COMPARISON OF CLINICAL, MAGNETIC RESONANCE IMAGING (MRI) AND ARTHROSCOPIC FINDINGS IN ASSESSMENT OF CARTILAGE DEFECTS AND INTERNAL DERANGEMENT OF KNEE

By

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In partial fulfilment of the requirements for the degree of

MASTER OF SURGERY
IN
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Under the Guidance of

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I hereby declare that this dissertation titled **"COMPARISON OF CLINICAL, MAGNETIC RESONANCE IMAGING (MRI) AND ARTHROSCOPIC FINDINGS IN ASSESSMENT OF CARTILAGE DEFECTS AND INTERNAL DERANGEMENT OF KNEE"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. ARUN H.S ,** Professor and HOD, Department of Orthopaedics, Sri Devaraj Urs Medical College, Kolar, in partial fulfilment of University regulation for the award "M.S. DEGREE IN ORTHOPAEDICS", the examination to be held in April/May 2022 by SDUAHER. This has not been submitted by me previously for the award of any degree or diploma from the university or any other university.

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GLOSSARY	ABBREVIATIONS
MRI	**Magnetic Resonance Imaging**
ACL	**Anterior Cruciate Ligament**
PCL	**Posterior Cruciate Ligament**
LCL	**Lateral Collateral Ligament**
MCL	**Medial Collateral Ligament**
PLC	**Postero-Lateral Corner**
MM	**Medial meniscus**
LM	**Lateral meniscus**
PPV	**Positive Predictive Value**
NPV	**Negative Predictive Value**
RTA	**Road Traffic Accident**

ABSTRACT

Background: Knee is the most commonly injured joint because of its anatomical structure, its exposure to external forces, and its functional demands. Ligament injuries are among common injuries occurring in knee due to contact sporting events. Although arthroscopy is considered gold standard for diagnosing ligament injuries and cartilage defects, magnetic resonance imaging (MRI) is considered non-invasive investigation of choice in diagnosing them. There have been literature studies comparing magnetic resonance imaging findings with that of arthroscopy. Orthopaedic surgeons previously relied on clinical evaluation for diagnosing any internal derangement of knee joint. With advent of new clinical methods for diagnosing ligament injuries and cartilage defects, there are very less studies comparing accuracy of all three methods, clinical examination, magnetic resonance imaging and arthroscopy to reach a definitive diagnosis. This study aims to compare the sensitivity, specificity, accuracy and predictive values of clinical examination and magnetic resonance imaging with that of arthroscopy which is the gold standard investigation of choice for cartilage defects and internal derangement of knee.

Material and Methods: A prospective, observational and hospital-based study conducted in Kolar, on patients with internal derangement of knee and cartilage defects. Clinical examination, magnetic resonance imaging and arthroscopy were done on all patients, the findings of which were compared using Chi square test. Accuracy, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were evaluated considering arthroscopy as standard of reference.

Results: Anterior cruciate ligament (ACL) was most common ligament to be injured followed by the medial meniscus. Overall accuracy of clinical evaluation and magnetic resonance imaging to diagnose meniscal injuries was found to be 94% and 91% respectively. Clinical examination had sensitivity and specificity of 96% and 82% in diagnosing anterior cruciate ligament tears, respectively, whereas magnetic resonance imaging had sensitivity and specificity of 88% and 76% respectively. For medial meniscus, clinical examination had sensitivity and specificity of 93% and 96% respectively whereas magnetic resonance imaging had sensitivity of 100% and specificity of 89%. We observed that accuracy of magnetic resonance imaging for grading anterior cruciate ligament and meniscal tears was similar i.e. 79% and 78% respectively, but was slightly low (70%) for grading of chondromalacia patellae.

Conclusion: The study supports both clinical evaluation and MRI in diagnosing internal derangement of knee and chondral defects. Clinical tests are reliable and have high sensitivity in diagnosing ACL tears and chondral defects when compared to MRI. The routine use of MRI for confirmation of diagnosis is not indicated for all lesions and should be done only for select cases. MRI is less reliable in grading anterior cruciate ligament tears, meniscal tears and chondral injuries.

Keywords: Knee, comparison, anterior cruciate ligament, clinical evaluation, magnetic resonance imaging, arthroscopy, meniscus

INTRODUCTION

INTRODUCTION

Knee is the most commonly injured joint because of its anatomical structure, its exposure to external forces, and its functional demands.(1–3) Ligament injuries are among common injuries occurring in knee due to contact sporting events like football, hockey, kabbadi, however RTAs and occupational injuries also accounted.

The anterior cruciate ligament (ACL) is most frequently injured ligament among others which results in knee pain and instability.(4,5) Tears of meniscus may be associated with trauma or may be chronic as a result of instability caused by ACL injuries. Long standing anterior cruciate ligament injuries accompany meniscal and cartilage lesions in knee joint.(6)

The correct preoperative diagnosis of internal derangement of knee may be difficult sometimes, even for experienced surgeons, therefore, meniscal, ligament injuries and cartilage defects can be misdiagnosed.

Clinical evaluation of knee helps in assessment of the extent of knee damage, but the advent of magnetic resonance imaging (MRI) helps in more accurate assessment of soft tissue and cartilage lesions of knee. MRI established itself as fast and non-invasive imaging alternative complementing physical examination in assessment of knee injuries. Yet, clinical findings and MRI interpretation for intra-articular knee injury can be difficult, especially in patients having acute ACL injury due to presence of hemarthrosis, pain and decreased range of motion with decreased diagnostic accuracy.

MRI is currently the non-invasive investigation of choice in planning management of meniscal and ligament injuries.

There is some debate over correlation of MRI and medical review with knee joint arthroscopy results.[7,8] According to literature reports, accuracy of clinical examination of knee, to diagnose meniscal injury is about 64-85 % and is about 90–100 % for ACL injury.[9]

MRI helps in assessing occult bone contusion and soft tissue trauma like ligament and meniscal tears.[10] MRI correctly detects meniscal tears in 85 % of cases and ACL injuries in 90–100 % of cases[11,12] but the diagnostic accuracy is related to sensitivity of scanner.[13,14]

Present study was an attempt to compare effectiveness of clinical assessment, MRI results and arthroscopy findings in knee injuries and latter considered as gold standard.

NEED FOR STUDY

Knee is a frequently injured joint. Its structure and functional demands make it the most stressed joint in human body.

Ligament injuries are most common injuries occurring around knee mainly during sports events like cricket, football, basketball, kabbadi but road traffic accidents (RTA) and occupational injuries are also held accountable.

Most acute knee traumas result from a twisting strain. Most commonly they involve medial joint structures and ACL. Meniscal injuries occur when substantial rotational forces are applied to flexed knee.

Most commonly injured ligament is ACL causing knee pain along with instability.

As there is scarcity of literature comparing specificity and sensitivity of clinical evaluation, magnetic resonance imaging, arthroscopic examination for knee injuries and cartilage defects, this study is conducted.

AIMS & OBJECTIVES

OBJECTIVES OF THE STUDY

1. To document the clinical, MRI and arthroscopic findings in knee injuries.
2. To correlate the findings of clinical examination, MRI and arthroscopy.
3. To evaluate the sensitivity and specificity of the above three mentioned diagnostic procedures.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

It has been observed that in spite of considerable incidence of injury and joint disease, there is scarcity of information concerning specific pattern of injury. That information will enable prevention, appropriate diagnosis and management of knee injuries, especially those caused during sporting activities.(4)

Need of MRI for assessing knee injuries is questioned as it is costly and its presumed reliability of clinical examination. With the advent of imaging and its usage for diagnosing ailments, the MRI requests have dramatically increased with time followed by number of knee arthroscopies.(12,15,16)

Need to repair torn ACL injuries has increased over time. ACL injuries frequently accompany meniscal tears. It can lead to chronic knee pain, early onset osteoarthritis, chronic instability of the knee, frequent falls and partial meniscal tears can lead to complete tears if left untreated.

In 1989, Barronian et al conducted a study on 23 patients with correlating MRI and arthroscopy findings. It was concluded that MRI accuracy for meniscal tears was 78%, with sensitivity 88% and specificity 72%. Also, MRI was 82% accurate, with sensitivity 67% and specificity 86% for anterior cruciate ligament. They concluded by stating that MRI should be done only in select cases.(17)

Kelly et al conducted a retrospective study of 60 patients in 1991, who underwent MRI before arthroscopy was undertaken. They found that for medial meniscal tears, MR imaging sensitivity was 97% whereas its specificity was 77%. For lateral meniscal tears, MR imaging was 90% sensitive and 87% specific. Positive predictive value of MR imaging was 85% to medial meniscal injuries and only 79% to lateral meniscal injuries. Negative predictive value of 95% to medial meniscus and 94% to lateral meniscus were documented. They also observed that MR imaging had an accuracy of 93% in assessing anterior cruciate ligament pathology and that clinical examination has high negative predictive value when compared to MRI for diagnosing meniscal and ACL tears. They observed that MRI is helpful diagnostic method. They concluded that it must be used selectively in association with clinical evaluation of knee injuries.(18)

Runkel et al in 2000 observed that MRI had sensitivity of 98%, specificity of 96%, an accuracy of 94%, and positive and negative value of prediction were 97% each for medial meniscus injuries. Regarding lateral meniscus, 85% sensitivity, 98% specificity, 92% accuracy, 88% positive predictive value and 85% negative predictive value were found. The authors concluded that if MRI was reported by an experienced radiologist, the number of arthroscopies could be reduced.(19)

Along with increased imaging in diagnosing ailments, MRI requests have dramatically increased with time followed by number in knee arthroscopies.

In the year 2001, Kocabey et al conducted a study in Turkey, and observed that MRI had no real advantages compared to clinical evaluation in managing meniscal and ACL injuries before arthroscopy. They recommended that MRI must be reserved for confusing cases only, also that well-trained orthopaedician may safely depend on clinical evaluation to diagnose meniscus and ACL tears.(12)

MRI has reduced diagnostic accuracy to evaluate intra-articular knee injury in patients of acute injury associated with hemarthrosis. This is attributed to paramagnetic properties of blood, also catabolic processes which occurs in chondral and meniscus cells while haemolysis.(9)

Authors have observed sensitivity of MRI is reduced for meniscus tears in presence of ACL injury irrespective of duration of injury.[20,21]

Diagnosis of ACL tear by means of MRI is difficult due to various tear patterns seen in the injury. Various types of partial tears show features on MRI which make them difficult to differentiate from a complete ACL tear, a mucoid ACL or even a normal ACL. Furthermore, the detection rates of an isolated ACL bundle tear are low on MRI.[22]

A retrospective study of 130 patients, conducted in 2003 by Mohan et al, the authors observed 88 % diagnostic accuracy of clinical examination for medial meniscal tears and 92% for lateral meniscal tears. They observed that clinical diagnosis is as dependable as MRI for meniscal injuries.[23]

Some authors have observed MRI to be essential in diagnosing causes of knee ligament injuries and have proposed that MRI should be done in all cases before arthroscopy.[24,25]

A study conducted by Ercin et al in 2012, the authors observed that MRI had 95% sensitivity and 60% specificity for medial meniscal tears, whereas 67% sensitivity and 88% specificity for lateral meniscal tears. They also observed that clinical examination had an accuracy of 80% and 93% to lateral and medial meniscus tears respectively. The authors reported that clinical examination provides sufficient information and performing MRI as a routine diagnostic support is unnecessary.[26]

Nam et al in 2014, observed that the diagnostic MRI sensitivity in ACL injury patients was significantly lower than that in the ACL-intact group for MM and LM injury. Negative predictive value was also lower in the group with ACL injury for both the MM and LM. The authors concluded, MRI has lesser diagnostic accuracy to detect meniscal tears in acute ACL rupture patients.[27]

In 2015, Dufka et al concluded that pre-operative MRI has moderate sensitivity and specificity for detecting meniscal tears which require operative treatment in patients with ACL injury. They observed high rates of false diagnoses with MRI. The authors recommended considering knee MRI in three scenarios that is for defining return to sport of professional athletes, to detail differential diagnosis and for defining location, size of meniscal tears. Yet, it is still considered to be diagnostic procedure of choice before knee arthroscopy.[11]

R John et al, in an observational study done at northern India, 2016 observed that anterior cruciate ligament is most commonly injured ligament in sports related traumas and accounts for 86.5% of ligament injuries. Meniscal injury accounted for 78.24% of ligament injuries. Medial meniscus was most commonly injured (53.72%) when compared to lateral meniscus (24.52%). MCL injury was observed in 25.62% and LCL injuries in 11%. PCL injury was the least observed injury accounting for 2.76% of ligament injuries. ACL injury with medial meniscus tear was seen in 45.2% of the study population.[28]

The clinical tests and arthroscopic cartilage findings have been noted to have poor correlation with each other as described by a study conducted by Royle et al.[29] In agreement with the above, Yoon et al, in a study found sensitivity of clinical tests for chondromalcia to be 50%, specificity of 100% and an accuracy of 99%, but the authors did not list the clinical tests that were used. Their worth in diagnostic screening of patellar chondromalacia is questionable.[30]

Neither MRI nor arthroscopy can guarantee complete detection of all knee pathologies, and MRI findings are not always consistent with arthroscopic findings. In few previous retrospective studies, it was observed that many patients who underwent MRI for knee injury, did not have the pathology identified on arthroscopic examination.[31]

ANATOMY

The knee is the largest synovial joint in the body. It consists of three functional compartments that collectively form a dynamic, specialized hinge joint. During propulsion, the knee is able to withstand impressive weight-bearing loads while conducting precision movements, providing a stable yet fluid mechanism for relatively efficient bipedal locomotion.(1)

Knee joint has two articulations – patello-femoral and tibio-femoral. Surfaces of joint are lined with hyaline cartilage, and they are accommodated within a single joint cavity.

PATELLO-FEMORAL JOINT:

Articulating surfaces - Articular surface of the patella is adapted to that of the femur. The latter extends on to the anterior surfaces of both femoral condyles like an inverted U. Since the whole area is concave transversely and convex in the sagittal plane, it is an asymmetrical sellar surface.

In full extension, only the lowest patellar facets are in contact with femur. On flexion, the patello-femoral contact point moves proximally and the contact area broadens to cope with the increasing stress that accompanies progressive knee flexion.(1) (Figure 1 and 2)

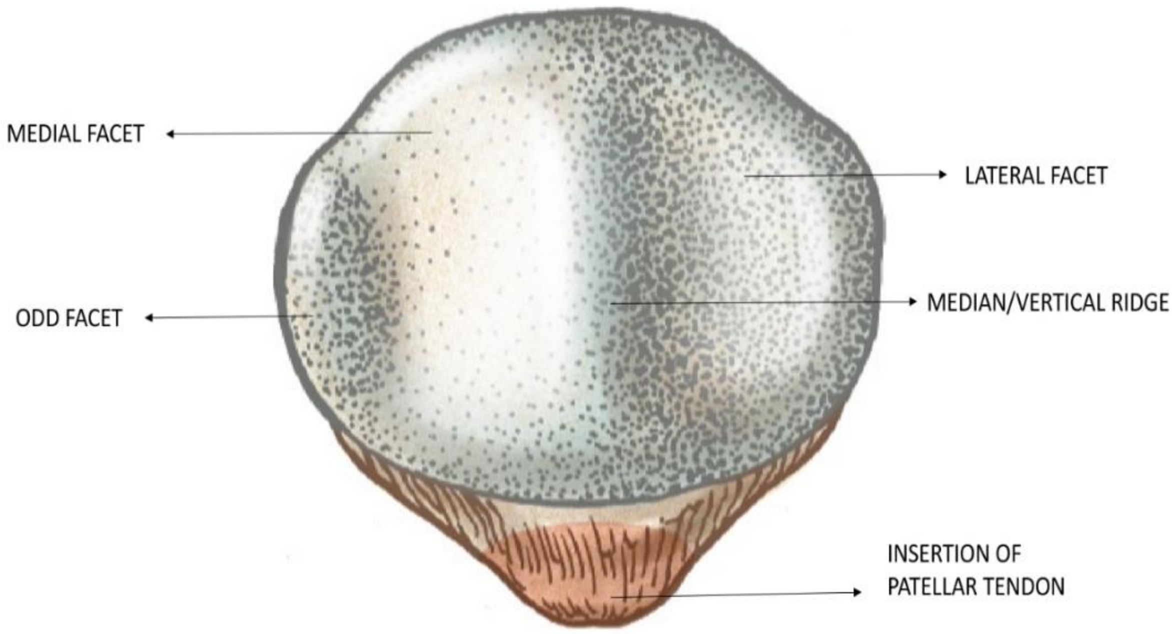


FIGURE 1 - Articulating surface of patella

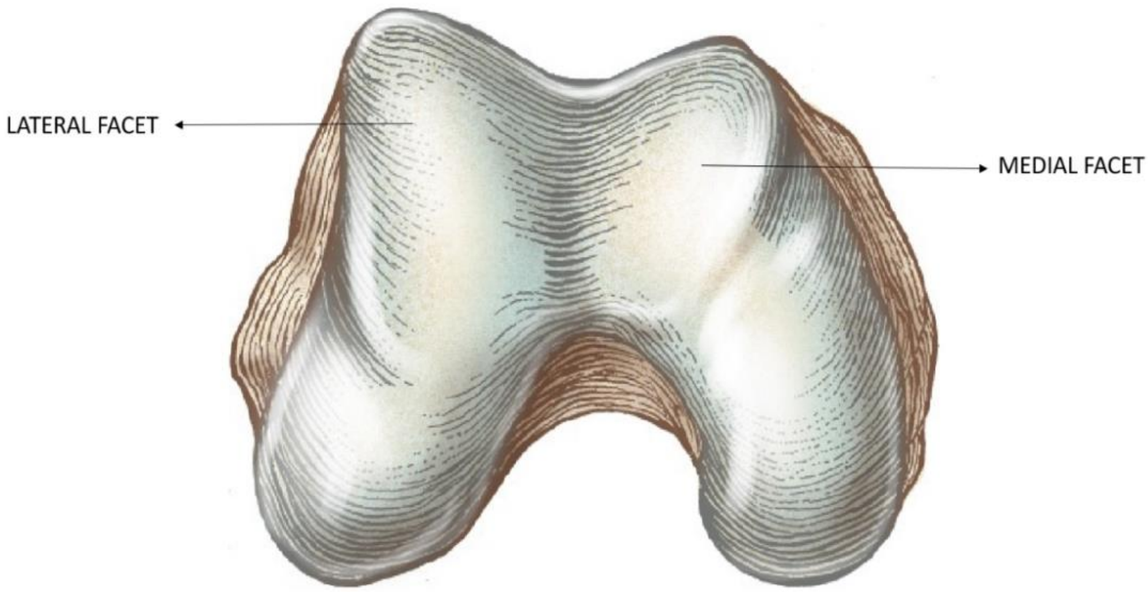


FIGURE 2 – Articulating surface of distal femur

TIBIO-FEMORAL JOINT:

Articulating surfaces-

Proximal tibial articulating surface:

It slopes posteriorly and downwards relative to long axis of tibial shaft. Tibial plateau has medial and lateral articulating surfaces (facets) for articulation with corresponding femoral condyles. Posterior surface, distal to articular margin, displays a horizontal, rough groove to which the capsule and posterior part of tibial collateral ligament are attached. Medial articular surface is oval and longer compared to lateral articular surface. Around its medial, anterior and posterior margins, it is related to medial meniscus; meniscal imprint, wider posteriorly and narrower antero-medially, is often discernible. The meniscus covers much of the posterior surface so that, overall, a concave surface is presented to medial femoral condyle. Its lateral margin is raised as it reaches intercondylar region. Lateral articular surface of tibia is comparatively more circular and coapted to meniscus. In the sagittal plane, articular surface is fairly flat centrally and, anteriorly and posteriorly, the surface slopes inferiorly. Overall, this creates a rather convex surface so that, with lateral femoral condyle in contact, there are anterior and posterior recesses (triangular in section), which are occupied by anterior and posterior meniscal 'horns'. Elsewhere, the surface has a raised medial margin that spreads to lateral intercondylar tubercle. Its articular margins are sharp, except postero-laterally, where the edge is rounded and smooth: here the tendon of popliteus is in contact with bone.(1)

Intercondylar area:

Roughened surface area, where there is an intercondylar eminence, between the condylar articular surfaces is narrowest centrally. The edges of intercondylar eminence extend as medial and lateral intercondylar tubercles slightly proximally. This intercondylar region broadens behind and in front of tibial eminence where articular surfaces diverge. Anterior intercondylar part is widest more anteriorly. Antero-medially, a depression points the area of attachment of medial meniscus-anterior horn, anterior to medial articular part. A smooth area receives anterior cruciate ligament behind anterior horn of medial meniscus. Anterior horn of lateral meniscus is attached anterior to intercondylar eminence, lateral to the ACL. The eminence is the narrow central region of area, with medial and lateral tubercles. Raised tubercles provide a stabilizing influence on femur. Eminence becomes more prominent once walking begins and tibial condyles transmit weight of body through tibia. Posterior horn of lateral meniscus is attached to the intercondylar area, to its posterior slope. Posterior intercondylar area slopes down and backwards behind posterior horn of lateral meniscus.[1] (Figure 3)

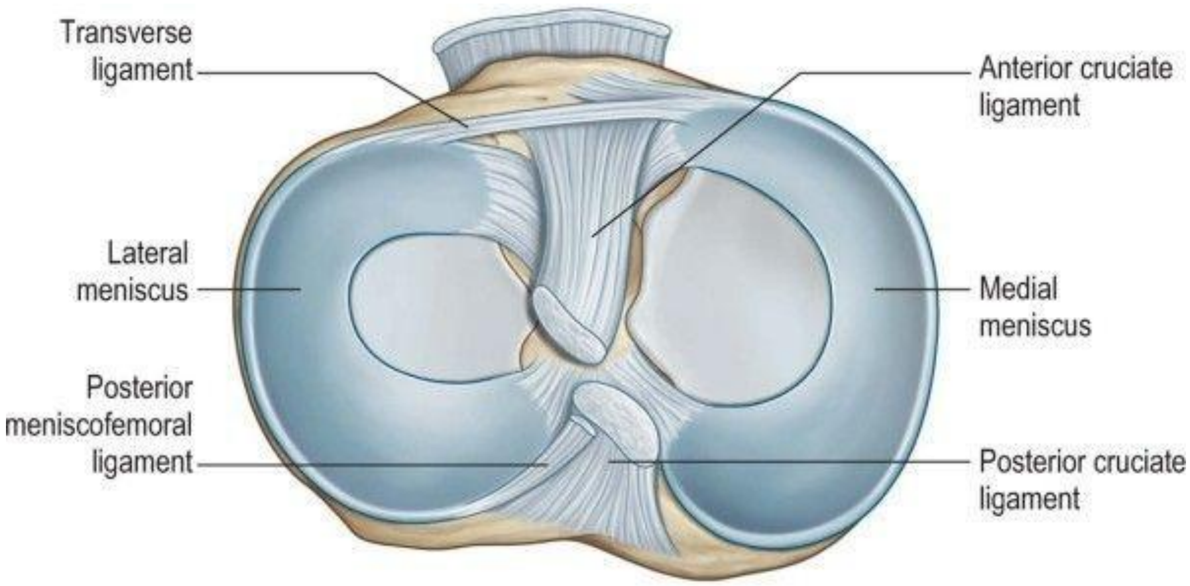


FIGURE 3 – Superior aspect of left tibia showing the menisci and cruciate attachments

