meniscal tears not communicating with the

articular surface of the meniscus or misinterpretation of normal anatomy or operator/ procedure dependant drawback of arthroscopy. however this finding is noted in our study due inferior surface injury.

De Smet *et al,,* **2012** [64] How I Diagnose Meniscal Tears on Knee MRI, MRI is a highly accurate imaging method for diagnosing meniscal tears. To avoid errors in diagnosing meniscal tears, those interpreting MR examinations of the knee need to be aware of the attachments of the menisci and the normal variations in meniscal anatomy that may resemble a meniscal tear. In addition, by being aware of the patterns of meniscal tears, it is easier to diagnose the less common tears. In my recent experience, a definitive diagnosis of an intact or a torn meniscus can be made in 95% of knee MR examinations. In the remaining 5% of patients, it is not possible to be definitive but a diagnosis of a possible tear or a probable lateral posterior root tear or adifferential diagnosis of meniscal fraying or tear should be given. In our study grade I tear were diagnosed were diagnosed.

Out of total 9 cases (25%) meniscal injury were detected, In our study showed medial meniscus were more common than lateral meniscus. We found 4 cases with posterior horn tear and 2 cases with anterior horn tear in medial meniscus. Grade III tear were common with total of 3 cases(9.09%).Out of 6 cases showed 5 horizontal tears and 1 radial tears were detected. Grade I tear could not be identified by arthroscope due to inferior surface tear of meniscus could not be visualized by arthroscope due to

limited field of vision. Lateral meniscus injury counting to total of 2 cases (6.06%) with each in anterior horn and posterior horn respectively. Grade II &III injury in meniscus respectively. Radial tears were detected in

LM injury in both cases.

Osseous osteochondral lesions.

In our study Osseous/Osteochondral lesions were seen in 11 patients (33 %). Most of these were bony contusions involving the femoral and tibial condyles. Osteochondral lesions are seen in nine patients. In our study we found a case of Comminuted bicondylar fracture of proximal end of Tibia with intra-articular and intracondylar extension. There is also fracture of medial tibial condyle in 4 cases anterolateral. A case of Segond fracture of the lateral tibial rim with bony contusionof the lateral femoral condyle was also seen. These findings were correlated with findings described by Thomas H. Berquist . The finding of hemarthrosis and lipohemoarthrosis was associated in two cases with presence of intercondylar fractures. These findings were correlated with findings described by **Thomas H.Berquist** [42]

In our study, a correlation of MRI findings with arthroscopic / surgical findings was performed in 11 patients (33 %). Among which in 09 patients (84%) MRI findings are well correlated with arthroscopic / surgical findings with 95% Confidence interval. Correlation between MRI and arthroscopic /surgical findings are statistically significant with 95% CI (70.04-95.83%)

Bekir Yavuz Uçar *et al,,* **2012** [59] Determining Bone Bruises of the Knee with Magnetic Resonance Imaging

Type I lesions showed a signal intensity loss that was primarily located within the medullar cavity of the bone, without cortical interruption.

A Type II lesion was defined as a loss of signal intensity associated with interruptions in the black cortical line; such an abnormality was defined in the present study as a fracture combined withbone bruise. On short TE images, a type III lesion was defined as a loss of signal intensity without definite cortical interruption in the bone regions adjacent to the cortex.

They reported that MR imaging performed before arthroscopy of the knee reduced costs. In there study, positive results were obtained *via* MR images of the patients in whom radiographs showed no pathological findings, and these patients were classified as Type I, based on the arthroscopic findings. Therefore, it can be assumed that using MR imaging in acute minor knee traumas might prevent unnecessary diagnostic arthroscopy.

However in our study there were cases reposted with bone contusion, howeverwe went ahead with surgery, there associated injuries.

Arthroscopy and MRI findings

In our study MRI finding were very well correlated, however in few cases such as mid-substance tear of ACL (grade I) could be correlated because of hyperintensity on PD/T2WI sequences appeared to be grade I (tear), On arthroscopy it was false negative.