Femoral surface:

The femoral condyles with articular cartilage are almost completely convex. Lateral femoral condyle is believed to describe a single arc and thus to possess a single radius of curvature. Tibio-femoral congruence is improved by the menisci, which are shaped to produce concavity of the surfaces presented to the femur; the combined lateral tibio-meniscal surface is deeper. Lateral femoral condyle has a faint groove anteriorly, which rests on peripheral edge of lateral meniscus in full extension. A similar groove appears on the medial condyle but does not reach its lateral border, where a narrow strip contacts the medial patellar articular surface in full flexion. These grooves mark the femoral, patellar and tibial surfaces. Differences between shapes of articulating surfaces correlate with movements of the knee joint.(1)

ARTICULAR CARTILAGE OF KNEE:

Articular cartilage covers the joint surfaces where the femur, tibia, and patella articulate with each other. This glistening white substance has the consistency of firm rubber but has very low friction to allow sliding motion with almost no resistance. This hyaline cartilage is a tissue composed of Type II collagen and other special molecules, including glycosaminoglycans (GAG), which help to attract water into the cartilage, giving it viscoelasticity to dampen shock and distribute forces to the bone underneath. Embedded in this matrix are chondrocytes.(32)

The mean cartilage thickness of the patella ranges from 1.76 to 2.59 mm, with the thickest being at the centre of the patella, of femoral condyles from 1.65 to 2.65 mm and that of tibia from 2.07 to 2.98 mm.(33)

CHONDROMALACIA

It is a condition that results in softening and then subsequent tearing, fissuring, and erosion of hyaline cartilage. Most commonly, it is recognized as involving the extensor mechanism of knee and accordingly is often referred to as chondromalacia of the patella, patello-femoral syndrome, or runner's knee. Post-traumatic injuries, microtrauma wear and tear, and iatrogenic injections of medication can lead to the development of chondromalacia.(34)

Although the etiology of chondromalacia patella is complex, several factors, such as trauma, patello-femoral instability (dislocation, subluxation, etc.), athletic trainees and army, jobs requiring excessive kneeling and squatting, etc., are some of the common causes responsible for this condition.(35)

KNEE STABILIZERS

The primary stability of knee is dependent on static stabilizers and dynamic stabilizers. Static comprises of the bony articulations and medial and lateral ligaments, ACL, PCL, both the menisci, joint capsule, oblique popliteal ligament, arcuate ligament and iliotibial band. The dynamic stabilisers are inclusive of the muscles and aponeurosis including quadriceps femoris and extensor retinaculum, pes anserinus, popliteus, biceps femoris, semi-membranosus and medial and lateral compartment structures.(2)

MENISCI (Figure 4)

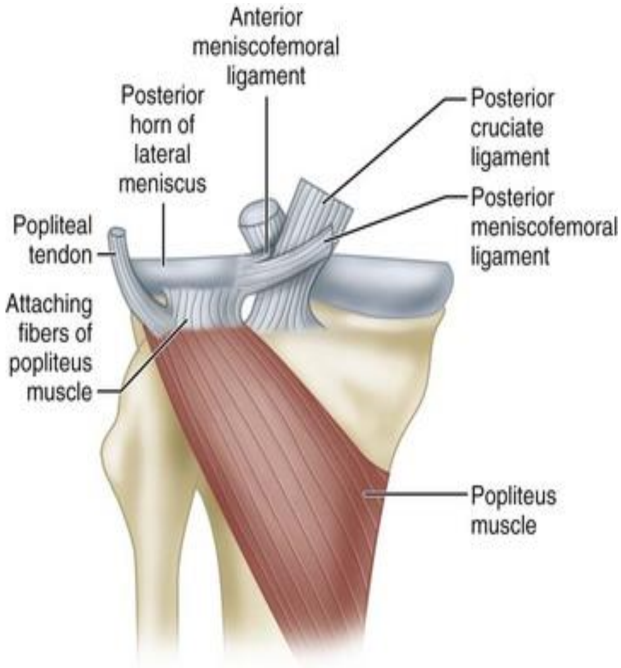
Menisci (semilunar cartilages) are crescentic, intra-capsular, fibro-cartilaginous laminae. They serve to widen, deepen and prepare tibial articular surfaces which receive femoral condyles. Their attached borders, situated peripherally, are thick and convex, and their free, inner borders are thin and concave. Tears of menisci are common. Peripheral tears (e.g. in the vascularized zone) have the potential to heal satisfactorily, especially with surgical intervention. Tears in the less vascular or inner zones seldom heal spontaneously; if surgery is indicated, these menisci are often resected. Menisci spread load by increasing congruity of the articulation, provide stability by their physical presence and proprioceptive feedback, and may cushion underlying bone from considerable forces generated during extremes of flexion and extension of knee.[1]

Medial meniscus -

Medial meniscus is semi-circular in shape and broader posteriorly. It is attached to anterior tibial intercondylar area in front of anterior cruciate ligament, by its anterior horn; the posterior fibres of anterior horn are continuous with transverse ligament of knee (when present). Anterior horn is in floor of a depression medial to upper part of patellar ligament. Posterior horn is fixed to posterior tibial intercondylar area, between the attachments of lateral meniscus and posterior cruciate ligament. Its peripheral border is attached to deep surface of tibial collateral ligament and to fibrous capsule. Tibial attachment of meniscus is known as the ‘coronary or menisco-tibial ligament’. Collectively, these attachments ensure that medial meniscus gets relatively fixed and is less mobile than lateral meniscus.[1]

Lateral meniscus -

Lateral meniscus is saucer-shaped and, owing to the convex topography of lateral tibial plateau, is more triangular-shaped in cross section than wedge- shaped medial meniscus. It is grooved by tendon of popliteus postero-laterally, which separates it from lateral collateral ligament. Its anterior horn partly blends with ACL and is attached in front of intercondylar eminence, postero-lateral to ACL. Its posterior horn is attached in front of medial meniscus-posterior horn, behind intercondylar eminence. Its anterior attachment is contorted so that the free margin faces postero-superiorly, and anterior horn rests on anterior slope of the lateral intercondylar tubercle. Near its posterior attachment, it commonly sends a posterior menisco-femoral ligament supero-medially behind posterior cruciate ligament to medial femoral condyle. An anterior menisco-femoral ligament may also connect posterior horn to medial femoral condyle, anterior to posterior cruciate ligament. Menisco-femoral ligaments are often the sole attachments of lateral meniscus-posterior horn. More laterally, part of tendon of popliteus is attached to lateral meniscus, and so mobility of its posterior horn may be controlled by menisco-femoral ligaments and by popliteus.



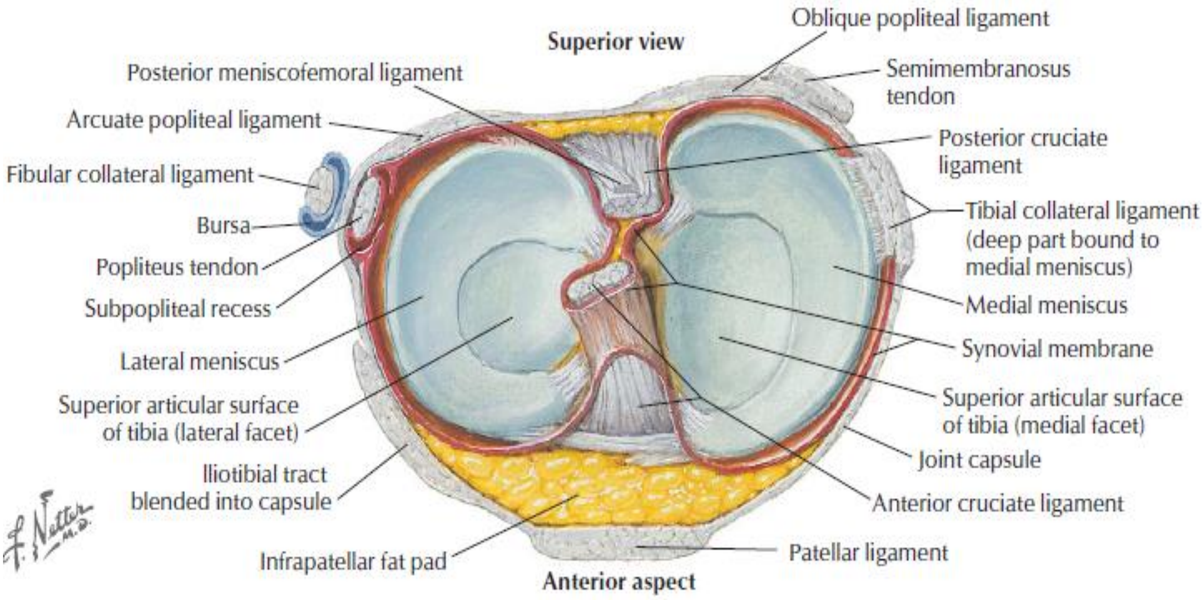


FIGURE 4 – Structure and relation of menisci

Discoid lateral meniscus -

Discoid lateral meniscus occurs in up to 5% of population, often bilaterally. The distinguishing features of discoid lateral meniscus are its shape and posterior ligamentous attachments. In its mildest form, the partial discoid meniscus is simply a wider form of the normal lateral meniscus. The acute, medial free edge is interposed between femoral and tibial condyles, but it does not completely cover the tibial plateau. Complete discoid meniscus appears as a biconcave disc with a rolled medial edge and totally covers lateral tibial plateau (Figure 5). The normal tibial attachment of lateral meniscus-posterior horn is lacking, but posterior menisco-femoral ligament persists. As the result, such type of meniscus is attached anteriorly to the tibia and posteriorly to the femur, which renders the posterior horn unstable. Under these circumstances, the meniscus is liable to get caught between femur and tibia: this accounts for the classic presenting symptom of the 'clunking knee' in some patients.(36)

FIGURE 5 – Discoid lateral meniscus

LIGAMENTS

Cruciate ligaments -

The cruciate ligaments, so named because they cross each other, are very strong, richly innervated intra-capsular structures. The point of crossing is located a little posterior to the articular centre. They are named anterior and posterior with reference to their tibial attachments. A synovial membrane almost surrounds the ligaments but is reflected posteriorly from posterior cruciate ligament to adjoining parts of the capsule; the intercondylar part of posterior region of fibrous capsule therefore has no synovial covering.[(1)] *(Figure 6)*

Anterior Cruciate Ligament:

Anterior cruciate ligament is attached to anterior intercondylar area, just anterior and lateral to the medial tibial eminence in tibia and postero-medial part of lateral femoral condyle. Average length and width of an adult ACL are 38 and 11 mm respectively. ACL is formed of two bundles, an antero-medial and postero-lateral bundle, although some controversy exists as to whether an intermediate bundle is present as well. Based on flexion angle, tension in bundles varies, with antero-medial bundle being tight in extension and postero-lateral tighter in flexion. In full extension, anterior surface of ACL lies against intercondylar shelf assisting the ligament in preventing hyper-extension. Primary function of ACL is to resist anterior translation. Blood supply of ACL arises from anastomosis of lateral and medial inferior geniculate arteries through the fat pad and middle geniculate artery branching off posterior capsule. In any substance tear of ACL, the blood supply gets usually permanently disrupted, which affects it's healing potential, thus reconstruction rather than repair is the preferred surgical tactic. An absent anterior cruciate ligament is rare where in such cases, the condition is usually associated with lower limb dysplasia, and can cause instability of the knee.[(1)]

Posterior Cruciate Ligament:

Posterior cruciate ligament is stronger and thicker than ACL. It is attached to lateral surface of medial femoral condyle, where attachment is extensive in antero-posterior direction, the fibres pass distally and attaches posteriorly in intercondylar region in a depression on adjacent posterior tibia. Average length and width of an adult posterior cruciate ligament is 38 and 13mm respectively. The PCL consists of anterolateral and posteromedial bundles named according to their femoral attachments. Posteromedial bundle is tauter in extension and anterolateral bundle is tauter in flexion. Ligaments of Wrisberg and Humphry originating in posterior capsular attachment of lateral meniscus courses forward to attach posteriorly and anteriorly respectively with the PCL on femur. Posterior cruciate ligament ruptures less commonly than anterior cruciate; rupture is usually better tolerated by patients than that of anterior cruciate ligament. Unlike ACL, because of its association with posterior capsule, blood supply is not permanently lost with a substance tear of PCL. Thus, primary repair of these injuries is possible.[1]

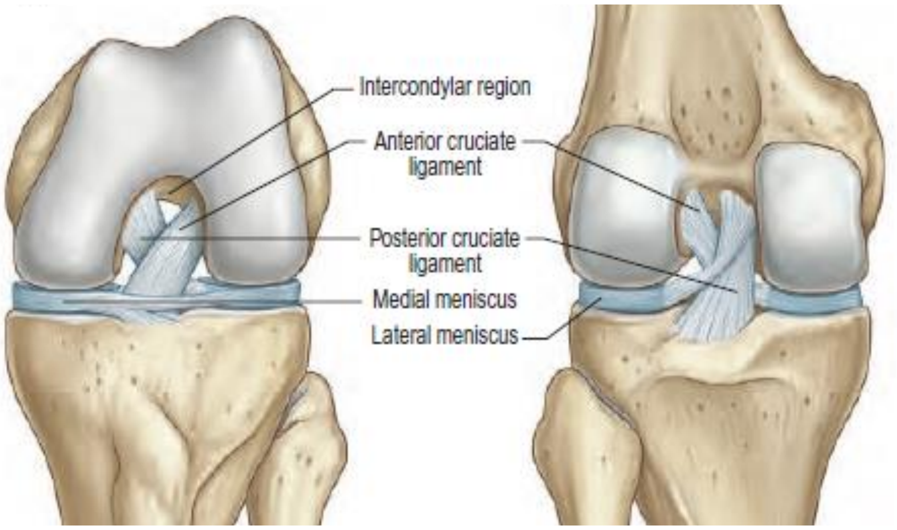


FIGURE 6 – A. Anterior aspect in full flexion B. Posterior aspect in extension

Collateral ligaments (Figure 7 and Figure 8)

Medial collateral ligament:

Medial or tibial collateral ligament is a strong flat band that extends from medial epicondyle of femur to tibial medial condyle and to medial surface of shaft of tibia. It is a primary restraint to valgus angulation at knee, which has a superficial and deep part of it.[1,2]

Superficial Medial Collateral ligament:

Superficial medial collateral ligament is the largest structure of medial side of knee joint which has got one femoral and two tibial attachments. The femoral attachment of the superficial medial collateral ligament is round to slightly oval in shape and is located in a depression proximal and posterior to the medial epicondyle. As the superficial medial collateral ligament coursed distally, it has two separate tibial attachments, the proximal tibial attachment to the anterior arm of semi membranous tendon and distal tibial attachment to the anterior aspect to the posteromedial crest of tibia.[1]

Deep medial collateral ligament:

Deep medial collateral ligament is a thickening of medial joint capsule that is most distinct along its anterior border, where it roughly parallels anterior aspect of superficial medial collateral ligament. Deep medial collateral ligament consists of distinct menisco-femoral and menisco-tibial ligament components. The ligament blends with the central arm of posterior oblique ligament and become inseparable.[1]

Lateral collateral ligament:

Lateral or fibular collateral ligament originates from the external tuberosity of the lateral femoral condyle, directly anterior to the origin of the lateral head of the gastrocnemius muscle. Lateral collateral ligament and biceps femoris tendon end by inserting on head of the fibula as a conjoined tendon.[1]

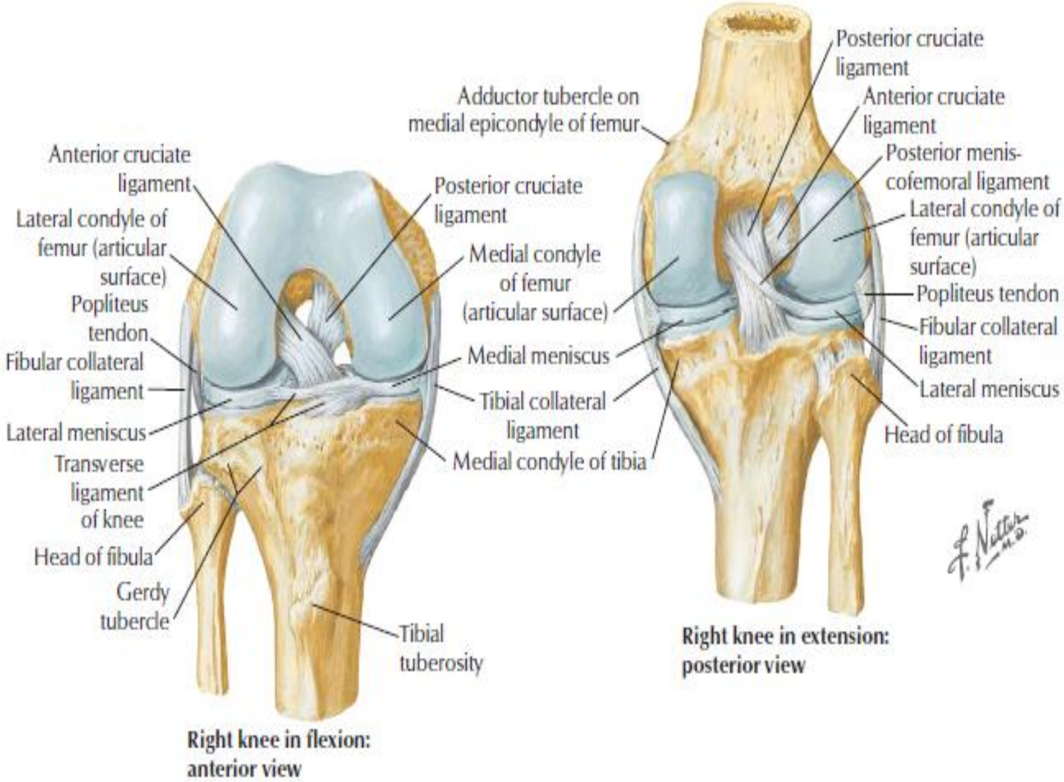


FIGURE 7 – Structure of collateral ligaments

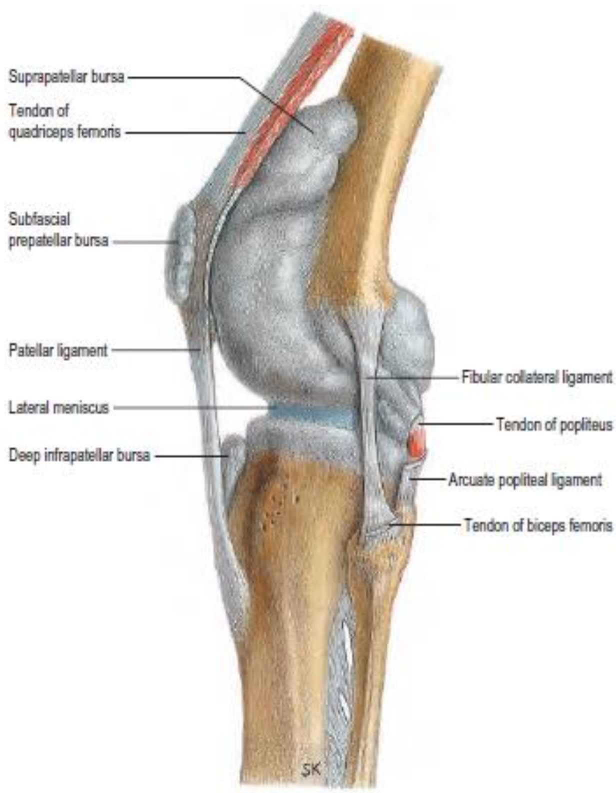


FIGURE 8 – Structures as seen from the lateral aspect of knee

LOCKING MECHANISM OF KNEE JOINT:

During the final stages of the knee extension, tibia undergoes obligatory lateral rotation. This is a coupled motion which does not occur under the influence of the muscles. Thus, it is called AUTOMATIC or TERMINAL ROTATION. This motion is most evident during the final 50° of knee extension bringing the knee into close packed or locked position which is called screw home mechanism of knee joint. During initiation of knee flexion, the locked knee will get unlocked when the tibia undergoes medial rotation. The popliteus muscle initiates the unlocking of the knee by facilitating the medial rotation of the tibia.(37)

INTERNAL DERANGEMENT OF KNEE JOINT

The term is commonly applied to those intra- and extra-articular affections, most often of traumatic origin, which are a result of lesions of the menisci, rupture of cruciate, medial and lateral ligaments, recurrent subluxation of patella, loose bodies, etc. It indicates a group of disorders that involve disruption of normal functioning of knee.(38)

Injuries of knee joint range from isolated single element injuries to combined multiple element injuries because of complex arrangements of ligaments, fascial layers, and tendon insertions. In addition, injuries can range from strains or partial tears to complete disruptions.

COLLATERAL LIGAMENT INJURIES(39,40)

Valgus stress without a rotary component results in isolated medial collateral ligament (MCL) injury. Biomechanical studies point out to fact that primary function of MCL as a limit for valgus stress is crucial only during flexion; therefore, knee flexion causes most of the injuries.

MCL tears are mostly associated (almost 73%) with other soft tissue injuries, such as medial meniscal and anterior cruciate ligament (ACL) injuries (O'Donoghue's unhappy triad) and are seldom isolated. There may be menisco-capsular separations and bone bruises too.

Abnormal varus stress placed on an internally rotated knee results in isolated injuries of lateral collateral ligament (LCL). Forces causing hyperextension or hyperextension and external rotation of knee joint result in Postero-lateral corner (PLC) injuries. Isolated LCL injuries are uncommon, as in MCL injuries and occur in association with ACL or PCL tears.

Individuals with MCL tears report a history of direct lateral blow to knee thereafter feeling a pop. Associated cruciate ligament tears must be suspected if mechanism of injury was indirect.

MCL injuries can be classified according to physical examination.

- Tenderness upon palpation of the MCL indicate grade I tears and are not characterised by laxity.
- Some laxity in valgus stress indicate Grade II tears but with a firm endpoint.
- Grade III tears demonstrate increased laxity and no identifiable endpoint.

Symptom of feeling a pop is rare in individuals with LCL tears, since they are usually dominated by more severe injuries. A hyperextension varus stress is most common mechanism of PLC injuries. Instability, buckling into hyperextension and posterior lateral pain is the usual presentation. Mild swelling and no effusion is found in isolated LCL injury as it is a completely extra-articular structure.

CRUCIATE LIGAMENT INJURIES

Anterior Cruciate Ligament -

ACL injuries occur from a non-contact mechanism 70–80% of the time.[41,42] There are two distinct mechanisms by which the ACL is ruptured in a non-contact manner. The first mechanism is deceleration during concomitant pivoting. This is a common movement used in cutting sports like football or basketball.[43]

The second non-contact mechanism is that of landing on one leg and then falling with a twisting, valgus force while maintaining quadriceps contraction. Again, with this mechanism, the quadriceps contraction leads to anterior tibial translation with minimal resistance from the secondary stabilizers, ultimately resulting in ACL rupture.[43]

Most common mechanism of contact-mediated ACL rupture involves an outside force that results in a valgus collapse of the knee.[41] An example of this is in American football when a defensive player dives at the knee of an opposing player from the side, in an attempt at making a tackle, thus delivering a medially directed blow to knee. If the player’s foot is planted, a valgus collapse of knee may ensue. Another example of this is in soccer, when a defensive player attempts to slide tackle the ball carrier while that player has his or her leg planted and is attempting to kick with the contralateral leg.[43]

Women are about 3 times at higher risk of having their ACL injured than men and it is probably attributed to the following reasons[5,44]:

- The relatively small size and difference in shape of intercondylar notch. The intercondylar notch is narrow & its plateau environment increases risk of predisposing women non-athletes with a knee OA to ACL injury in age of 41-65 years.
- Wider pelvis and greater Q angle. A wider pelvis requires the femur to have a greater angle towards the knee, lesser muscle strength provides less knee support, and hormonal variations may alter the laxity of ligaments.
- Greater ligament laxity.
- Young women athletes with non-modifiable risk factors, for e.g. ligament laxity-have increased risk of sustaining recurrent injury following an ACL reconstruction (ACLR).
- Shoe surface interface. The pooled data suggest that the chances of injury are approximately 2.5 times higher when higher levels of rotational traction are present at the shoe-surface interface.
- Neuromuscular factors

Grades of Injury[2,45]

An ACL injury is graded in the following way:

Grade I:

- The ligament fibres are stretched, but there is no tear.
- There is minimal tenderness and swelling.
- The knee feels stable or does not give out during activity.
- No increased laxity and there is firm end feel (2mm - 5mm tibial translation).

Grade II:

- The ligament fibres are partially torn or incompletely torn with haemorrhage.
- There is a mild tenderness and a moderate amount of swelling with a slight loss of function.
- The joint might feel unstable or may give out during activity.
- Increased anterior translation yet there is still firm end point (5-10mm tibial translation).
- Pain is present and the pain increases with Lachman's & anterior drawer stress tests.

Grade III:

- The ligament fibres are torn completely (ruptured)
- Tenderness is present, but there is only limited pain, especially when pain is compared to the seriousness of the injury.
- There may be swelling.
- The ligament cannot control knee movements.
- The knee tends to be unstable and may give out at certain times.
- Rotational instability is present and is indicated by a positive pivot shift test.
- No end point is evident (more than 10 mm tibial translation)
- Haemarthrosis occurs within 1-2 hours.

An ACL avulsion tends to occur when it is torn away either from femur or tibia. This kind of an injury is a bit more common in children when compared to adults. Term "*anterior cruciate deficient knee*" means a grade 3 tear, where there is complete tear of the ACL. It is generally believed that an ACL that is torn will not heal. About 50% of all the ACL ruptures have associated meniscal injuries. It can be seen in combination, usually with medial meniscal injury along with an MCL Injury, and is termed as O'Donoghue's Unhappy Triad which has 3 components[41]:

- ACL Tear
- MCL Tear
- Medial Meniscus Tear

Posterior Cruciate Ligament -

Injury to PCL ranges from a minor stretch to a complete tear or rupture of the ligament. PCL being broader and stronger is less frequently injured than ACL. Incidence of injury is around 5-20% of all knee ligamentous injuries.

Mechanism of injury includes direct blow to proximal tibia with knee flexed (dashboard injury), which is most common mechanism involved in PCL injuries. Another mode of injury being non-contact hyper-flexion with a plantar-flexed foot, commonly seen in football, baseball and soccer players. Less commonly, damage can occur due to a rotational hyperextension injury to knee joint.[46]

MENISCAL INJURIES

Usually, an acute meniscal tear occurs following a rotatory trauma to the knee, whereas chronic degenerative meniscal tears tend to occur in the elderly people, even after minimal rotatory trauma or stress on the knee. In adults, the attritional changes in the meniscus can lead to fragmentation of meniscus and may predispose to variety of tears (these usually tend to occur at medial meniscus-posterior horn).

Location: Medial tears are more common than lateral tears, with an exception- in setting of an acute ACL tear where lateral tears are more common. The chronic degenerative tears in elderly patients usually tend to occur in medial meniscus-posterior horn. Lateral tears are more common in acute ACL tears. Tears within the outer one-third vascular zone of menisci are "red-red" tears, whereas those extending into the middle one-third avascular zone are "red-white" tears. Tears contained within the inner one-third avascular zone are "white-white" tears. Tears located within the red zone have the highest potential for either spontaneous healing with conservative management or successful outcome following meniscal repair. Mechanism of injury includes compressive forces leading to rotation in a flexed knee resulting in meniscal tears. Type of injury is determined by the magnitude and direction of the force acting on the knee. Sports injuries are mainly due to deceleration, twisting or landing from a jump.[47]

CLINICAL ASSESSMENT OF LIGAMENT INJURY OF KNEE:

The clinical evaluation of knee is a fundamental tool to correctly address diagnosis and treatment, also should never be replaced by the findings retrieved by the imaging studies carried on the patient.[48] The physical examination should include careful inspection of the knee, palpation for point tenderness, assessment of joint effusion, range-of-motion testing, evaluation of ligaments for injury or laxity, and assessment of the menisci.

ANTERIOR CRUCIATE LIGAMENT

Anterior Drawer Test – It was described as early as 1845.

- Patient is supine on examination table with his involved knee flexed to 90° and his foot flat on the table. The examiner may or may not stabilize the foot by sitting on it. (By keeping the foot free, tibial rotation is not limited and the coupled motion of anterior tibial translation with internal rotation is not restricted).

- The examiner cups posterior aspect of tibia with both hands, resting the thumbs across anterior joint line (Fig. 9). An anterior force is then applied to the proximal tibia. Test is positive if examiner sees or feels the tibia slide anteriorly.
- The uninvolved knee should be tested first to provide a normative reference.
- Anterior drawer test can be graded to reflect the amount of anterior tibial translation.
- Most commonly used scale is as follows: grade I: 2-5 mm; grade II: 5-10 mm; grade III: more than 10 mm.
- Grade determination is based on examiner's subjective assessment of tibial translation.
- Anterior drawer test can also be done with tibia externally or internally rotated to assess the laxity of capsular structures.[48–50]

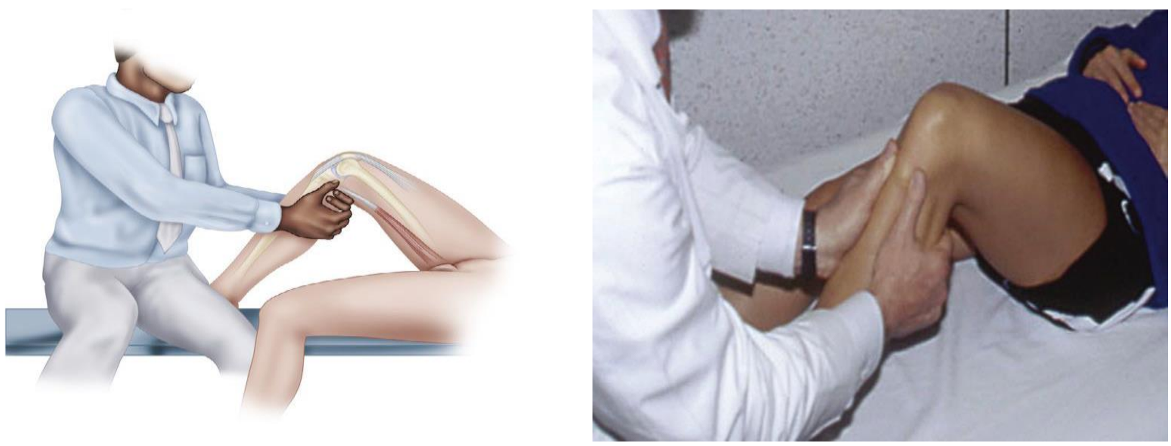


FIGURE 9 – Anterior Drawer test

Lachman Test **-** The Lachman test, which was initially described by Torg et al, is essentially an anterior drawer performed with knee at 20^0 to 30^0 of flexion.[45,50]

- Patient is supine on examination table with involved knee next to examiner.
- The examiner holds the knee in approximately 15-20^0 of flexion. One hand stabilizes distal femur while other hand applies an anterior force to posterior aspect of proximal

tibia (Fig. 10). The test is positive if the examiner sees or feels anterior translation of tibia. The uninvolved knee should be tested to provide a normative reference.

- The examiner also evaluates the end point of the tibia's translation. A soft or mushy end point is characteristic of an ACL tear.
- A positive Lachman test can be graded with the same scale that is used for anterior drawer test.[49]

FIGURE 10 – Lachman test

***Pivot Shift Test*[51] -**

- The clinician holds the leg with knee in extension.
- The foot is lifted and internally rotated and valgus stress applied to lateral side of knee.
- If the ACL is torn, then there is anterior subluxation of tibia as the knee is flexed beyond 30°. (Fig. 11)

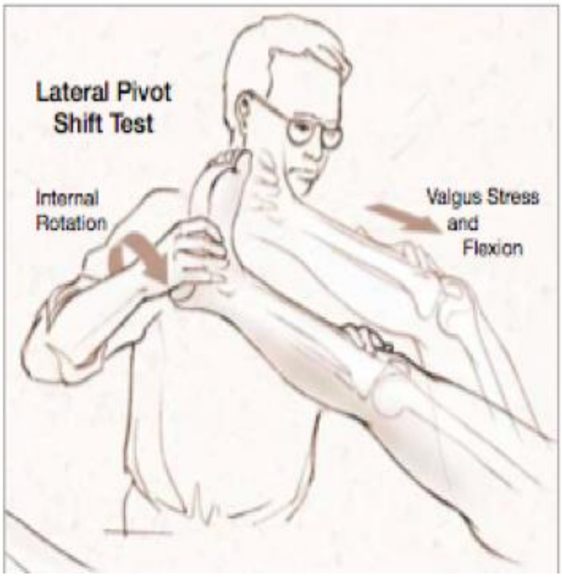


FIGURE 11 – Pivot shift test

POSTERIOR CRUCIATE LIGAMENT[2,45,48]

Posterior Drawer Test -

- Posterior drawer test is done with patient in supine and knee flexed to 90 degrees; foot is secured to table by sitting on it.
- A posterior force is applied on the proximal tibia, which is opposite but similar to the force applied in the anterior drawer test.
- Posterior movement of tibia on femur shows posterior instability compared with the normal tibia.
- It is sometimes difficult to interpret whether the tibia is abnormally moving too far anteriorly or too far posteriorly.
- Careful attention to the neutral position or unstressed reduction point prevents misinterpretation.
- Both knees are placed in the position to perform a posterior drawer test, and a thumb is placed on each anteromedial joint line.
- Loss of the normal 1-cm anterior step-off of medial tibial plateau with respect to medial femoral condyle indicates a torn PCL. (Fig. 12)

FIGURE 12 – Posterior Drawer test

Posterior Sag sign -

- It indicates abnormal posterior displacement of upper tibia, with PCL insufficiency.
- It can best be seen by supporting the distal tibia while the patient's hip and knee are both flexed at 90 degrees.
- With the patient's quadriceps thus relaxed, the tibial tubercle will be less prominent than that on the uninjured side.
- To facilitate comparison, the inferior pole of the patella may be used as reference point. (Fig. 13)

FIGURE 13 – Posterior sag sign - Patient's hip and knee is flexed to 90° and sagging of tibia checked posteriorly due to effects of gravity

MENISCI

***McMurray's test* -** First described in 1928 by Thomas Potter McMurray (1887-1949).[52]

- Patient's heel is grasped with one hand and knee with other, examiner's thumb is at the lateral joint line, and fingers are placed over medial joint line.
- Patient's knee is flexed fully.
- For testing lateral meniscus, tibia is rotated internally, valgus stress applied at knee and is extended from maximal flexion.
- For testing medial meniscus, tibia is rotated externally, varus stress applied and knee is extended from maximal flexion.
- Test is positive if a thud or click is produced, or causes pain in reproducible portion of range of motion of knee.[50] (Fig. 14)

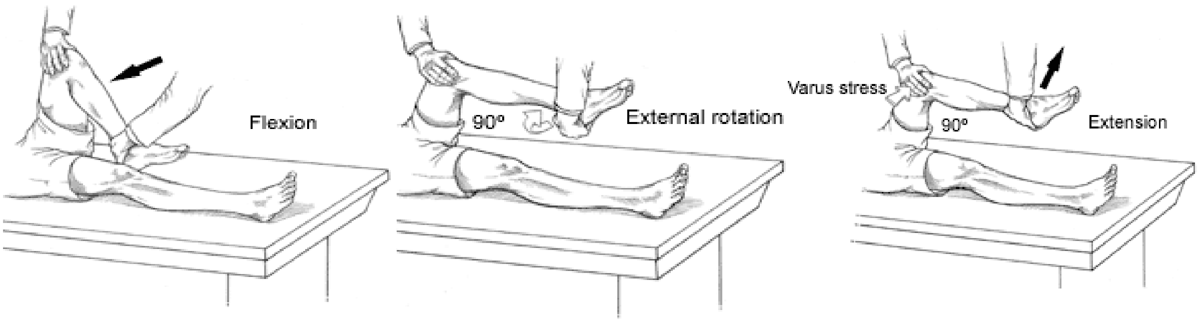


FIGURE 14 – McMurray's test

***Thessaly test* –**

- Physician helps patient by holding their outstretched hands while patient stands flat footed on floor on the affected leg only.
- Then, patient rotates his or her knee and body, internally and externally, three times with knee in flexion (10 to 20 degrees).
- Patients having meniscal tears experience lateral or medial joint line pain and can have sense of catching or locking.
- The test is usually started on normal knee first to teach patient how to recognize a positive result.
- Test done at 20 degrees knee flexion is effective as screening test for meniscus tears.[(2)] (Fig. 15)

FIGURE 15 – Thessaly test

Squat test -

- Several repetitions of a full squat with the feet and legs alternately fully internally and externally rotated as the squat is performed.
- Pain usually is produced on either medial or lateral side of knee, corresponding to side of torn meniscus.
- Pain in internally rotated position suggests injury to lateral meniscus, whereas pain in external rotation suggests injury to medial meniscus.[(2)] (Fig.16)

FIGURE 16 – Squat test

Apley's grinding test **–** named after Alan Graham Apley, a British orthopaedic surgeon, who discovered this assessment technique

- Involves placing the patient in the prone position with knee flexed to 90 degrees.
- The patient's thigh is then rooted to the examining table with the examiner's knee.
- The examiner laterally and medially rotates the tibia, combined first with distraction, while noting any excessive movement, restriction or discomfort.
- The process is then repeated using compression instead of distraction.
- If rotation plus distraction is more painful or shows increased rotation relative to the normal side, the lesion is most likely to be ligamentous.
- If the rotation plus compression is more painful or shows decreased rotation relative to the normal side, the lesion is most likely to be a meniscus injury.[53] (Fig.17)

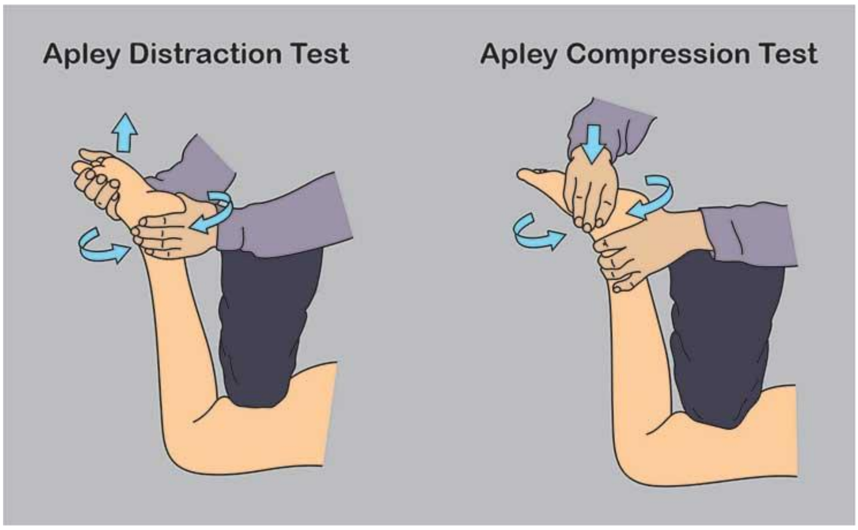


FIGURE 17 – Apley's grinding test

COLLATERAL LIGAMENTS

Medial Collateral Ligament – Valgus stress test

- Test is done with slightly abducted patient's leg.
- Examiner places one hand at medial aspect of distal tibia with other hand at lateral aspect of knee joint.
- Valgus force is subjected to knee at both zero degrees (full extension) and around 30^0 flexion (Fig. 18)
- With knee at zero degrees (full extension), integrity of medial collateral ligament along with anterior cruciate ligament is checked for, and with the knee at 30 degrees of flexion, application of valgus stress assesses integrity of medial collateral ligament.[41]

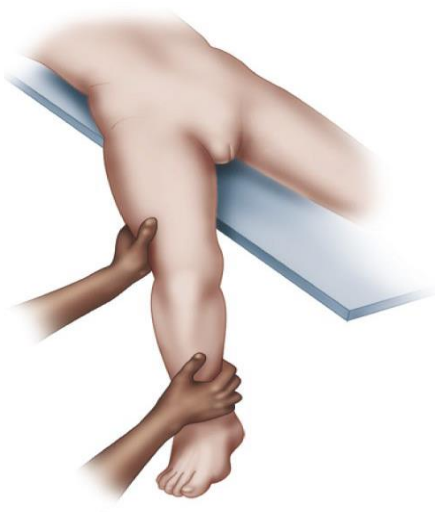


FIGURE 18 – Valgus stress test

Lateral Collateral Ligament – Varus stress test

- In this test, the examiner places one hand at lateral aspect of distal fibula and other hand at medial aspect of patient's knee.
- Varus force is subjected to knee, first at full extension (zero degrees), then with knee flexed to 30 degrees (Fig. 19)
- Integrity of lateral collateral ligament along with anterior cruciate ligament is checked in full extension, and with knee at 30^0 flexion, application of varus stress assesses integrity of lateral collateral ligament.
- A firm end point indicates that lateral collateral ligament is intact, an absent end point indicates complete rupture of ligament.(41)

FIGURE 19 – Varus stress test

TESTS FOR CHONDROMALACIA PATELLA

Patellar Grind test –

- Clarkes "patellar grind" test has been described as a confirmatory test for patellar chondromalacia.
- In this test, the patella is compressed against the trochlea manually while the clinician asks the patient to contract their quadriceps.
- Positive test is indicated by an exacerbation of the patient's symptoms.(54)

Retropatellar tenderness is present

Patella compression test –

- The patella compression test was performed in supine position with the tested knee flexed to 20°. The patella is then compressed against the femoral groove. When the patient reports pain, then test is positive.[55]

MRI OF KNEE:

CRUCIATE LIGAMENTS:

1. Anterior Cruciate Ligament (ACL):

The ACL originates from medial side of lateral femoral condyle to insert on anterior tibial spines, approximately 10 mm behind the anterior articular surface of tibia. It is usually 11 – 13 mm thick and is enveloped by a thin sheath. ACL courses at a shallow angle from lateral to medial. It is often not imaged in its entirety on a single sagittal image and must be evaluated on two or three contiguous images. While the ACL is best visualised on sagittal images, the coronal and axial images are often helpful for thorough assessment of integrity of this structure.

The normal ACL is relatively low in signal intensity, primarily at its femoral attachment. However, a striated appearance of the distal portion of the ACL on sagittal images is a common appearance and should not be mistaken for a tear.[56]

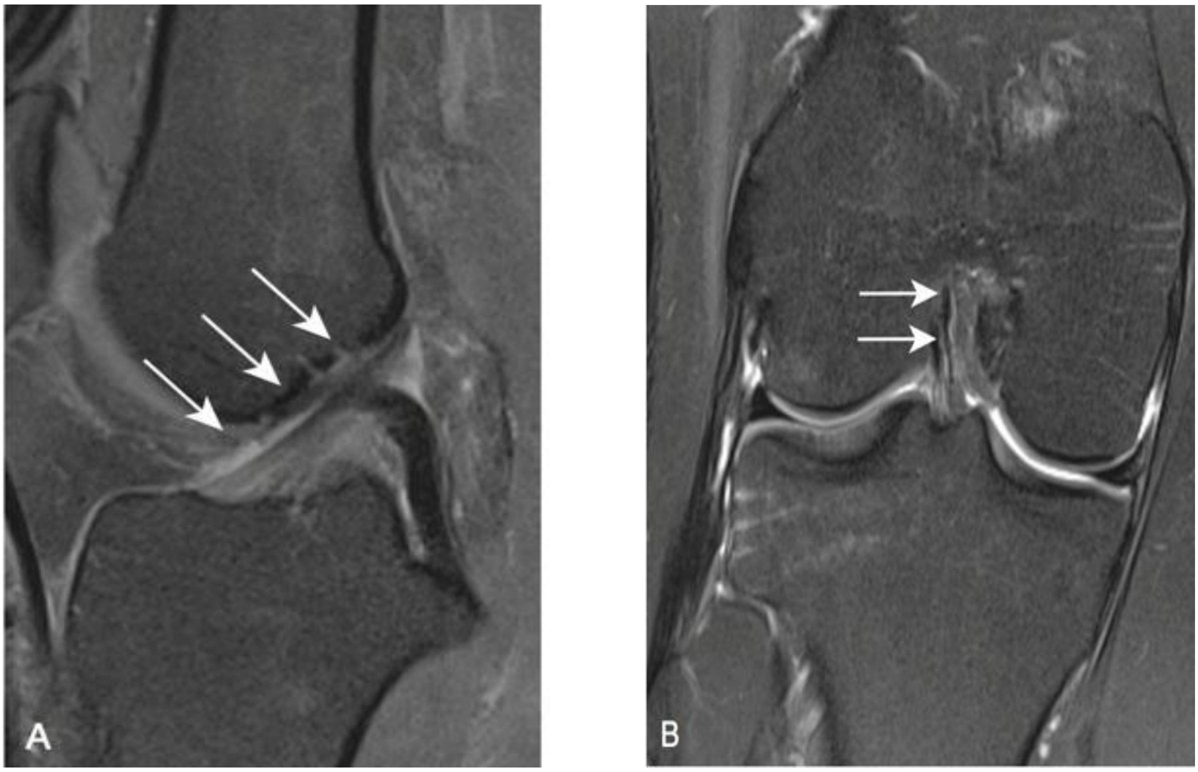


FIGURE 20 - A. Sagittal proton density weighted fat saturated image showing normal ACL (arrows) B. Coronal proton density weighted fat saturated image showing normal ACL (arrows)

MRI is highly accurate for detection of ACL tears. The primary signs of an acute ACL tear include the following:

- A heterogeneous “pseudomas” (hematoma) in intercondylar notch with increased signal on T2 weighted images. This results due to haemorrhage and oedema associated with injury.
- Discontinuity or disruption of ligament fibres.