Mensical injury showed grade I showed inferior surface of meniscus and arthroscope these finding could not be correlated, However MRI were well correlatedwith arthroscopy. In the past, a thorough clinical examination was the primary method used to identify ligamentous injuries to the knee

because radiographs by themselves were unable to do so. Even in the hands of skilled practitioners, clinical examination alone yielded incorrect diagnosis rates between 40% and 85%, particularly for meniscal lesions. 3,4. Interobserver differences can also occur during a clinical evaluation. The effectiveness of combining clinical examination and diagnostic arthroscopy in the identification of meniscal and ACL injuries was then the subject of numerous investigations. When arthroscopy was used as a diagnostic procedure on patients with acute traumatic hemarthrosis, DeHaven et al. reported a relatively high incidence of ACL tears and meniscal injuries9. When Johnson LL et al. compared diagnostic arthroscopy to clinical examination, they discovered a considerable number of additional diagnoses, some of which were previously unknown. With respect to 396 knee arthroscopies, Curran et al. discovered that the overall clinical accuracy rate was just 71%. Their accuracy rates for diagnostic arthroscopy rose to 97%11. Today, the main investigative technique is MRI of the knee, which has developed into a trustworthy tool for identifying knee problems. It is non-invasive and enables the examination of all the soft tissues as well as the articular cartilage and bone structures. More than 90% of MRI diagnoses of ligamentous injuries are sensitive and specific. 7, 8.

According to a review of the literature, there is a good link between ACL injuries that are first examined clinically and subsequently by MRI and arthroscopy. However, there is less of a correlation between clinical examination, MRI, and arthroscopy when evaluating meniscal injuries that

are clinically suspected. Rayan12 et al performed a similar study on 131 patients. They discovered that when clinical examination and an arthroscopic discovery of a medial meniscal tear were correlated, the accuracy, sensitivity, specificity, positive predictive value, and negative predictive value were all 79%, 86%, 73%, and 83% respectively. The accuracy, sensitivity, specificity, positive predictive value, and negative predictive value of the clinical examination with MRI and arthroscopy for ACL rupture were substantially higher at 93%, 77%, 100%, and 95%, respectively.

Comparable research conducted by other authors, such as Navaliet al.13, Nikolaou et al.14, and Loo WH et al.15, has produced similar findings when connecting with MRI and arthroscopy in the diagnosis of ligamentous knee injuries. The present study attempts to determine the role of magnetic resonance imaging in the evaluation of internal derangements of the knee joint. Knee joint being the largest and most complex weight bearing joint of the body is subject to damage because of its inherent structural complexity and the various types forces it is subjected to.

Magnetic resonance imaging has emerged as the frontline investigation for evaluation of internal derangements of the knee joint. It is noninvasive, does not involve ionizing radiation and has multiplanar capability with excellent soft tissue demonstration. Arthroscopy gives excellent visualization of the interior of the joint, but is invasive and can evaluate only the surface

abnormalities.

In the present study, 32 patients with knee joint symptoms, referred formagnetic resonance imaging of the knee joint were evaluated. Most common presenting symptoms were knee joint pain either acute or longstanding and swelling. The most common age group to be involved was between 30-40 years. Thefollowing patterns of knee injuries were seen:

1. Most common injury was ACL tear of which complete tears were morecommon. Posterior cruciate ligament tears were less common.

2. Among the Meniscal injuries medial Meniscal tears are more common thanlateral meniscus and grade 3 tears are more common in both.

3. Osseous/Osteochondral lesions were seen in 11 patients (33%). Most of these were bony contusions involving the femoral and tibial condyles.

The ligamentous & meniscal and associated injuries are of increased severity compared to the available literature that can be attributable to the severity of RTA andinjuries involved in young individuals.