Findings of Chronic ACL tear:

- Non visualization of ligament (owing to atrophy of its fibres).
- Abnormal horizontal orientation of the ACL. The abnormal oriented ACL maintains low signal in chronic tear and commonly scars down to the PCL.

FIGURE 21 - Chronic ACL tear, image showing absence of ACL fibres

Findings of Acute ACL tears:

- Acute ACL tears are typically associated with large joint effusion (hemarthrosis).
- Bone contusions are seen at posterior part of tibial plateau and anterior part of lateral femoral condyle and they occur as a result of impaction injury from anterior translation of tibia relative to femur.
- Osteo-chondral injury of lateral femoral condyle can be seen and occasional depression of articular surface as well. Other secondary signs of ACL tear include hanging of lateral meniscus-posterior horn, over lateral femoral condyle-posterior margin and "buckling" of PCL (both secondary to anterior translation of tibia).[56]

FIGURE 22 - Sagittal (A) and Coronal (B) proton density fat saturated image showing proximal fibre tear of ACL (arrows) with reactive oedema

2. Posterior Cruciate Ligament (PCL):

The PCL arises from postero-lateral part of medial femoral condyle and inserts into the posterior intercondylar portion of tibia. PCL is thicker than the ACL, varying from 12 – 20mm in thickness. The PCL is diffusely low in signal intensity and has a hockey stick configuration.[56]

FIGURE 23 - Sagittal proton density fat saturated image showing normal PCL (arrows)

The ligament is visualized on sagittal and coronal images of knee. PCL tears appear on the MRI as a bright signal within the substance of the ligament or as a disruption of the ligament fibres. Chronic tears of PCL can result in thinning or non-visualization of the ligament or abnormal angulation (buckling) of this structure.[56]

FIGURE 24 - PCL tear - sagittal proton density weighted image with fat saturation shows discontinuity of the distal PCL (arrow).

Menisci:

MRI identification of meniscal tears is based on presence of linear signal changes that come in contact with meniscal surfaces, or is based on shape and size alterations of menisci. Nevertheless, presence of signal changes within meniscus which are not in contact with meniscal surfaces are not more likely to represent a significant lesion than a meniscus without any internal changes seen on MRI.[57]

Menisci are best studied in sagittal and coronal planes. On sagittal images, menisci appear as dark triangles in central part of joint and assume a “bow tie” configuration at periphery of knee joint.[2]

Areas of abnormal hyper-intense signal may or may not communicate with a meniscal articular surface. Generally, communicating signal abnormalities that are seen on only one image should not be considered tears unless there is associated anatomic distortion of the meniscus.[2]

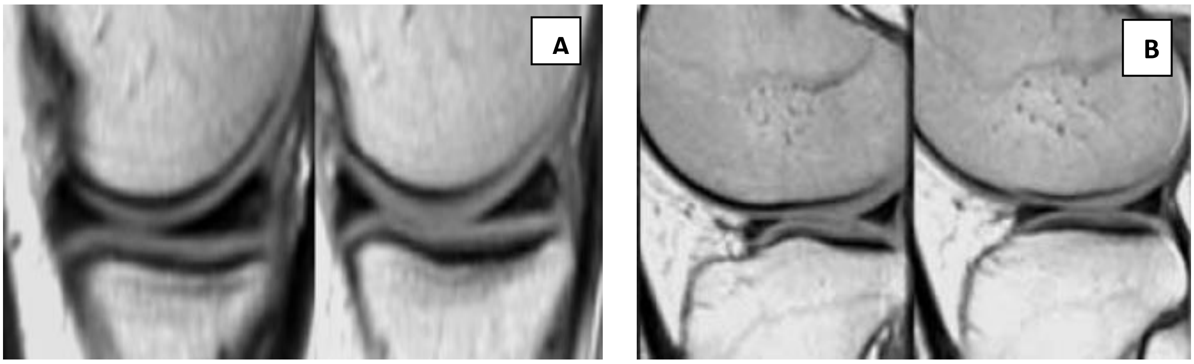


FIGURE 25 – MRI Sagittal view of (A) Normal bow-tie appearance of medial meniscus (Posterior horn is larger than anterior horn). (B) Normal bow-tie appearance of lateral meniscus (both posterior and anterior horn are of same size)

Meniscal tears must be defined as to location (anterior horn, body, posterior horn, free edge, or periphery) and orientation i.e. horizontal, vertical/longitudinal, radial, complex (Table 1). Relatively common and particularly debilitating in elderly patients, radial tears of posterior horn or posterior root ligament of medial meniscus are best seen on far posterior coronal images.

Careful examination of joint, often in coronal plane, will reveal displaced, hypo-intense meniscal fragment.(2,58)

TABLE NO. 1 – Depicting types of meniscal tears

MENISCAL TEAR MORPHOOGY	**DESCRIPTION**	**APPEARANCE ON MRI**
HORIZONTAL	Separates meniscus into superior (femoral) and inferior (tibial) fragments	Primarily horizontal signal on sagittal images
VERTICAL RADIAL	Splits central margin of meniscus	Vertical signal oriented perpendicular to the curvature of the meniscus
VERTICAL LONGITUDINAL	Extends along length of meniscus, separates it into inner and outer fragments	Vertical signal oriented parallel to the curvature of the meniscus
BUCKET HANDLE	Subtype of longitudinal tear in which the displaced central fragment resembles a bucket handle	"Double PCL" sign (Figure 28), displaced fragment often seen parallel to PCL in intercondylar notch on sagittal images
COMPLEX	Combination of multiple planes, commonly horizontal and radial	Characteristics of each tear type or fragmented/macerated
MENISCOCAPSULAR SEPARATION	Rupture of meniscus-capsule junction	Increased signal between edge of meniscus and capsule

FIGURE 26 - Sagittal fat-suppressed, proton density–weighted image of knee shows a hyper-intense meniscal cyst *(straight arrow)* adjacent to medial meniscus. Associated tear is present in inferior articular surface of meniscus *(curved arrow)*.

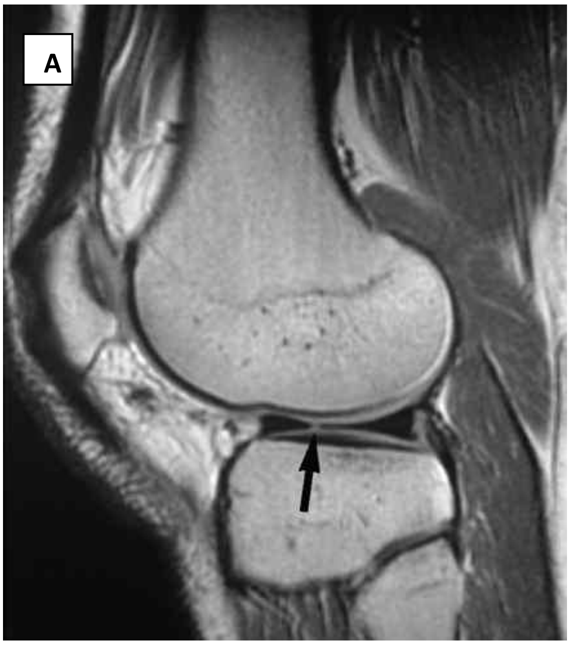


FIGURE 27 - (A) Sagittal proton density–weighted image reveals radial tear in free edge of body of lateral meniscus *(arrow)*. (B) Fat-suppressed, proton density–weighted image demonstrates portion of medial meniscus displaced inferiorly and deep to medial collateral ligament *(arrow)*.

FIGURE 28 - A sagittal fat-suppressed proton-density image shows a meniscal flap (*arrow*), arising from medial meniscus and displaced inferior to the PCL (*arrowhead*), exhibiting the double-PCL sign.

The MRI features of meniscal injuries are classified into 3 grades as show in Table 2.[59]

TABLE NO. 2 – Depicting grades of meniscal injury

GRADE	DESCRIPTION
1	Small area of hyper intensity, no extension to the articular surface
2	Linear areas of hyper intensity, no extension to the articular surface
2A	Linear abnormal hyper intensity with no extension to the articular surface
2B	Abnormal hyper intensity, reaches the articular surface on single image
2C	Globular wedge shaped abnormal hyper intensity with no extension to the articular surface
3	Abnormal hyper intensity extends to atleast one articular surface (superior or inferior) and is referred as a definite meniscal tear

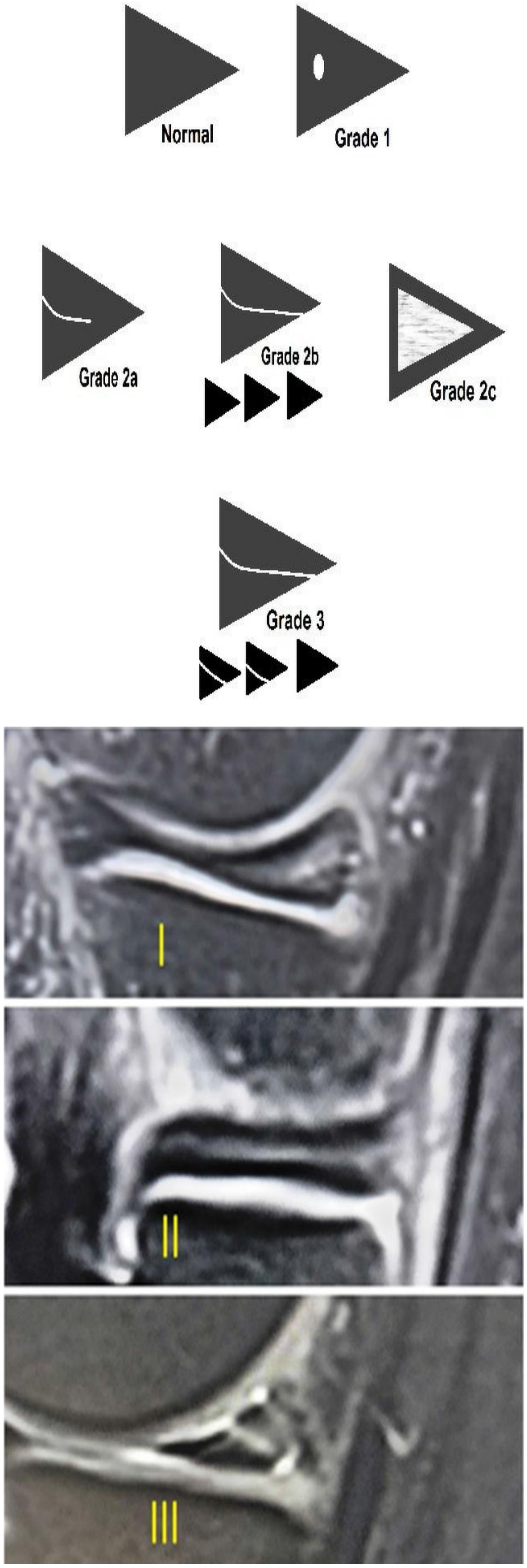


FIGURE 29 – Grades of meniscal tear

Cartilage:

Chondral pathologies are depicted as areas of focal cartilaginous defects or deeper fractures involving sub-chondral bone on MRI and graded upon thickness of articular cartilage disruption according to Modified Outer-bridge classification.[60] (Table 3)

TABLE NO. 3 – MODIFIED OUTER-BRIDGE CLASSIFICATION

GRADE	MRI	ARTHROSCOPY
I	Focal areas of hyper-intensity with normal contour	Softening of cartilage, easily indented with probe
II	Blister-like swelling or fraying of articular cartilage extending to the surface	Surface fibrillation
III	Partial thickness cartilage loss with focal ulceration, ‘crab meat’ appearance	Full thickness fissuring or splitting of cartilage
IV	Full thickness cartilage loss with underlying bone reactive changes	Complete loss of cartilage with exposed subchondral bone

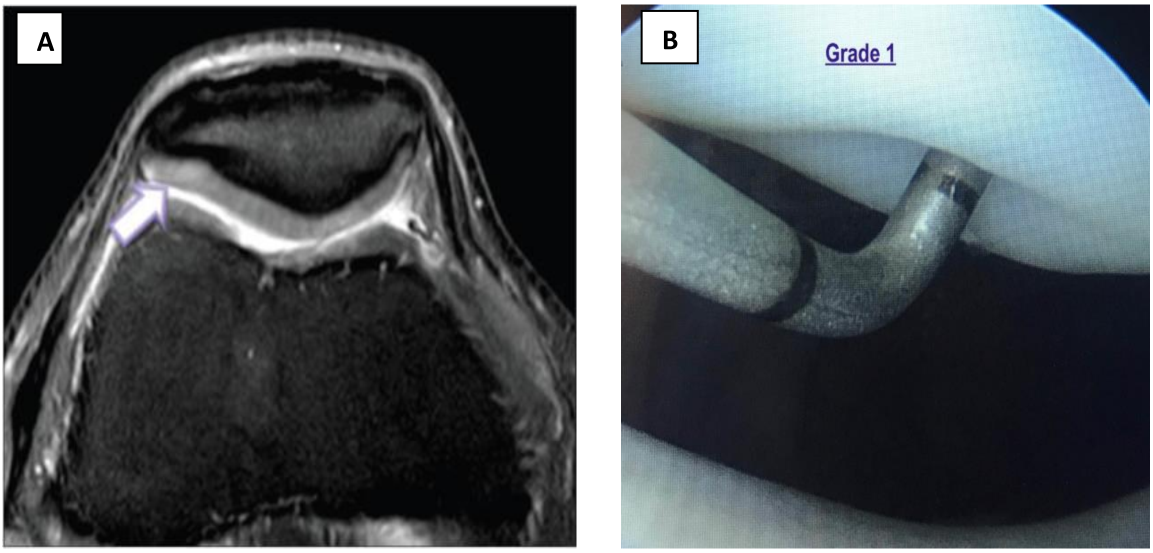


FIGURE 30 – (A)Axial image showing Grade I cartilage lesion of the patella. There is a focal area of chondral softening revealed as area of focal hyper intensity (arrow) (B)Arthroscopic image showing softening of the articular cartilage of the patella

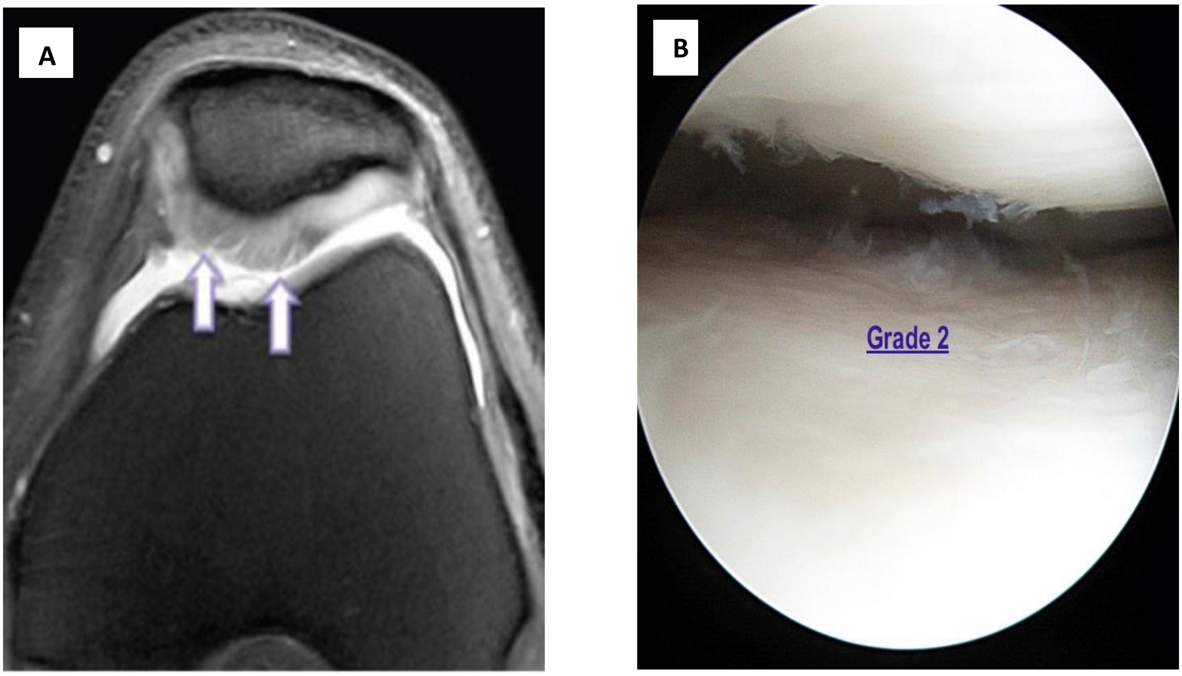


FIGURE 31 – (A) Axial image showing Grade II cartilage lesion, showing fissures over the patella articular cartilage (arrow) (B) Arthroscopic image showing surface fibrillation.

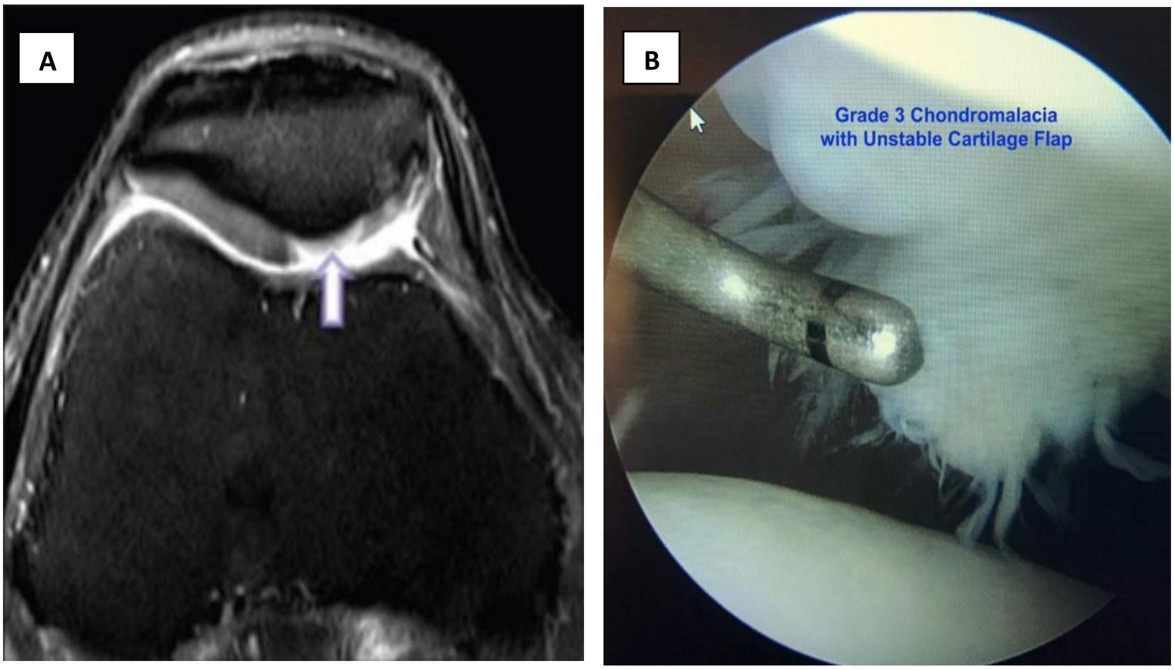


FIGURE 32 – (A) Axial image showing grade III cartilage lesion, with fissuring of the cartilage extending to subchondral bone (arrow) (B)Arthroscopic image showing full thickness fissuring.

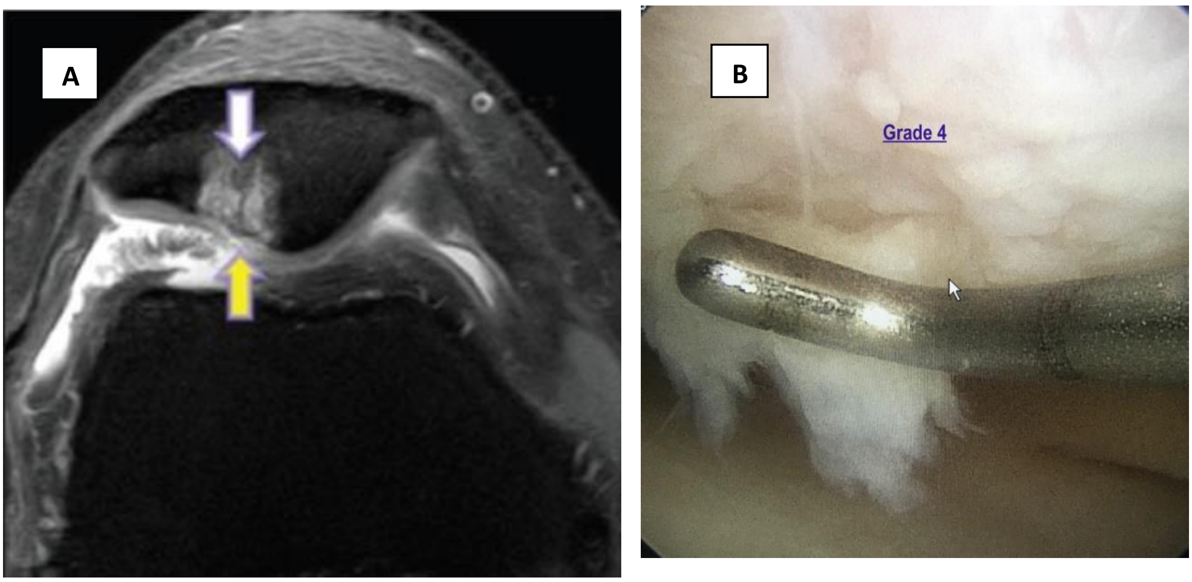


FIGURE 33 – (A) Axial image of patella showing grade IV cartilage defect extending to subchondral bone (yellow arrow) with subchondral bone contusions (white arrow) (B) Arthroscopic image showing exposed subchondral bone.

DIAGNOSTIC ARTHROSCOPY

Knee arthroscopy is an important diagnostic and therapeutic tool in management of disorders of the knee.(61) A complete diagnostic arthroscopy includes visualization of the supra-patellar pouch, medial gutter, lateral gutter, medial and lateral compartments, intercondylar notch, postero-medial and postero-lateral compartments. Diagnostic arthroscopy is a crucial skill for diagnosing intra-articular disorders of knee including meniscal, synovial, ligamentous, and articular cartilage pathology.(62)

Patient is positioned and knee marking are done for portal entry (Figure 34). Standard anterolateral and anteromedial portals are used for the diagnostic procedure

The arthroscope is placed into the supra-patellar pouch through the anterolateral portal. The light cord is rotated downward to look up at the patella, and then the light cord is raised to look down at the trochlear groove to evaluate for cartilage injury.

The arthroscope is then moved medially into the medial gutter, and the hand is raised to follow the floor down to the tibia, checking for loose bodies.

Next, the medial compartment is opened by straightening knee and placing a valgus force on leg. The arthroscope is brought into the medial compartment. At this point, the anteromedial compartment is seen. Medial meniscus is inspected and probed for tears (Figure 35). Cartilage on tibial plateau and medial femoral condyle are evaluated. Knee flexion angle can be changed to inspect entire weight-bearing portion of medial femoral condyle.

Knee is then bent to 90°, and arthroscope is brought into intercondylar notch to examine anterior cruciate ligament (Figure 36), posterior cruciate ligament and to check for loose bodies. The ligaments can be probed to check for integrity. To enter lateral compartment, a triangle between lateral meniscus, lateral femur, and anterior cruciate ligament is identified.

Light cord is turned to look laterally, and arthroscope is advanced into triangle. A varus force is applied to knee either using the figure-of-4 position or directly using the circumferential leg holder. Care is taken to keep the arthroscope in the triangle as the leg is manipulated. Lateral meniscus and articular cartilage are examined similarly to the medial compartment. Next, the arthroscope is brought directly into lateral gutter to check for loose bodies and to examine the postero-lateral compartment.[3]

FIGURE 34 - Landmarks on knee

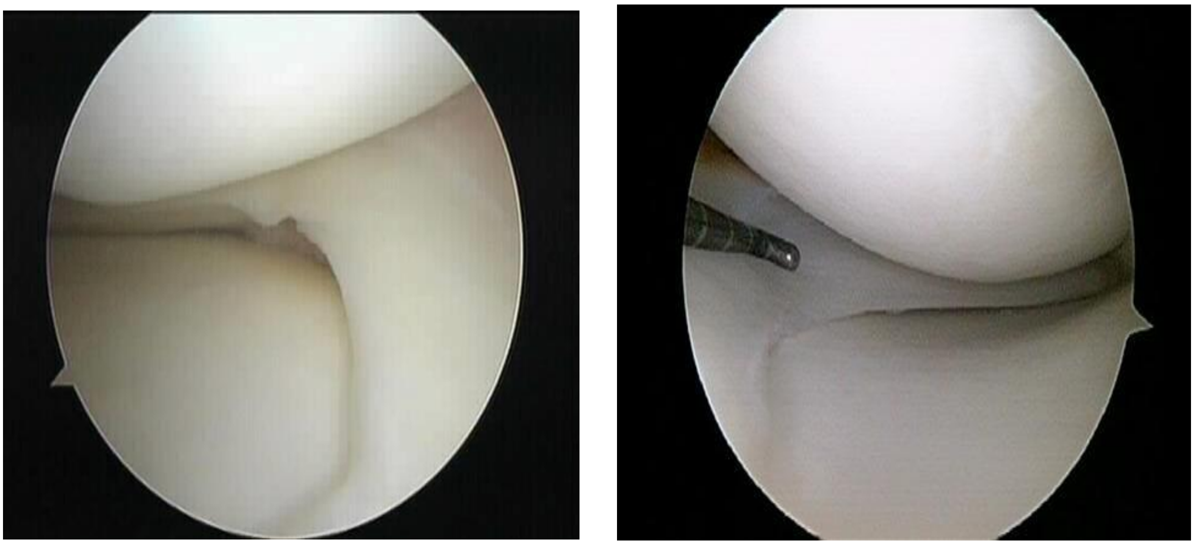


FIGURE 35 - Arthroscopic view of normal meniscus with normal femoral and tibial cartilage

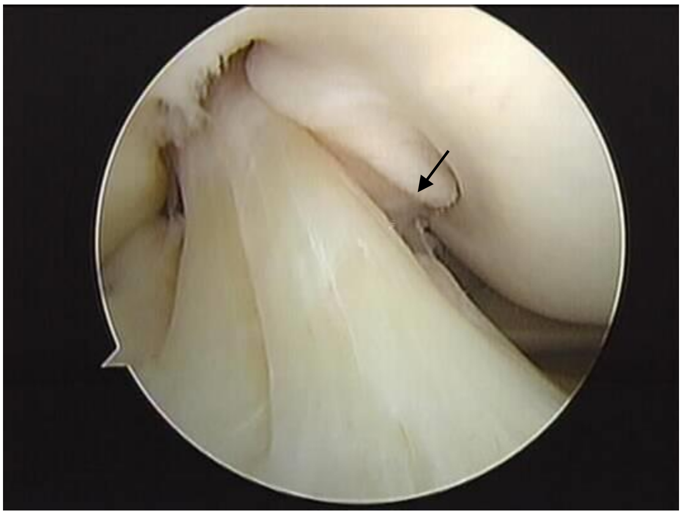


FIGURE 36: Arthroscopic view of normal ACL (arrow)

MATERIAL & METHOD

MATERIALS AND METHOD

Study design – Prospective observational study

Study population -Patients with suspected knee injury presenting to Department of Orthopaedics in R.L Jalappa Hospital, Kolar were included in study after informed written consent.

Duration of study – From October 2019 to September 2021

Sample size – 43

Formula –

$$n = \frac{z^2 1 - \frac{a}{2} P(1-p)}{d^2}$$

p: Expected proportions

d: absolute precision

1-α/2: desired confidence level

SOURCE OF DATA

Inclusion criteria –

- Patients between 18-50 years of age presenting with suspected knee injury.

Exclusion criteria –

- Patients with associated fractures around the knee joint
- Patients with previous history of knee surgery
- Patients with degenerative knee joint disorders
- Patients with isolated collateral ligament injuries
- Patients with infectious and inflammatory conditions of knee joint, ferromagnetic implants, pacemakers and aneurysm clips

METHODOLOGY

43 patients with suspected knee injury presenting to R.L. Jalappa Hospital, Kolar attached to Sri Devaraj Urs Medical College were taken up for the study.

After obtaining informed consent from the patients who agreed to be part of study, demographic data, history, clinical examination during admission, radiographs of knee joint to rule out any fractures and all intra-articular findings with regard to knee derangement on MRI were documented in the study proforma, and were taken up for arthroscopy. Videos and photographs were taken and stored for later use and retrieval.

Systematic objective examination was conducted before MRI evaluation. Knee objective evaluation using joint line tenderness, meniscal clinical tests, McMurray test and signs of ligament laxity (Lachman test, anterior and posterior drawer tests, varus and valgus stress tests) were elicited.

MRI images were studied in detail for injuries to cruciate ligaments, menisci, collateral ligaments, loose bodies, meniscal cysts, articular cartilage, bony contusions and evidence of soft tissue injuries around the knee joint.

Diagnostic and therapeutic arthroscopy was done for all patients, findings of which were separately noted for all 43 patients and necessary repair/reconstruction of the ligament/cartilage was done.

STATISTICAL ANALYSIS

Collected data was entered in Windows Microsoft Excel sheet and analysed with SPSSv22.

Statistical analysis was performed for medial meniscus, lateral meniscus, anterior cruciate and posterior cruciate ligaments, and cartilage surfaces considering arthroscopy as ‘‘gold standard’’. Clinical examination and MRI results were analysed with Chi-Square test.

Sensitivity, specificity, accuracy, positive predictive value (PPV) and negative predictive value (NPV) were evaluated considering arthroscopy as standard of reference.

Study required investigations to be done on human subjects mandatory for anaesthesia, arthroscopy and MRI of the knee joint. Surgical intervention was undertaken after adequate preoperative assessment and after taking informed written consent.

INVESTIGATIONS

Basic investigations

- Haemoglobin %, Total white blood cell (WBC) count, differential count, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), Bleeding time (BT), Clotting time (CT)
- Blood urea, serum creatinine, random blood sugar (RBS)
- HIV, HBsAg status
- Electrocardiograph (ECG), 2D Echocardiogram if required.

Radiological investigations

- Plain radiograph of affected knee joint in antero-posterior and lateral view.
- MRI of affected knee joint.

Endoscopic investigation

- Arthroscopy

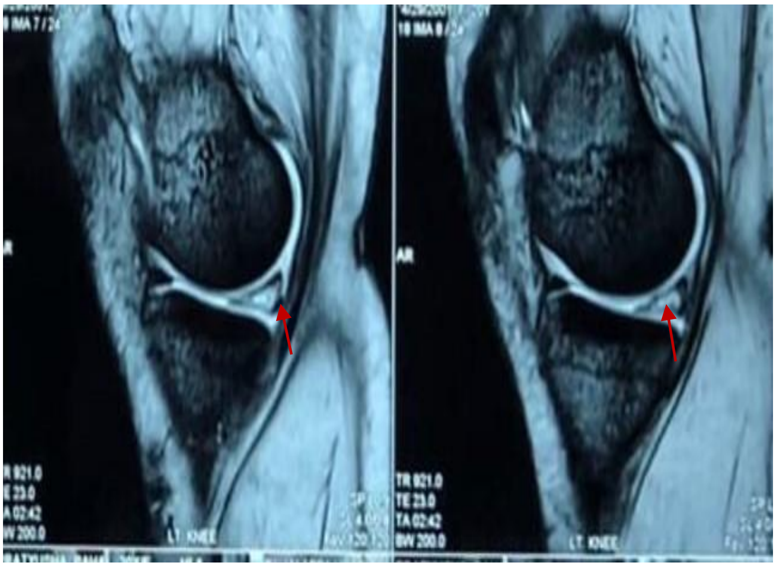
CASE PHOTOS

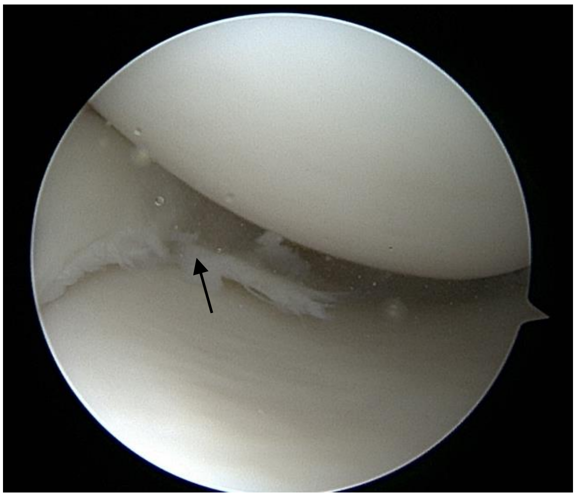
CASE 2

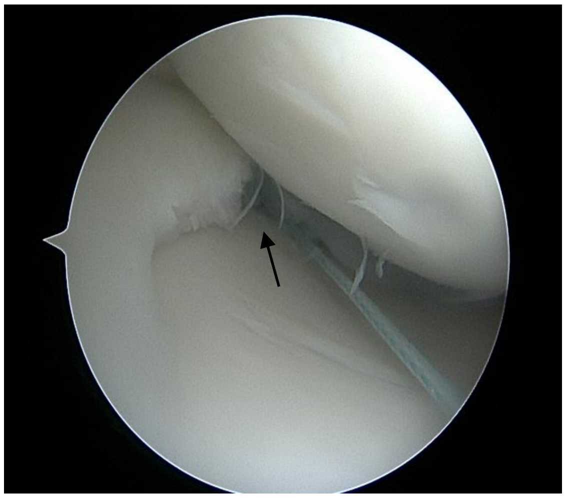
CLINICAL EXAMINATION: MCMURRAY'S POSITIVE FOR MM

MRI: TEAR INPOSTERIOR HORN OF MEDIAL MENISCUS

ARTHROSCOPY: MEDIAL MENISCUS TEAR







Images showing MRI findings of posterior horn of medial meniscus tear (red arrows) which was confirmed on arthroscopy (black arrows)

CASE 4

CLINICAL EXAMINATION: MCMURRAY'S POSITIVE FOR LM AND ANTERIOR DRAWER POSITIVE FOR ACL (GRADE 3)

MRI: MEDIAL MENISCUS TEAR WITH COMPLETE ACL TEAR WITH SOFT TISSUE EDEMA AND BONE BRUISE

ARTHROSCOPY: COMPLETE ACL TEAR WITH NORMAL LATERAL MENISCUS TEAR

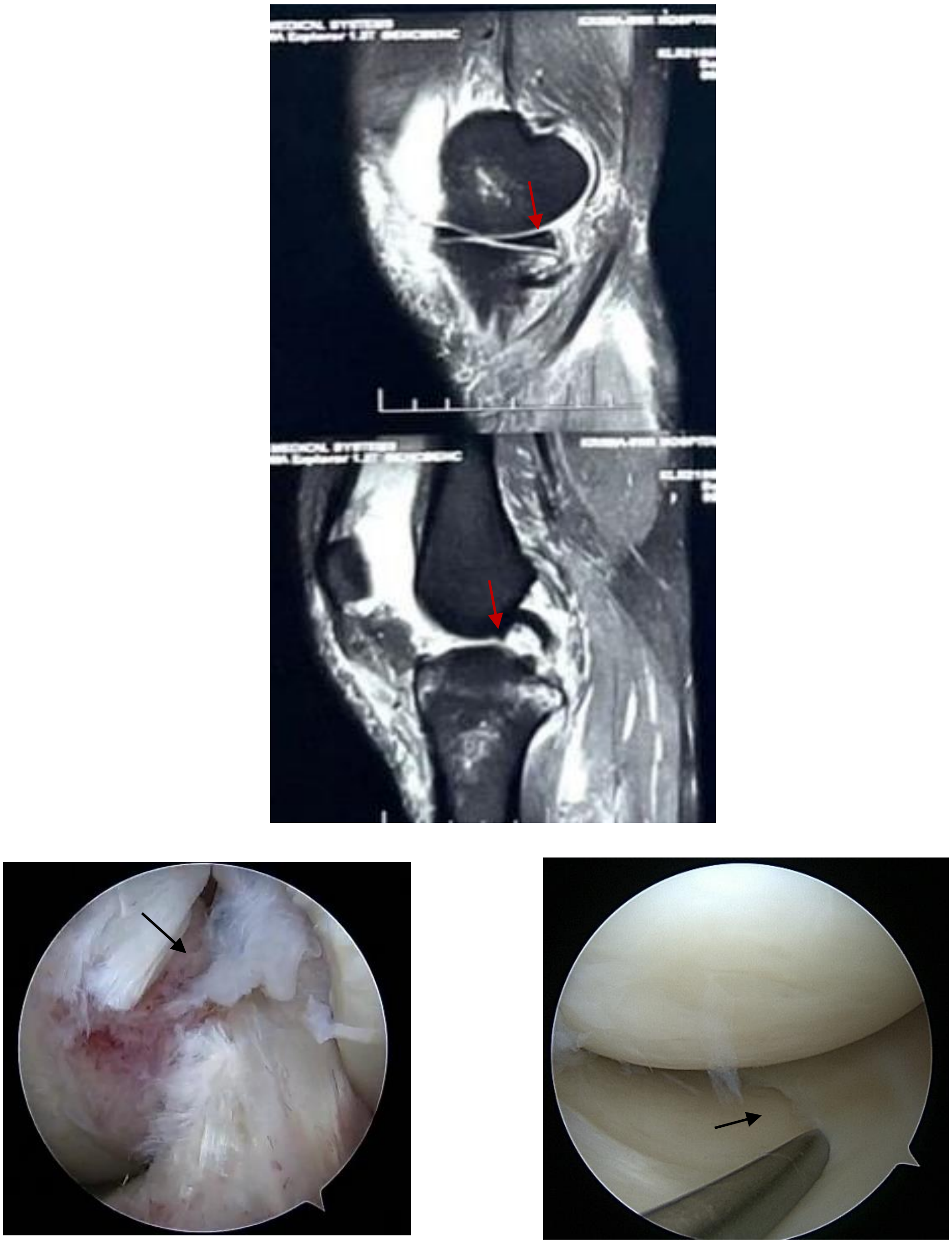


Image showing MRI finding of complete ACL tear and medial meniscus grade 2 hyper-intensity (red arrows). Arthroscopy (black arrows) showed complete ACL tear with normal medial meniscus

CASE 7

CLINICAL EXAMINATION: ANTERIOR DRAWER POSITIVE FOR ACL (GRADE 2)

MRI: PARTIAL ACL TEAR

ARTHROSCOPY: CHRONIC COMPLETE ACL TEAR

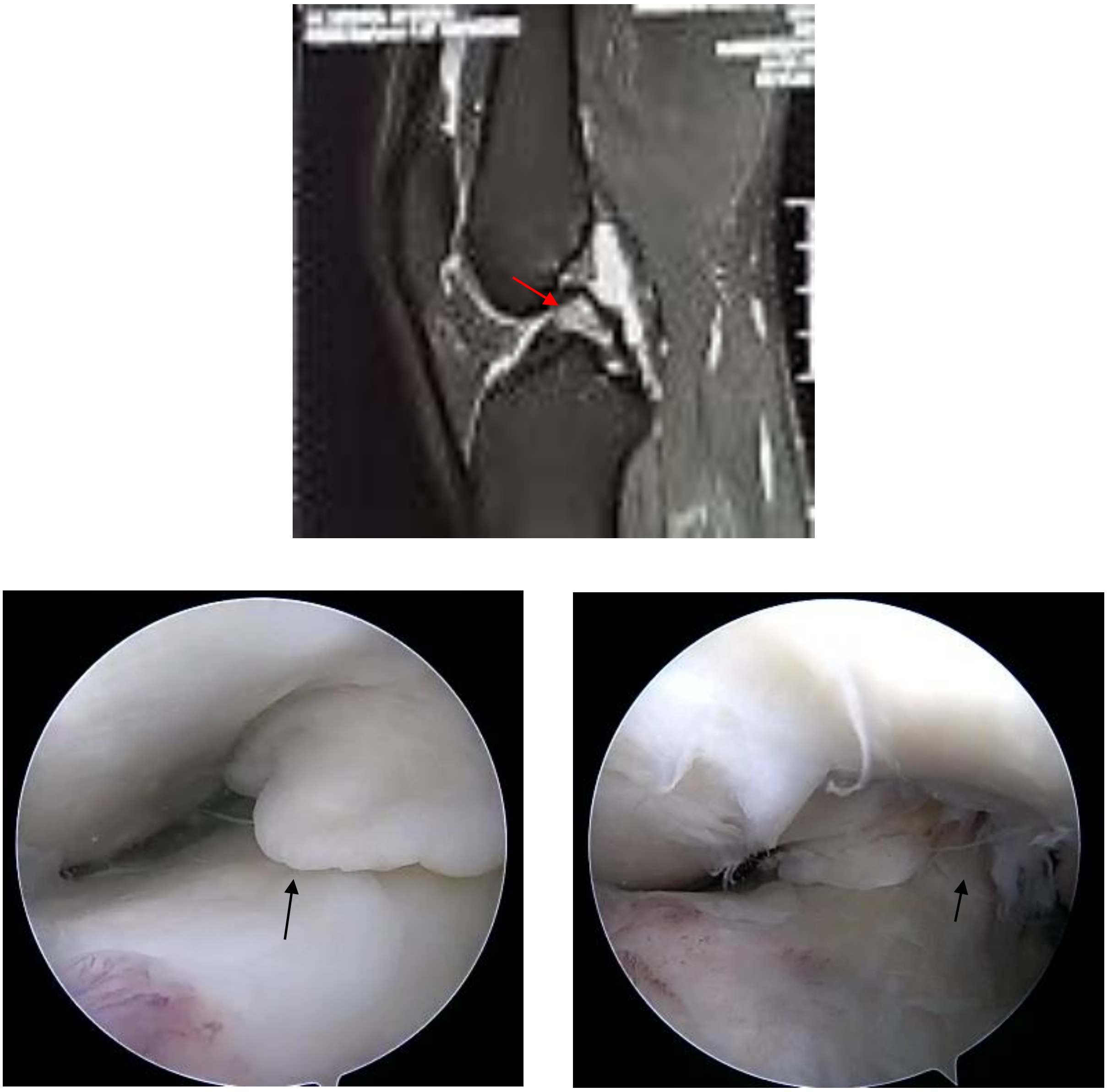


Image showing MRI finding of partial ACL tear (red arrows). Arthroscopy (black arrows) showed chronic complete ACL tear

CASE 8

CLINICAL EXAMINATION: MCMURRAY'S POSITIVE FOR MM AND ANTERIOR DRAWER POSITIVE FOR ACL (GRADE 2)

MRI: MEDIAL MENISCUS TEAR AND COMPLETE ACL TEAR

ARTHROSCOPY: COMPLETE ACL TEAR WITH MEDIAL MENISCUS TEAR

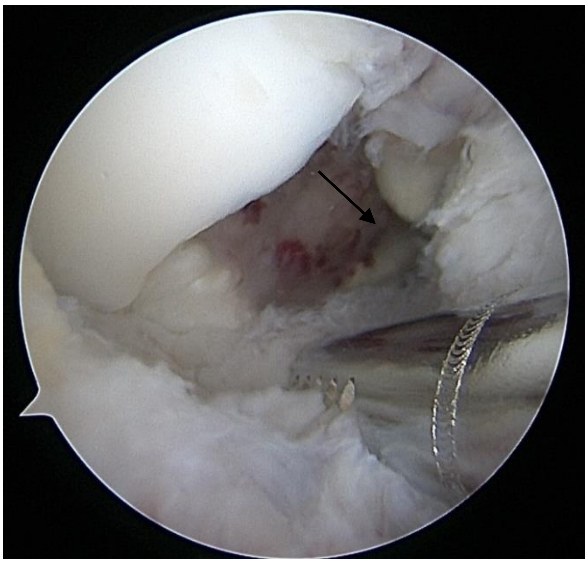


Image showing MRI finding of complete ACL tear (red arrow) which was confirmed on arthroscopy (black arrows)

<u>CASE 11</u>

<u>CLINICAL EXAMINATION</u>: ANTERIOR DRAWER POSITIVE (GRADE 3)