Our study's MRI accuracy for the medial meniscus was lower than that of other research but a smaller margin. This can be explained by the fact that arthroscopy revealed an osteochondral defect in a large number of our instances where testing for a medial meniscus were positive. All of the study participants had their MRIs evaluated in a 1.5 Tesla machine without the use

of any particular imaging sequences for articular cartilage. Therefore, the MRI picture missed these flaws. Our study's findings are comparable to those of earlier research looking at ACL and lateral meniscal injuries. As a result, a patient who has been clinically determined to have either an ACL injury or lateral meniscal injury can be advised for definitive care of these injuries with a greater degree of assurance, relying just on clinical evaluation. Pre-operative MRI scans are now routinely performed prior to putting a patient under anaesthesia.

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CONCLUSION

MRI is non invasive and reliable investigation for ligament pathologies, which helps in diagnosis of meniscal and ligament injuries, which helps in proper management by planning treatment. However arthroscopy still remains gold standard for diagnosis and treatment at same time.

We would like to arrive at these conclusions from our study

1) MRI to detect ACL and lateral meniscal injuries have a high degree of correlation when compared with arthroscopy.

2) MRI to detect medial meniscal tears have a low degree of correlation when compared with arthroscopy.

3) MRI done to detect medial meniscal injuries can be false positive for Osteochondral defects of the medial compartment of the knee.

4) When treating medial meniscal tears, the surgeon should be prepared to treat unsuspected Osteochondral defects found at arthroscopy, especially when a sub-optimal MRI has been done.

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<u>ANNEXURE I</u>

Table 14 Demographic details

MR No.	Name	OPD/ Inpatient	Age	Sex	Unit	Date

1. Clinical Parameters.

   a) Mechanism of injury:

   b) Duration of injury:

   c) Clinical findings:

2. Investigation Results

MRI Findings

a) Joint effusion: Present/Absent

b) Anterior Cruciate Ligament tear: Present/Absent,

Partial/Complete

c) Posterior Cruciate Ligament tear: Present/Absent,

Partial/Complete

d) Medial Collateral Ligament tear : Present/Absent

Grade- 1/2/3

e) Lateral Collateral Ligament tear: Present/Absent

Grade- 1/2/3

f) Medial Meniscal Tear : Present/Absent

Location & Type

g) Lateral Meniscal Tear: Present/Absent

Location & Type

h) Osseous / Osteochondral lesions: Present/Absent

Location & Type

Final MRI Diagnosis.

Arthroscopic findings.

ANNEXURE - 2
CONSENT FORM

B.L.D.E.U'S SHRI B.M.PATIL MEDICAL COLLEGE HOSPITAL AND

RESEARCH CENTER, BIJAPUR-586103

<u>RESEARCH INFORMED CONSENT FORM</u>

TITLE OF THE PROJECT: "STUDY THE DIAGNOSTIC ACCURACY OF MRI VERSUS ARTHROSCOPY IN KNEE INJURIES "

PRINCIPAL INVESTIGATOR: Dr.SYED MOHAMAD FAIZAN RAZVI.MBBS
POST GRADUATE
DEPARTMENT OF ORTHOPAEDICS
Email: fizansyed@gmail.com

P.G.GUIDE: **Dr. ASHOK. R. NAYAK** MS
PROF. AND UNIT CHIEF
DEPARTMENT OF ORTHOPAEDICS

PURPOSE OF RESEARCH:

I have been informed that this study is "STUDY THE DIAGNOSTIC ACCURACY OF MRI VERSUS ARTHROSCOPY IN KNEE INJURIES".

I have been explained about the reason for doing this study and selecting me/my ward as a subject for this study. I have also been given free choice for either being included or not in the study.

PROCEDURE:

I/my ward have been explained that, I/my ward will be subjected to MRI scan and arthroscopy.

RISKS AND DISCOMFORTS:

I/my ward understand that necessary measures will be taken to reduce these complications as and when they arise.

BENEFITS:

I/my ward understand that my participation in this study will help to MRI kneewith arthroscopy.