<u>MRI</u>: COMPLETE ACL TEAR

<u>ARTHROSCOPY</u>: COMPLETE ACL TEAR

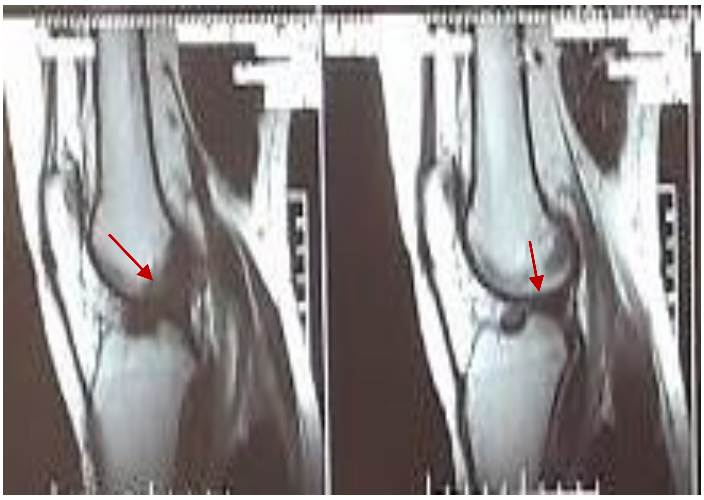


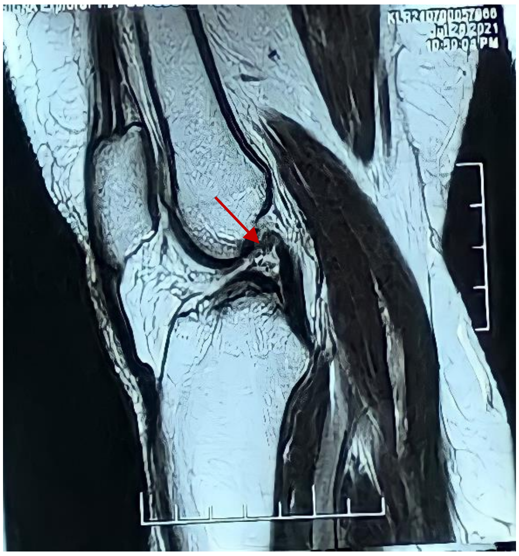
Image showing MRI finding of complete ACL tear (red arrow) which was confirmed on arthroscopy (black arrow)

CASE 13

CLINICAL EXAMINATION: ANTERIOR DRAWER TEST POSITIVE (GRADE 2)

MRI: PARTIAL ACL TEAR

ARTHROSCOPY: COMPLETE ACL TEAR



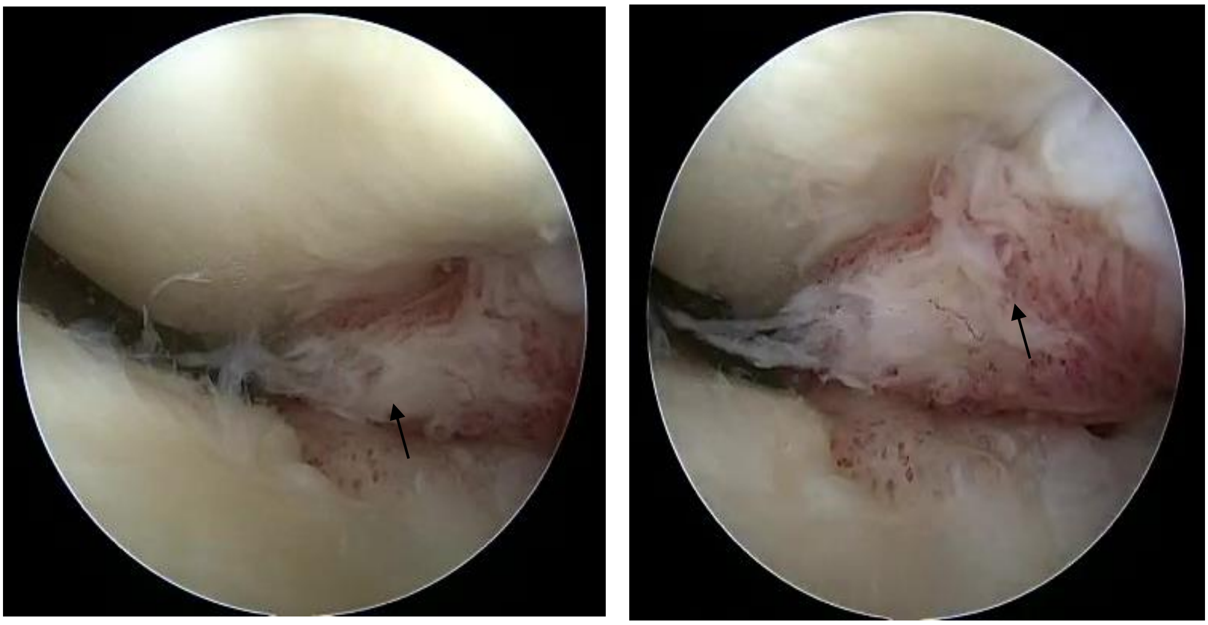
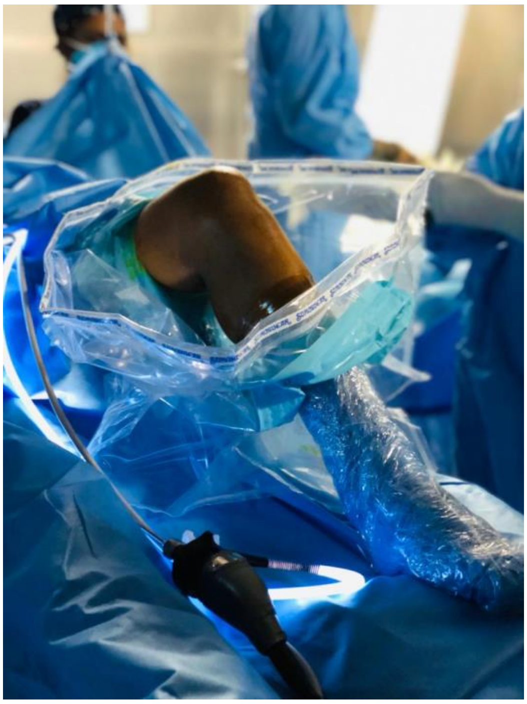


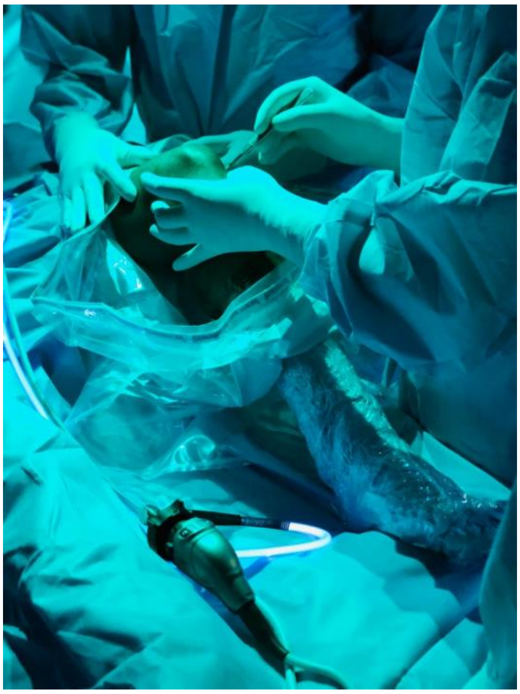
Image showing MRI findings of partial ACL tear (red arrows) but arthroscopy shows complete ACL tear (black arrows)

INTRA-OPERATIVE IMAGES

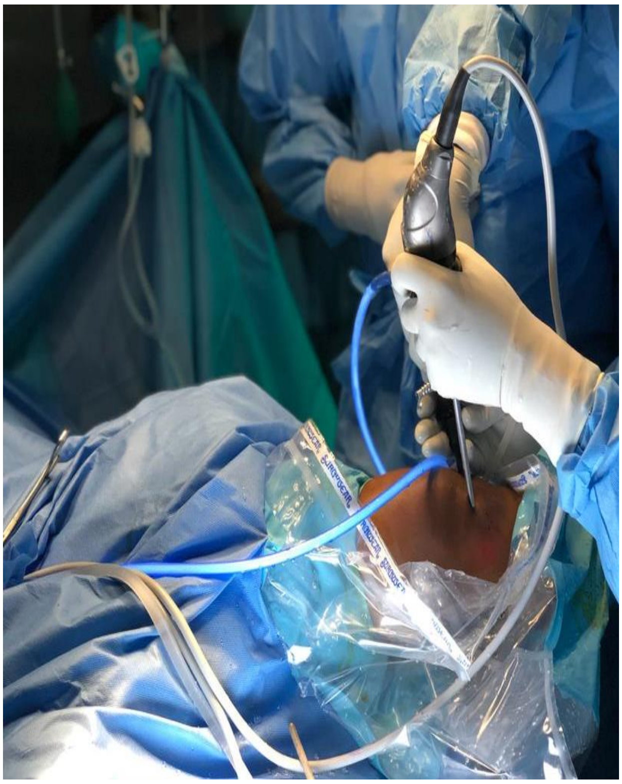
Patient positioning

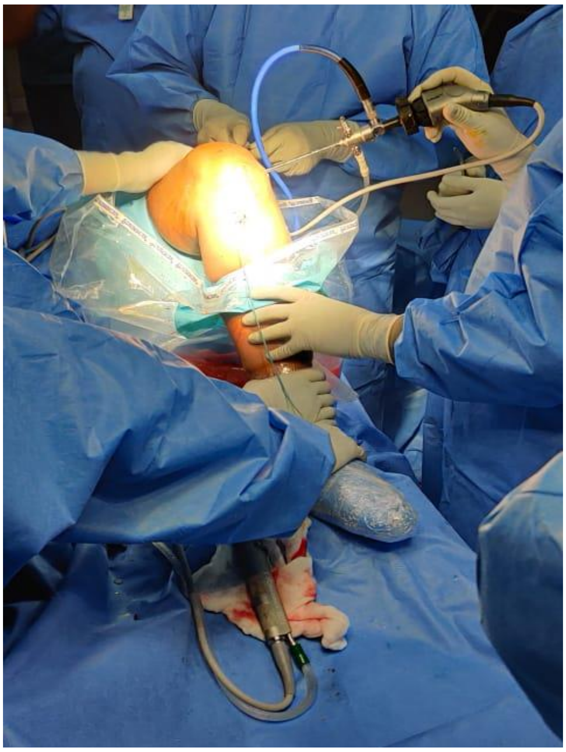


Portal placement



Viewing portals





ARTHROSCOPIC INSTRUMENT AND PORTALS

ARTHROSCOPIC MONITOR

RESULTS

RESULTS

In this study, 43 patients with internal derangement of knee and cartilage defects were studied at R.L. Jalappa Hospital of Sri Devaraj Urs Medical College, Kolar from October 2019 to September 2021. The following observations were made.

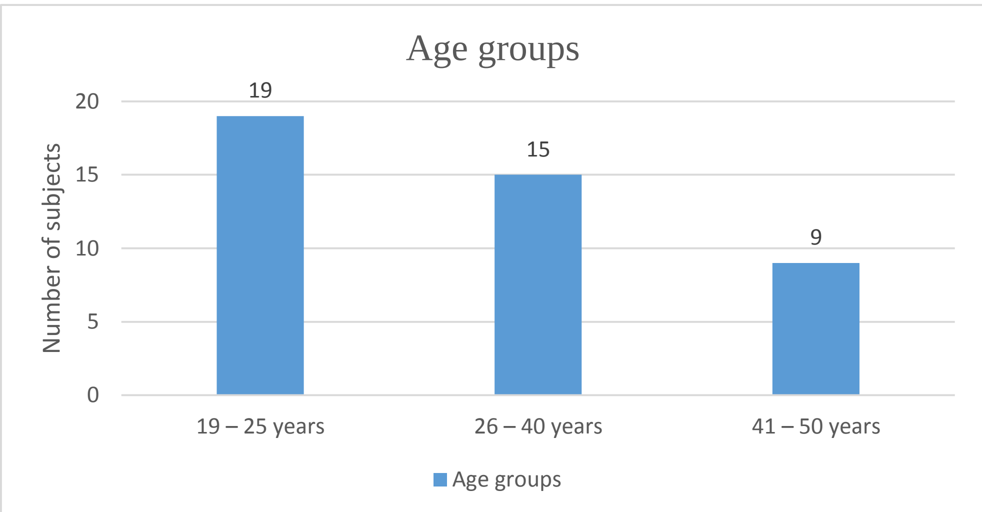
DEMOGRAPHIC FEATURES OF THE PATIENTS –

1. **AGE INCIDENCE** – The average age in our study population was 30 years. The youngest patient being 19 years and oldest patient being 50 years. Most of the patients were within age group of 19-25 years.

TABLE NO. 4 – Descriptive analysis of age in study population

Parameter	Frequency	Percentage
Age categories		
19 – 25 years	19	44.2%
26 – 40 years	15	34.9%
41 – 50 years	9	20.9%
Mean (SD) age in years	29.9 (9.8)	

CHART NO. 1 - Distribution of age among the study participants



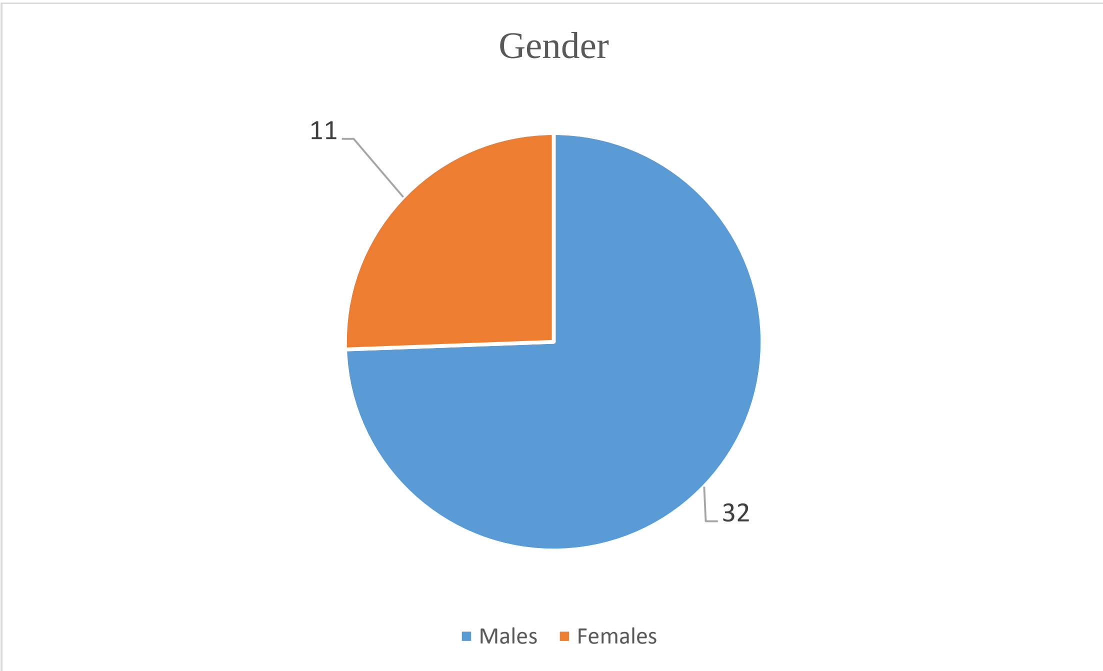
SEX INCIDENCE – In this study, 11 cases were female and 32 cases were male.

Male to female ratio for the whole series was 3:1.

TABLE NO. 5 - Descriptive analysis of gender in study population

Parameter	Frequency	Percentage
Gender		
Male	32	74.4%
Female	11	25.6%

CHART NO. 2 – Distribution of gender among study participants

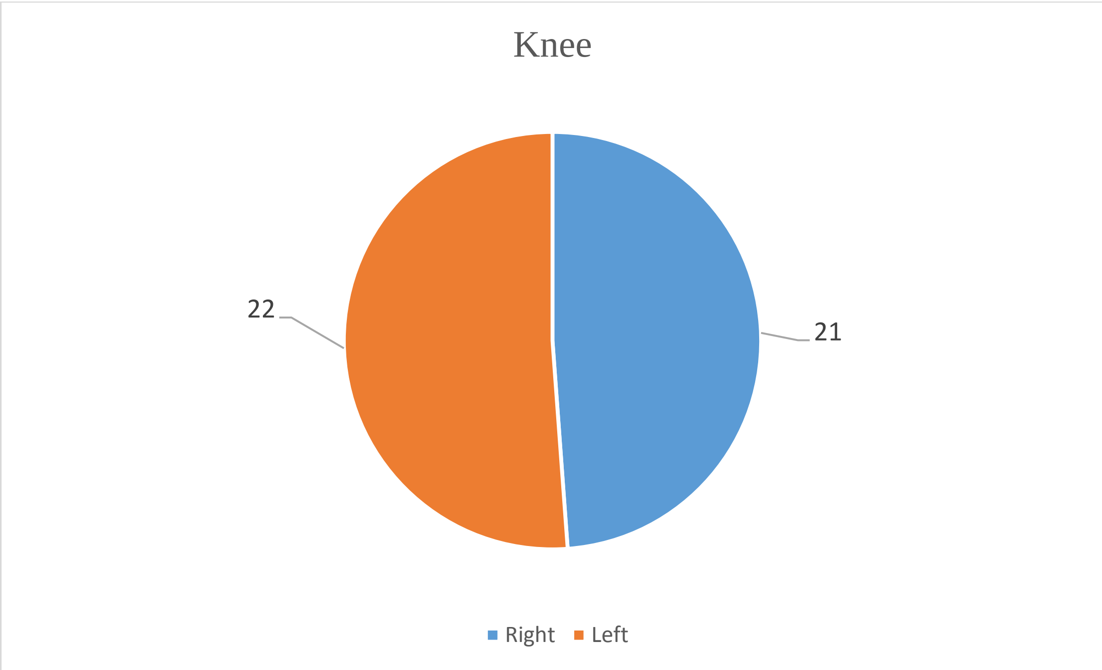


2. **SIDE INVOLVED –** The right knee was involved in 21 patients and left knee in 22 patients. No bilateral knee cases were present.

TABLE NO. 6 - Descriptive analysis of side in study population

Parameter	Frequency	Percentage
Affected side		
Right	21	49%
Left	22	51%

CHART NO. 3 – Distribution of affected knee among study participants



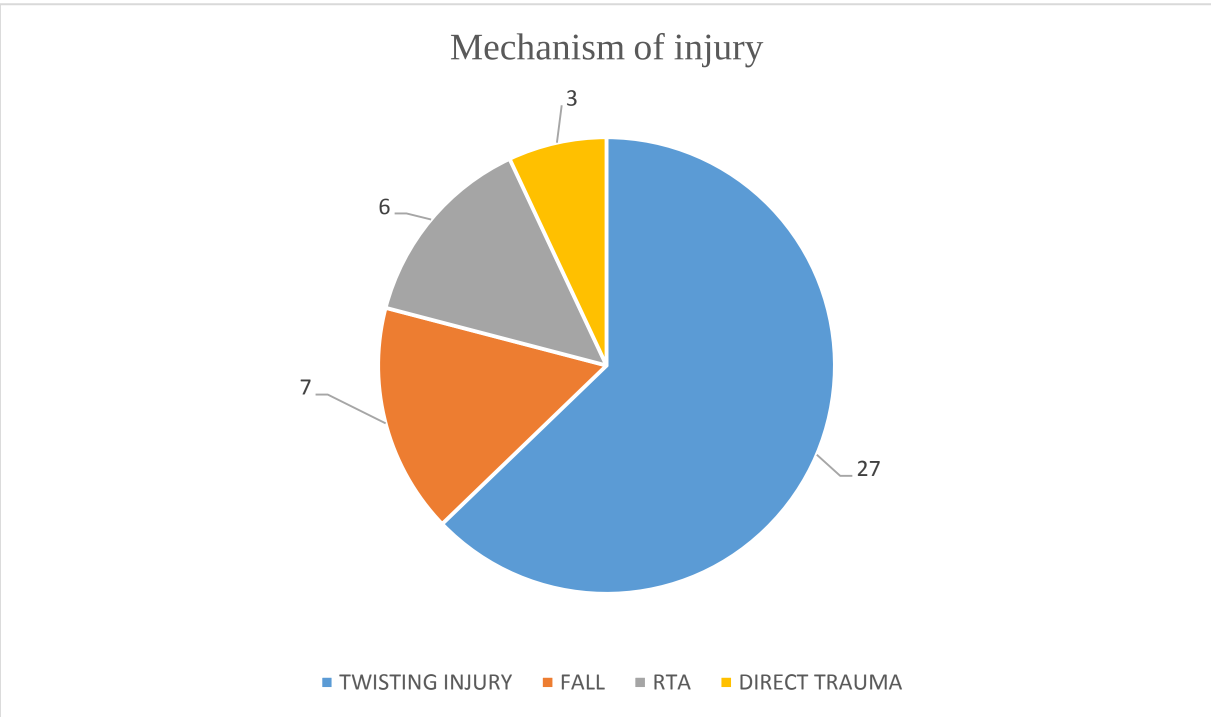
MECHANISM OF INJURY –

In this study, 27 patients (62.8%) sustained twisting injury of knee. Only 3 patients (7%) sustained direct trauma to knee.

TABLE NO. 7 - Descriptive analysis of mechanism of injury in study population

Parameter	Frequency	Percentage
Mechanism of injury		
Twisting injury	27	62.8%
Fall	7	16.3%
Road Traffic Accident	6	13.9%
Direct trauma	3	7.0%

CHART NO. 4 – Distribution of mechanism of injury of study participants



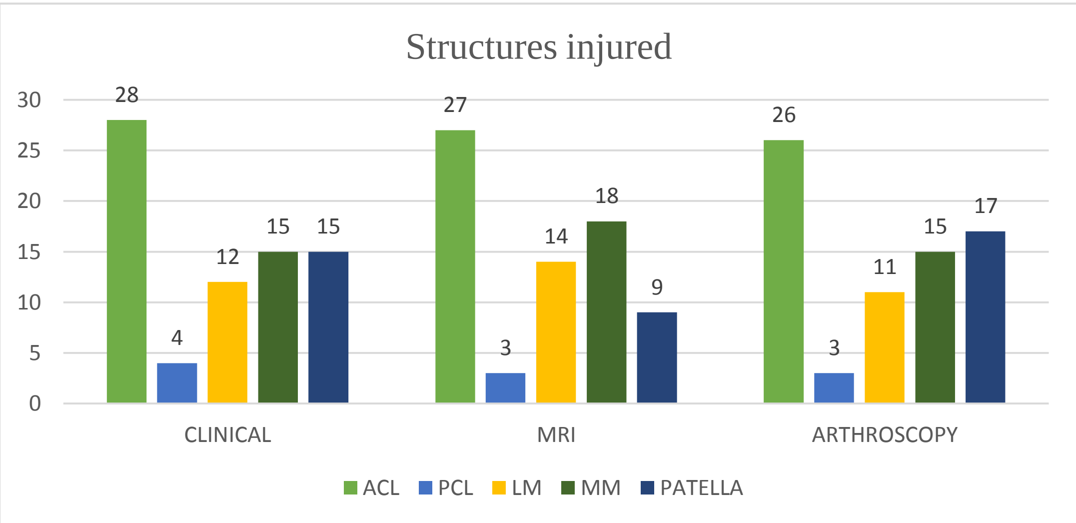
STRUCTURES INJURED –

In our study, we observed that anterior cruciate ligament was most commonly injured among study population followed by medial meniscus and patellar cartilage.

TABLE NO. 8 - Descriptive analysis of structures injured in study population

Parameter	Clinical Exam (Positive)	MRI (Positive)	Arthroscopy (Positive)
Injured structure			
Anterior cruciate ligament (ACL)	28	27	26
Posterior cruciate ligament (PCL)	4	3	3
Lateral Meniscus (LM)	12	14	11
Medial Meniscus (MM)	15	18	15
Patella articular cartilage	15	9	17

CHART NO. 5 - Distribution of structures injured among study participants



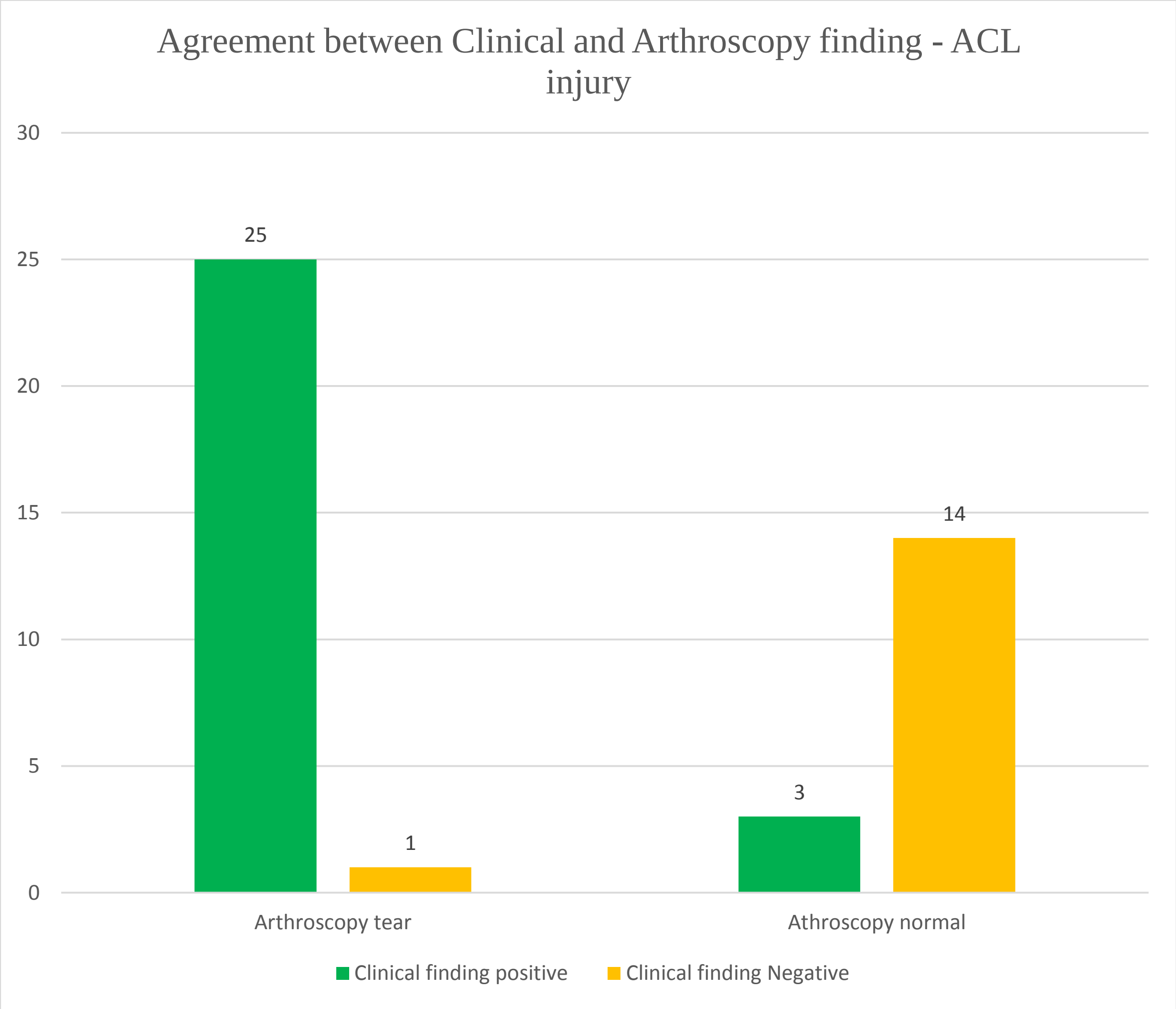
ANTERIOR CRUCIATE LIGAMENT INJURY –

In the table below, we have compared the findings of ACL injury on clinical examination and arthroscopic evaluation. We observed that 25 patients had positive clinical and arthroscopic findings i.e. tear was clinically suspected after performing the tests for ACL injury, the same was confirmed on arthroscopy. The remaining 04 patients showed discrepancy between clinical examination and arthroscopic findings.

TABLE NO. 9 - Cross tabulation between Clinical finding and Arthroscopy (gold standard) for ACL injury

ACL		Arthroscopy Tear	Arthroscopy Normal	Total
Clinical finding	Positive	25 (58.1%)	3 (7.0%)	28 (65.1%)
	Negative	1 (2.3%)	14 (32.6%)	15 (34.9%)
	Total	26 (60.5%)	17 (39.5%)	43 (100%)
Chi-square value= 27.89; p-value<0.001				
Percentage Agreement = 90.7%				
Kappa value = 0.801	Interpretation: Almost perfect agreement			

CHART NO. 6 - Comparison between Clinical finding and Arthroscopy (gold standard) for ACL injury



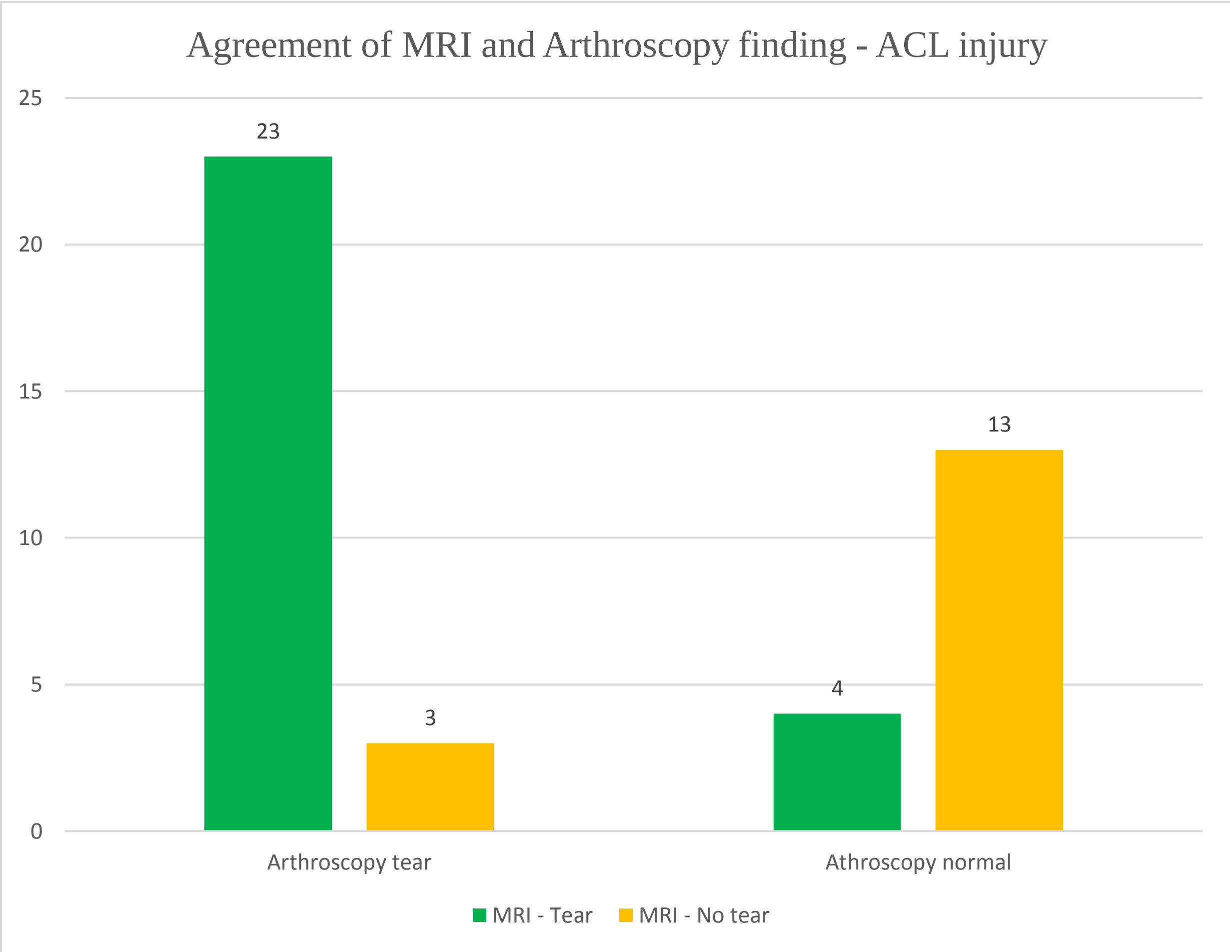
It was observed that, with respect to ACL injury, clinical examination has sensitivity of 96.1% and specificity of 82.3%. Accuracy of clinical examination to detect ACL tears in study population was observed to be 90%.

With regard to MRI findings, we observed that 23 patients had positive MRI and arthroscopic findings that is, ACL tear was present on MRI evaluation of affected knee joint and same was correlated on arthroscopy. The remaining 07 patients showed discrepancy in MRI and arthroscopic findings.

TABLE NO. 10 -Cross tabulation of MRI and Arthroscopy finding (gold standard) for ACL injury

ACL		Arthroscopy Tear	Arthroscopy Normal	Total
MRI finding	Tear	23 (53.5%)	4 (9.3%)	27 (62.8%)
	No tear	3 (7.0%)	13 (30.2%)	16 (37.2%)
	Total	26 (60.5%)	17 (39.5%)	43 (100%)
Chi-square value= 18.54 p-value<0.001				
Percentage Agreement = 83.7%				
Kappa value = 0.656		Interpretation: Substantial agreement		

CHART NO. 7 - Comparison of MRI and Arthroscopy finding (gold standard) for ACL injury



After comparing MRI and arthroscopic findings of ACL injury, it was noted that MRI has sensitivity of 88% and specificity of 76.4%. Accuracy of MRI to detect ACL tears in study population was observed to be 83.7%.

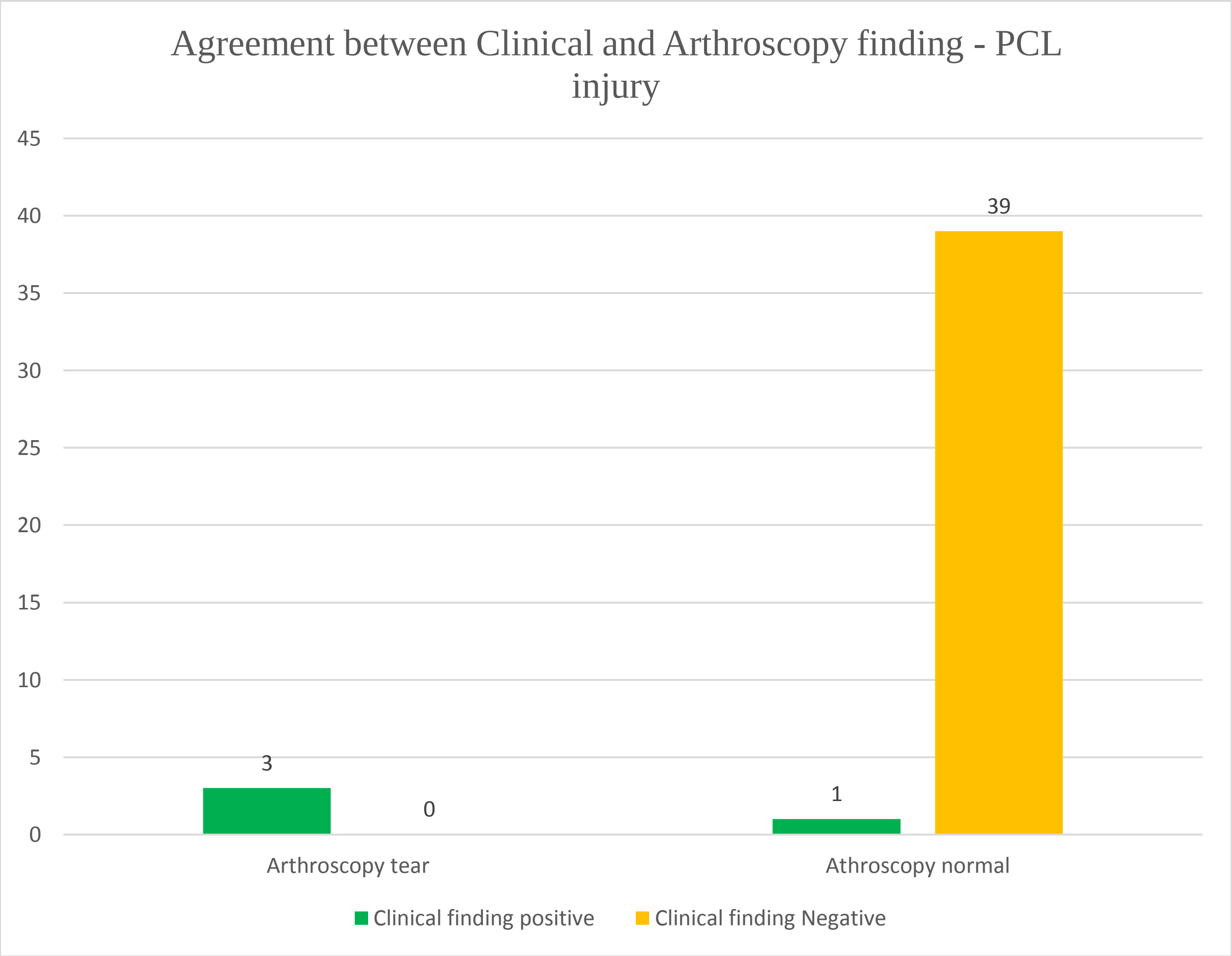
POSTERIOR CRUCIATE LIGAMENT INJURY –

In the given table, findings of PCL injury on clinical examination and arthroscopic evaluation is documented. We observed that 3 patients had positive clinical and arthroscopic findings, which implied, positive result of clinical test led to suspicion of PCL tear which was correlated on arthroscopy. 01 patient showed discrepancy of clinical examination and arthroscopic findings.

TABLE NO. 11 - Cross tabulation between Clinical finding and Arthroscopy (gold standard) for PCL injury

PCL		Arthroscopy Tear	Arthroscopy Normal	Total
Clinical finding	**Positive**	3 (7.0%)	1 (2.3%)	4 (9.3%)
	Negative	0	39 (90.7%)	39 (90.7%)
	Total	3 (7.0%)	40 (93.0%)	43 (100%)
Chi-square value= 31.44; p-value<0.001				
Percentage Agreement = 97.7%				
Kappa value = 0.845		Interpretation: Almost perfect agreement		

CHART NO. 8 - Comparison between Clinical finding and Arthroscopy (gold standard) for PCL injury



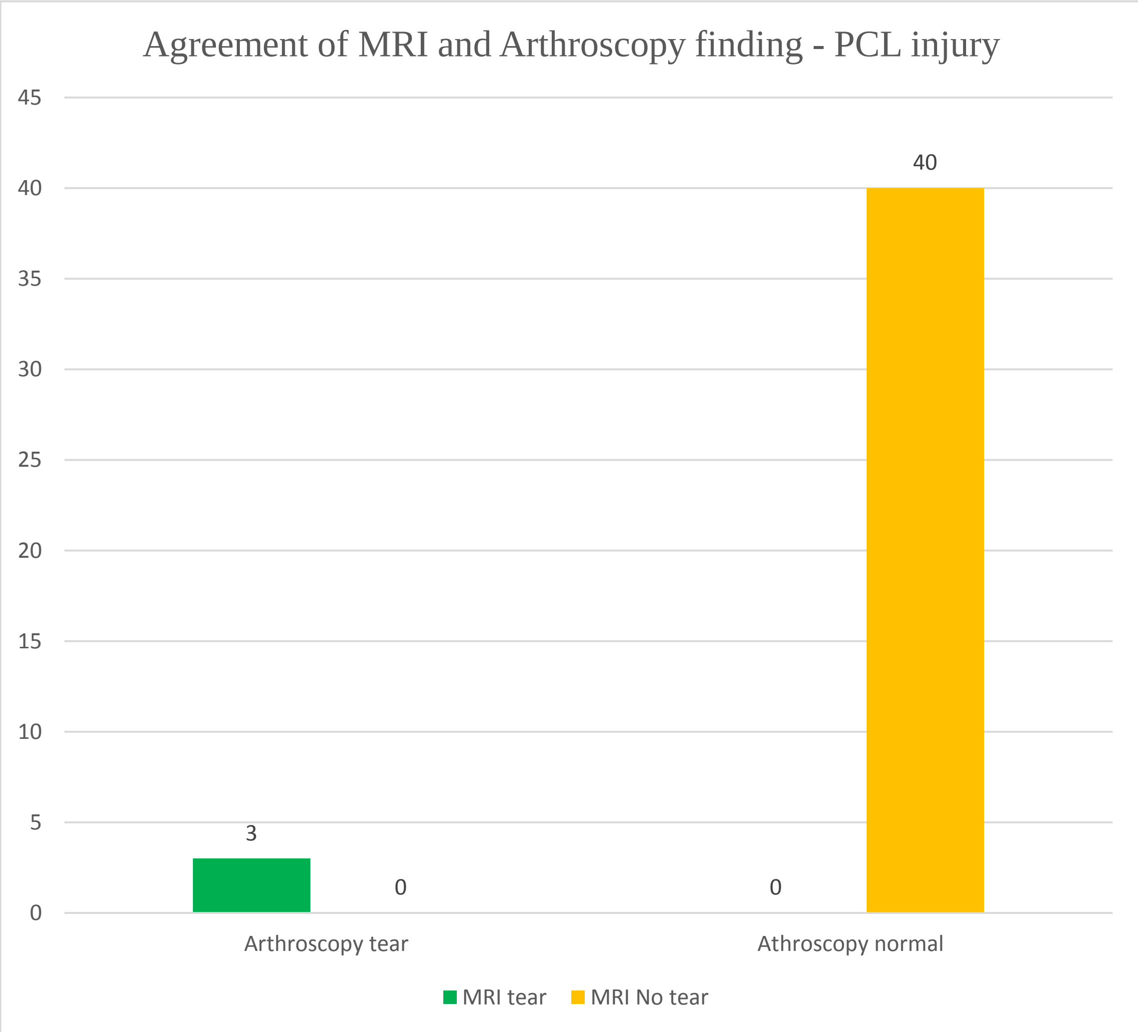
With respect to PCL injury, it was ascertained that clinical examination has sensitivity of 100% and specificity of 97.5%. Accuracy of clinical evaluation to detect PCL tears in study population was noted to be 97.7%.

On comparing MRI and arthroscopic findings, we observed that 3 patients had positive MRI and arthroscopic findings which implied PCL tear was present on both MRI evaluation and arthroscopy. The remaining 40 patients showed no tear on MRI and on arthroscopy.

TABLE NO. 12 - Cross tabulation of MRI and Arthroscopy finding (gold standard) for PCL injury

<table>
<tr><th colspan="2">PCL</th><th>Arthroscopy Tear</th><th>Arthroscopy Normal</th><th>Total</th></tr>
<tr><td rowspan="2">MRI finding</td><td>Tear</td><td>3 (7.0%)</td><td>0</td><td>3 (7.0%)</td></tr>
<tr><td>No tear</td><td>0</td><td>40 (93.0%)</td><td>40 (93.0%)</td></tr>
<tr><td></td><td>Total</td><td>3 (7.0%)</td><td>40 (93.0%)</td><td>43 (100%)</td></tr>
<tr><td colspan="5">Chi-square value= 43.00 p-value<0.001</td></tr>
<tr><td colspan="5">Percentage Agreement = 100%</td></tr>
<tr><td colspan="2">Kappa value = 1.00</td><td colspan="3">Interpretation: Perfect agreement</td></tr>
</table>

CHART NO. 9 - Comparison of MRI and Arthroscopy finding (gold standard) for PCL injury



For a total number of 43 patients that were studied, we found that sensitivity, specificity and accuracy by MRI evaluation of PCL tear is 100%.