CONFIDENTIALITY:

I/my ward understand that medical information produced by this study will become a part of this Hospital records and will be subjected to the confidentiality and privacy regulation of this hospital. Information of a sensitive, personal nature will not be a part of the medical records, but will be stored in the investigator's research file and identified only by a code number. The code key connecting name to numbers willbe kept in a separate secure location.

If the data are used for publication in the medical literature or for teaching purpose, no names will be used and other identifiers such as photographs and audio or video tapes will be used only with my special written permission. I understand that I may see the photograph and videotapes and hear audiotapes before giving this permission.

REQUEST FOR MORE INFORMATION:

I understand that I may ask more questions about the study at any time. Dr. Naveen S is available to answer my questions or concerns. I/my ward understand that I will be

informed of any significant new findings discovered during the course of this study, which might influence my continued participation.

If during this study, or later, I wish to discuss my participation in or concerns regarding this study with a person not directly involved, I am aware that the social worker of the hospital is available to talk with me and that a copy of this consent form will be given to me for careful reading.

REFUSAL OR WITHDRAWAL OF PARTICIPATION:

I/my ward understand that my participation is voluntary and I may refuse to participate or may withdraw consent and discontinue participation in the study at any time without prejudice to my present or future care at this hospital.

I/my ward also understand that Dr. will terminate my participation in this study at any time after he has explained the reasons for doing so and has helped arrange for my continued care by my own physician or therapist, if this is appropriate.

INJURY STATEMENT:

I understand that in the unlikely event of injury to me/my ward, resulting directly to my participation in this study, if such injury were reported promptly, then medical treatment would be available to me, but no further compensation will be provided.

I understand that by my agreement to participate in this study, I am not waiving any of my legal rights.

I have explained to_____the

purpose of this research, the procedures required and the possible risks and benefits, to

the best of my ability in patient's own language.

Date: Dr. ASHOK. R. NAYAK   Dr. SYED MOHAMAD FAIZAN
                                                                        RAZVI

                 (Guide)   (Investigator)

ANNEXURE - 3

STUDY SUBJECT CONSENT STATEMENT:

I/my ward confirm that Dr. SYED MOHAMAD FAIZAN. has explained to me the purpose of this research, the study procedure that I will undergo and the possible discomforts and benefits that I may experience, in my own language.

I/my ward have been explained all the above in detail in my own language and I understand the same. Therefore I agree to give my consent to participate as a subject in this research project.

_____   _____

(Participant)   Date

_____   _____

(Witness to above signature)   Date

ANNEXURE - 4

CASES

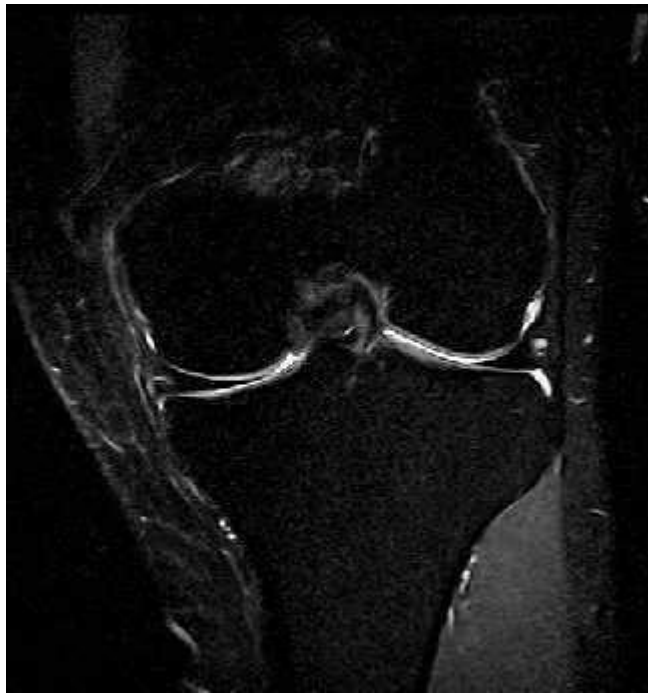History and presentation a 32 year old male presented with knee pain.

Arthroscopy shows mid substance tear.

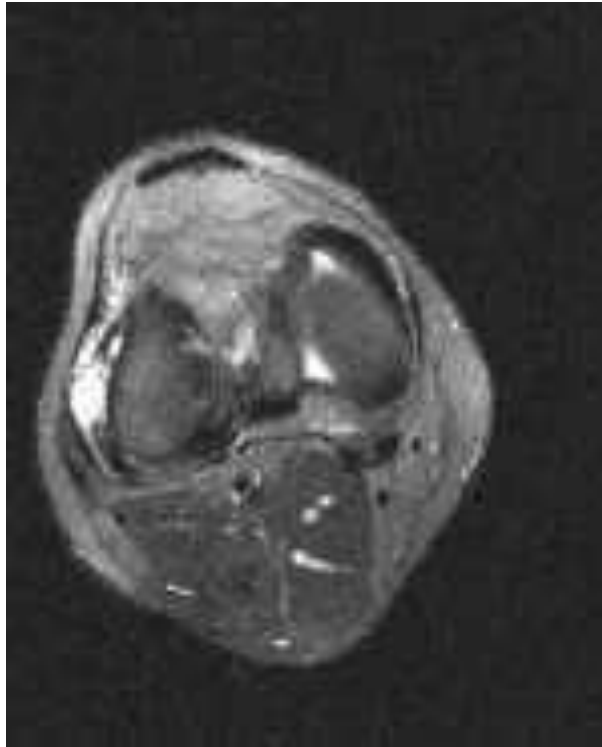MRI on PD sequences shows altered signal changes in ACL.

Arthroscopy shows meniscal tear on lateral meniscus.

PD/T1WI shows horizontal tear on lateral meniscus.

MRI on axial/saggital section on PD/T2WI sequence shows small cystic lesion lateral meniscus.

Arthroscopy shows small cystic lesion lateral meniscus.

ANNEXURE 5

IEC/no-09/2021
Date-22/01/2021

B.L.D.E. (DEEMED TO BE UNIVERSITY)
(Declared vide notification No. F.9-37/2007-U.3 (A) Dated. 29-2-2008 of the MHRD, Government of India under Section 3 of the UGC Act, 1956)
The Constituent College
SHRI. B. M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE
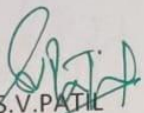
INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Institutional ethical committee of this college met on 11-01-2021 at 11 am to scrutinize the synopsis of Postgraduate students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected and revised version synopsis of the Thesis has been accorded Ethical Clearance

Title: To study the diagnostic accuracy of MRI versus arthroscopy in knee injuries

Name of PG student: Dr Syed Mohamad Faizan Razvi, Department of Orthopaedics

Name of Guide/Co-investigator: Dr Ashok Nayak, Professor & HOD of Orthopaedics

DR .S.V.PATIL
CHAIRMAN, IEC
Institutional Ethical Committee
B L D E (Deemed to be University)
Shri B.M. Patil Medical College,
VIJAYAPUR-586103 (Karnataka)

Following documents were placed before Ethical Committee for Scrutinization:

1. Copy of Synopsis / Research project
2. Copy of informed consent form
3. Any other relevant documents.

5

ANNEXURE - 6 MASTER CHART

Sl No	Age	sex	Mode of injury	Presenting symptom	Duration of injury	Joint effusion	ACL tear	ACL	PCL tear	PCL	MM tear	MM	LM tear	LM	Oseous /osteochondral lesions	Final diagnosis	Arthroscope	ACL	PCL	MM	LM
1	46	F	RTA	Knee pain and swelling	1	Yes	Grade 2	Yes	No	No	grade 3	Yes	No	No	No	Grade 2 ACL tear with Grade 3 tear of medial meniscus and popliteal cyst.	grade 3 MM tear	No	No	Yes	No
2	27	M	Selffall	knee pain and instability	2	No	Grade 2	Yes	No	No	No	No	No	No	Yes	Grade 2 ACL tear	grade 2 ACL tear	Yes	No	No	No
3	29	F	RTA	Swelling, locking and instability	3	Yes	Grade 2	Yes	No	No	No	No	No	No	No	Grade 2 ACL Tear	grade 2 ACL tear with grade 2 MM tear	Yes	No	Yes	No
4	32	M	Sports injury	Knee pain and swelling	2	No	Grade 2	Yes	No	No	No	No	No	No	No	Grade 2 of ACL	grade 2 ACL tear	Yes	No	Yes	No
5	54	F	Others	Knee pain	5	Yes	No	No	No	No	No	No	Grade 3	Yes	No	Grade 3 LM tear	grade 2 medial meniscus tear	No	No	No	Yes
6	33	M	Selffall	Knee pain	2	Yes	Grade 2	Yes	No	No	No	No	grade 3	Yes	No	Grade 2 tear, grade 3 Lateral meniscus tear	grade 2 ACL tear with grade 3 LM tear	Yes	No	No	Yes
7	29	F	Others	Knee pain	3	Yes	Grade 2	Yes	No	No	grade 3	Yes	No	No	No	Grade 2 ACL with grade 3 MM tear	grade 2 ACL tear with grade 3 MM tear	Yes	No	Yes	No
8	24	M	Sports injury	Knee pain	1	Yes	Grade 3	Yes	No	No	grade 2	Yes	No	No	Yes	grade 3 tear of ACL,Grade 2 tear MM with bony contusions.	grade 3 ACL tear	Yes	No	No	No
9	39	M	RTA	knee pain and instability	10	Yes	Grade 3	Yes	No	No	No	No	No	No	Yes	Grade 3 tear of ACL with bony contusions.	grade 3 ACL tear	Yes	No	No	No
10	31	F	Others	Knee pain	2	No	Grade 3	Yes	No	No	No	No	No	No	No	grade 3 ACL tear	grade 3 ACL tear	Yes	No	No	No
11	26	M	Selffall	Instability	1	No	Grade 3	Yes	No	No	No	No	No	No	Yes	grade 3 ACL tear	grade 3 ACL tear with mm tear	Yes	No	Yes	No
12	20	F	Others	Knee pain	2	Yes	Grade 3	Yes	No	No	No	No	No	No	Yes	Grade 3 tear of ACL with bony contusions.	grade 3 ACL tear	Yes	No	No	No

ANNNEXURE

No	Age	Sex	Cause	Symptom												MRI Finding	Diagnosis				
13	31	M	Sports injury	knee pain and instability	3	Yes	Grade 3	Yes	No	No	No	No	No	No	No	Grade 3 ACL tear its femoral attachment	grade 3 ACL tear	Yes	No	No	No
14	30	M	RTA	Knee pain and locking	3	Yes	No	No	No	No	No	No	No	No	Yes	Grade 2 MM with parameniscal cyst with contusion of medial femoral condyle	Grade 2 ACL tear with Grade 2 MM tear	Yes	No	Yes	No
15	32	F	Sports injury	Knee pain and locking	1	Yes	No	No	No	No	grade 3	Yes	No	No	No	Grade 3 MM	Grade 3 MM tear	No	No	Yes	No
16	43	M	Others	Knee pain	2	No	Grade 2	Yes	No	No	grade 3	Yes	No	No	Yes	Grade 2 ACL, Grade 3 tear of medial meniscus & bony contusions.	Grade 2 ACL with no MM tear	Yes	No	Yes	No
17	52	F	Selffall	Knee pain and swelling	1	No	No	No	No	No	No	No	grade 1	Yes	Yes	Grade 1 LM tear with grade II osteochondral fracture lateral condyle of tibia.	Grade 2 LM tear	No	No	No	Yes
18	35	M	Sports injury	Knee pain	1	No	Grade 3	Yes	No	No	grade 3	Yes	No	No	No	Grade 3 ACL and grade 3 tears of MM	Grade 3 ACL tear with associated MM tear	Yes	No	Yes	No
19	32	M	Sports injury	Knee pain	3	No	Grade 2	Yes	No	No	No	No	No	No	No	Grade 2 Partial tear of ACL	Grade 2 ACL tear	Yes	No	No	No
20	23	F	RTA	Knee pain and swelling	2	Yes	No	No	No	No	No	No	grade 2	Yes	No	Grade 2 LM tear with joint effusion.	Grade 2 LM tear with Grade 2 MM Tear	No	No	Yes	Yes
21	28	M	Sports injury	Knee pain	2	No	Grade 2	Yes	No	No	No	No	No	No	No	Grade 2 tear of LCL with partial tear of ACL Tear.	grade 2 ACL tear with Grade 3 LCL tear	Yes	No	No	No
22	34	M	Selffall	Knee pain	1	Yes	Grade 3	Yes	grade 3	Yes	No	No	grade 2	Yes	No	Grade 3 ACL and PCL tear with Grade 2 LCL and Grade 2 MM tear with joint effision	Grade 3 ACL and PCL tear with Grade 2 LCL and Grade 2 MM and LM tear	Yes	Yes	Yes	Yes
23	32	F	Sports injury	Knee pain and swelling	3	Yes	No	No	No	No	grade 3	Yes	No	No	No	Grade 3 MM tear with joint effusion	Grade 3 MM tear	No	No	Yes	No
24	45	M	Others	Knee pain	2	Yes	Grade 2	Yes	No	No	No	No	No	No	No	joint effusion with Grade 2 tear ofACL.	Grade 3 ACL tear	Yes	No	No	No
25	42	M	Sports injury	Knee pain	3	No	Grade 2	Yes	No	No	Partial	Yes	No	No	No	Grade 2 tear of ACL with Grade 2 of medial meniscus	Grade 3 ACL with Grade 2 tear of MM	Yes	No	Yes	No
26	40	F	RTA	Knee pain	1	No	No	No	No	No	No	No	No	No	No	Grade 2 partial tear of ACL Tear.	Grade 3 ACL tear	Yes	No	No	No

ANNNEXURE

27	36	M	Others	Instability	3	Yes	Grade 2	Yes	No	No	No	No	No	No	No	partial tear of ACL	grade 2 ACL tear	Yes	No	No	No
28	32	F	Sports injury	Knee pain	1	No	No	No	No	No	grade 2	Yes	grade 2	No	No	Grade 2 MM and LM	Grade 2 MM and LM tear	No	No	Yes	Yes
29	52	M	Others	Knee pain	2	Yes	No	No	No	No	No	No	Grade 2	Yes	No	Joint effusion with Grade 2 LM tear	Grade 2 LM with Synovitis	No	No	No	Yes
30	26	M	RTA	Knee pain	3	Yes	Grade 3	Yes	No	No	No	No	Grade 2	Yes	Yes	Grade 3 ACL with Joint effusion with Grade 2 LCL with contusions of medial condyle with Grade 2 LM	Grade 3 ACL with Grade 2 tear of LCL with LM	Yes	No	No	Yes
31	38	M	Sports injury	knee pain and instability	2	Yes	Grade 2	Yes	No	No	No	No	No	No	Yes	Joint effusion with Partial Grade 2 ACL tear with medial condyle contusions	Grade 3 ACL tear	Yes	No	No	No
32	39	F	Selffall	Knee pain and swelling	3	Yes	Grade 3	Yes	No	No	No	No	No	No	parameniscal cyst	Joint effusions with Grade 3 ACL tear and paramensical cyst.	Grade 3 ACL tear	Yes	No	No	No