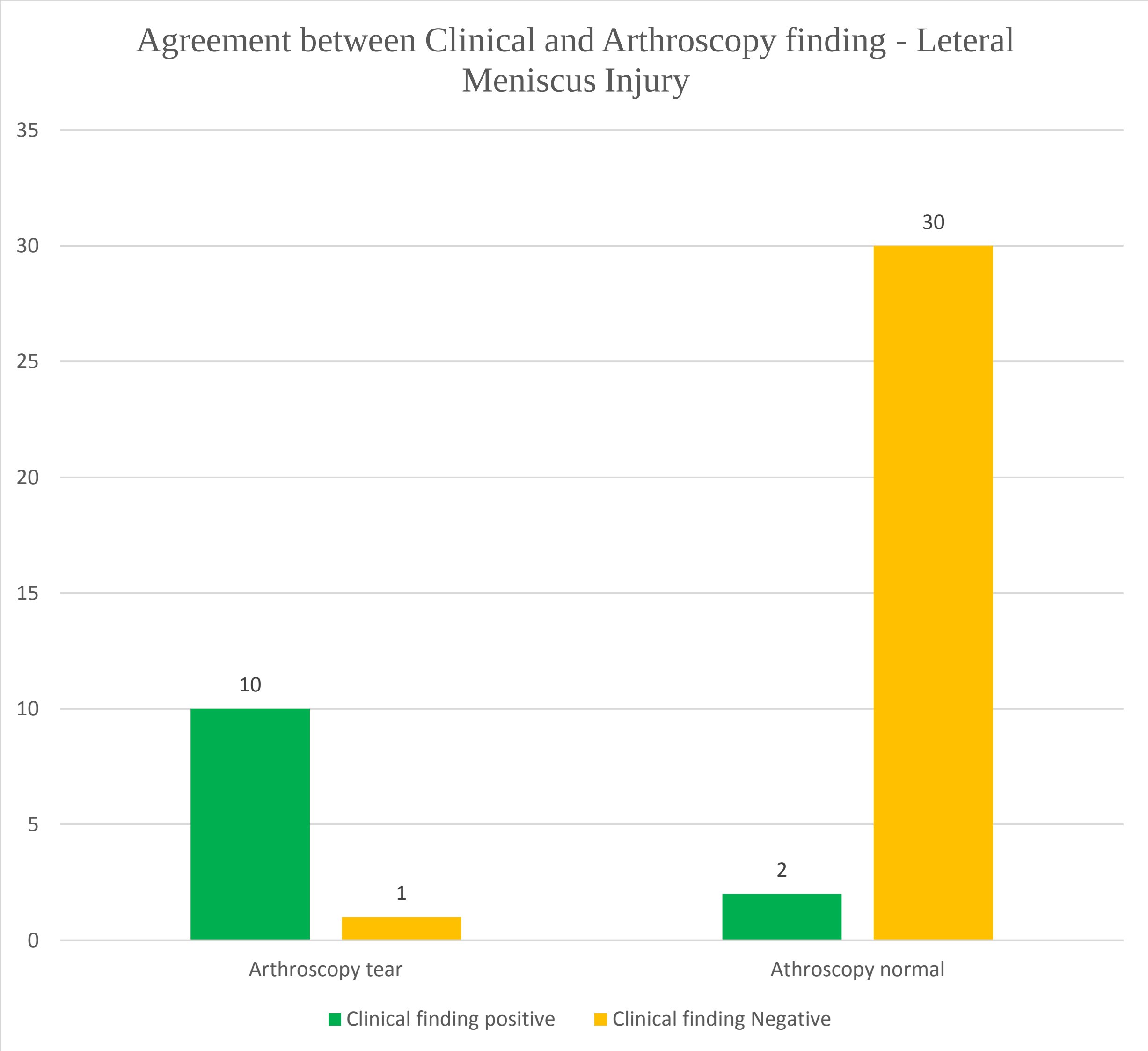
LATERAL MENISCUS INJURY –

The observations of LM injury on clinical examination and arthroscopic evaluation is noted below. We observed that 10 patients had positive clinical and arthroscopic findings, which implied, positive result of the clinical test led to the suspicion of LM tear which was confirmed on arthroscopy. 03 patients showed discrepancy of clinical examination and arthroscopic findings.

TABLE NO. 13 - Cross tabulation between Clinical finding and Arthroscopy (gold standard) for Lateral Meniscus injury

Lateral Meniscus		**Arthroscopy Tear**	**Arthroscopy Normal**	**Total**
Clinical finding	**Positive**	10 (23.3%)	2 (4.6%)	12 (27.9%)
	Negative	1 (2.3%)	30 (69.8%)	31 (72.1%)
	Total	11 (25.6%)	32 (74.4%)	43 (100%)
Chi-square value= 29.16; p-value<0.001				
Percentage Agreement = 93.0%				
Kappa value = 0.822	Interpretation: Almost perfect agreement			

CHART NO. 10 - Comparison between Clinical finding and Arthroscopy (gold standard) for Lateral Meniscus injury



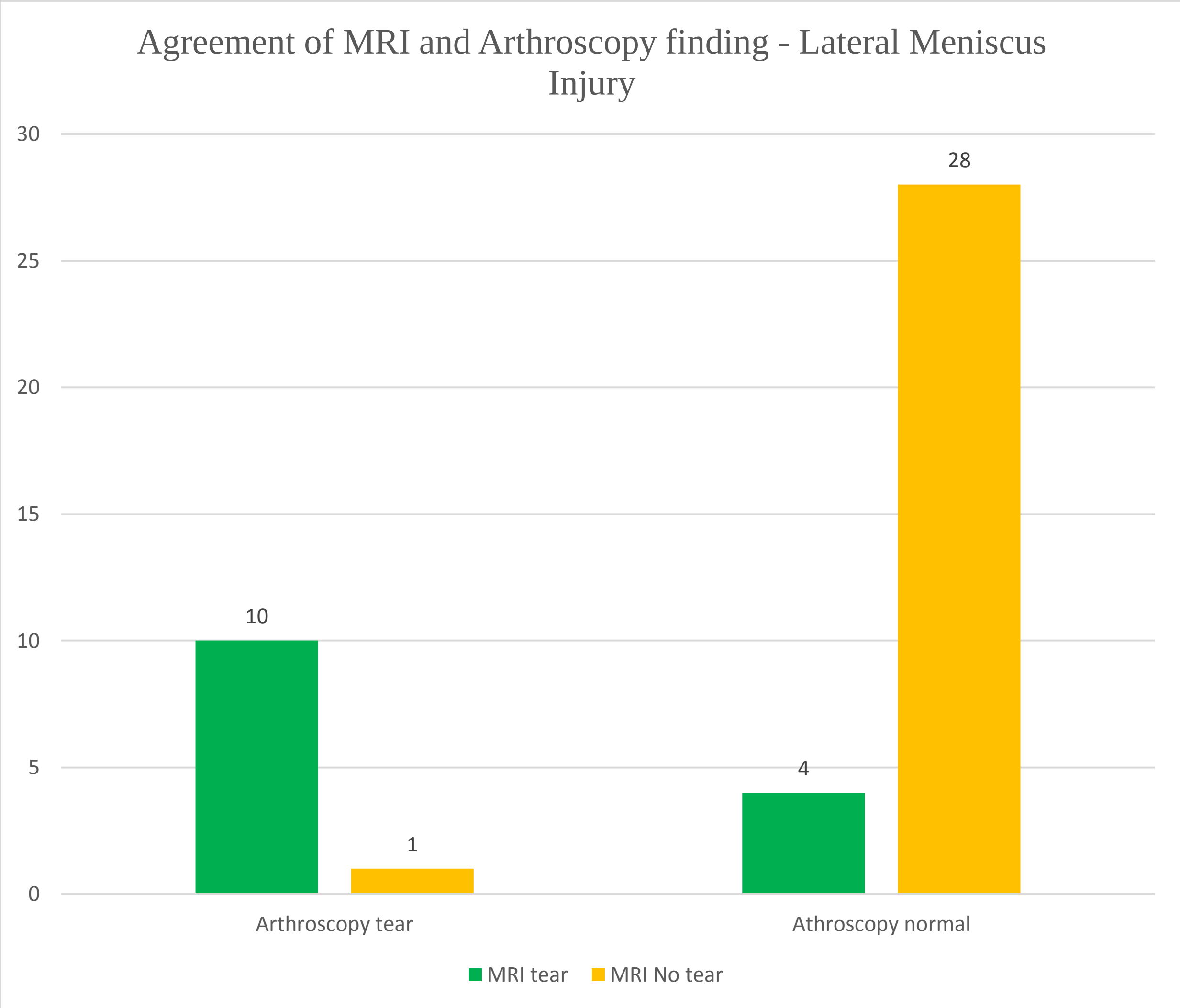
For LM injury, we observed that clinical examination has a sensitivity of 90.9% and a specificity of 93.7%. The overall accuracy of clinical evaluation to detect LM tears in the study population was noted to be 93%.

On LM tears, we observed that 10 patients had positive MRI and arthroscopic findings which implied LM tear was present on both MRI evaluation as well as on arthroscopic evaluation. 05 patients showed discrepancy of MRI and arthroscopic findings.

TABLE NO. 14 - Cross tabulation of MRI and Arthroscopy finding (gold standard) for Lateral Meniscus injury

Lateral Meniscus		**Arthroscopy Tear**	**Arthroscopy Normal**	**Total**
MRI finding	**Tear**	10 (23.3%)	4 (9.3%)	14 (32.6%)
	No tear	1 (2.3%)	28 (65.1%)	29 (67.4%)
	Total	11 (25.6%)	32 (74.4%)	43 (100%)
Chi-square value= 22.92 p-value<0.001				
Percentage Agreement = 88.4%				
Kappa value = 0.719	Interpretation: Substantial agreement			

CHART NO. 11 - Comparison of MRI and Arthroscopy finding (gold standard) for Lateral Meniscus injury



In the study population, it was observed that MRI has sensitivity of 90.9% and specificity of 87.5% in diagnosing LM tears and an accuracy of 88.4%.

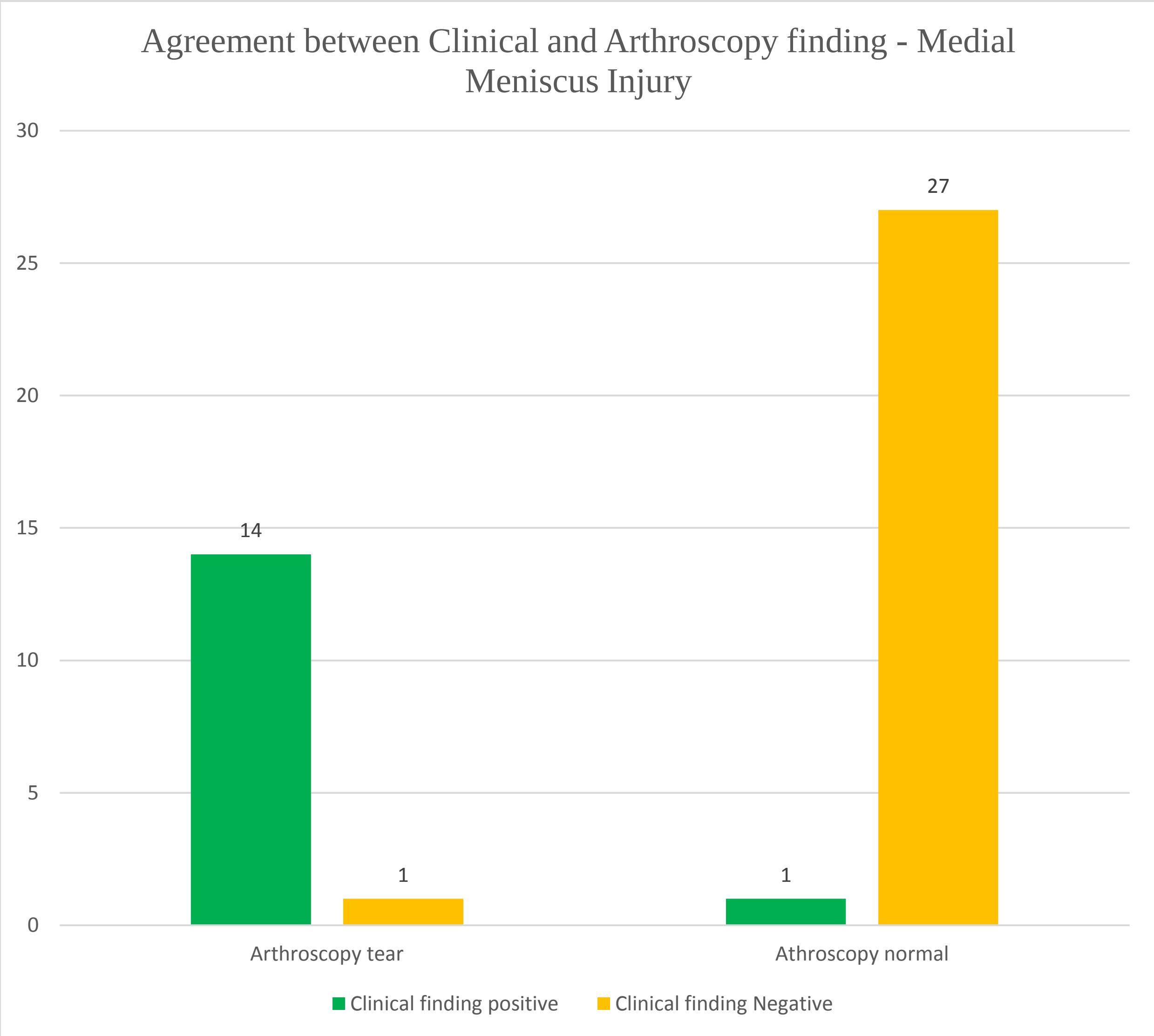
MEDIAL MENISCUS INJURY –

In the table below, comparison of findings of MM injury on clinical examination and arthroscopic evaluation has been documented. It was observed that 14 patients had positive clinical and arthroscopic findings i.e. tear was clinically suspected after performing the tests for MM injury, the same was confirmed on arthroscopy. 02 patients showed discrepancy between clinical examination and arthroscopic findings.

TABLE NO. 15 - Cross tabulation between Clinical finding and Arthroscopy (gold standard) for Medial Meniscus injury

Medial Meniscus		**Arthroscopy Tear**	**Arthroscopy Normal**	**Total**
Clinical finding	**Positive**	14 (32.6%)	1 (2.3%)	15 (34.9%)
	Negative	1 (2.3%)	27 (62.8%)	28 (65.1%)
	Total	15 (34.9%)	28 (65.1%)	43 (100%)
Chi-square value= 34.64; p-value<0.001				
Percentage Agreement = 95.3%				
Kappa value = 0.897	Interpretation: Almost perfect agreement			

CHART NO. 12 - Comparison between Clinical finding and Arthroscopy (gold standard) for Medial Meniscus injury



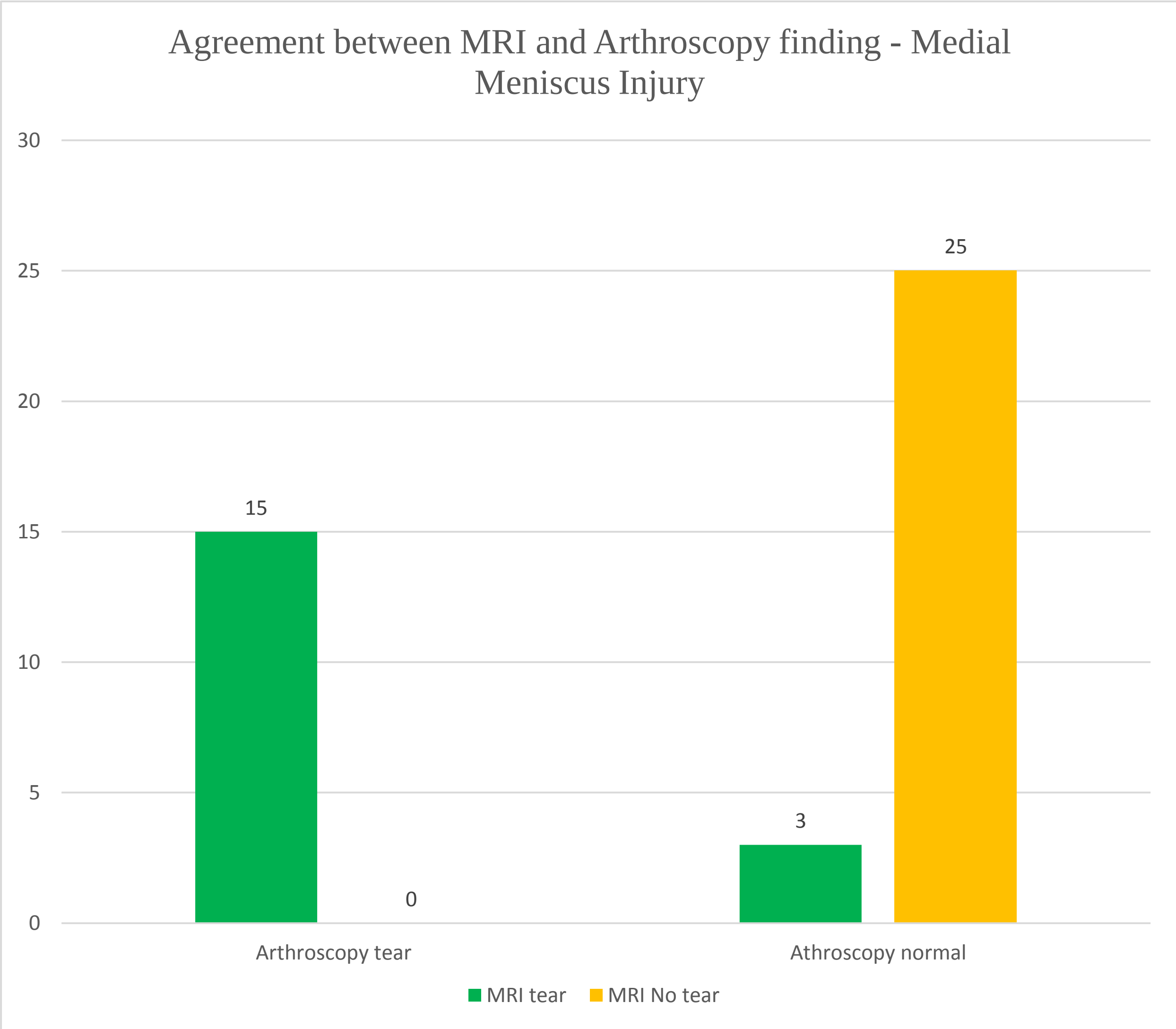
It was observed that, with respect to MM injury, clinical examination has a sensitivity of 93.3% and a specificity of 96.4%. The overall accuracy of clinical examination to detect MM tears in the study population was observed to be 95.3%.

With regard to MRI findings, we observed that 15 patients had positive MRI and arthroscopic findings i.e. MM tear was present on MRI evaluation of the affected knee joint and the same was confirmed on arthroscopy. 03 patients showed discrepancy between MRI and arthroscopic findings.

TABLE NO. 16 - Cross tabulation between MRI and Arthroscopy finding (gold standard) for Medial Meniscus injury

Medial Meniscus		**Arthroscopy Tear**	**Arthroscopy Normal**	**Total**
MRI finding	**Tear**	15 (34.9%)	3 (7.0%)	18 (41.9%)
	No tear	0	25 (58.1%)	25 (58.1%)
	Total	15 (34.9%)	28 (65.1%)	43 (100%)
Chi-square value= 31.99 p-value<0.001				
Percentage Agreement = 93.0%				
Kappa value = 0.853	Interpretation: Almost perfect agreement			

CHART NO. 13 - Comparison between MRI and Arthroscopy finding (gold standard) for Medial Meniscus injury



After comparing MRI and arthroscopic findings of MM injury, it was noted that MRI has a sensitivity of 100% and a specificity of 89.2%. The overall accuracy of MRI to detect MM tears in the study population was observed to be 93%.

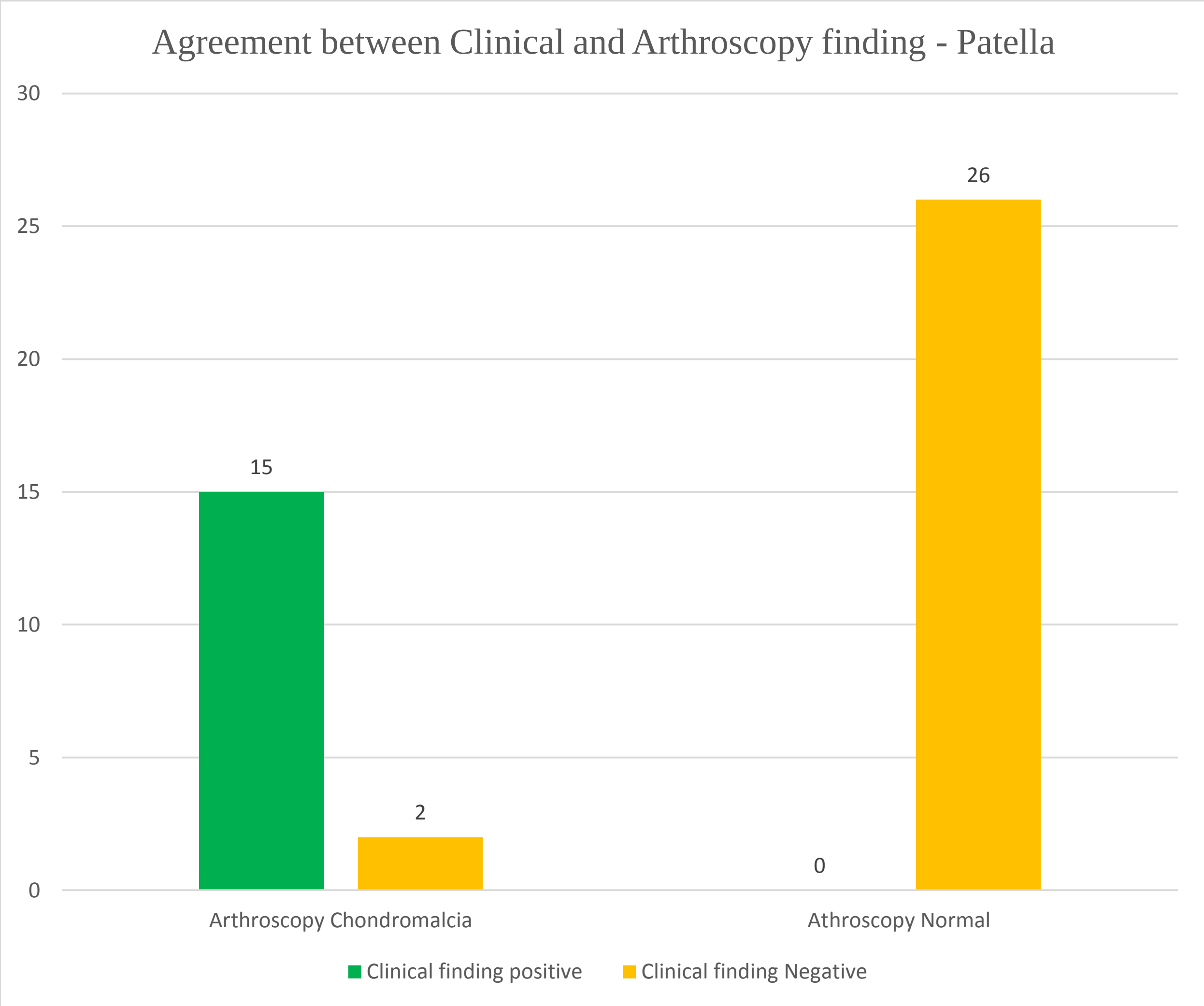
PATELLAR ARTICULAR CARTILAGE –

In the given table, clinical examination and arthroscopic evaluation of patellar cartilage is documented. It shows that 15 patients had positive clinical and arthroscopic findings, which implied, clinical tests led to suspicion of patellar articular damage which was correlated on arthroscopy. 02 patients showed discrepancy between clinical findings and arthroscopic findings.

TABLE NO. 17 - Cross tabulation between Clinical finding and Arthroscopy (gold standard) for Patellar injury

Patella		**Arthroscopy Chondromalacia**	**Arthroscopy Normal**	**Total**
Clinical finding	**Positive**	15 (34.9%)	0	15 (34.9%)
	Negative	2 (4.6%)	26 (60.5%)	28 (65.1%)
	Total	17 (39.5%)	26 (60.5%)	43 (100%)
Chi-square value= 35.23; p-value<0.001				
Percentage Agreement = 95.3%				
Kappa value = 0.900		Interpretation: Almost perfect agreement		

CHART NO. 14 - Comparison between Clinical finding and Arthroscopic findings (gold standard) for Patellar injury



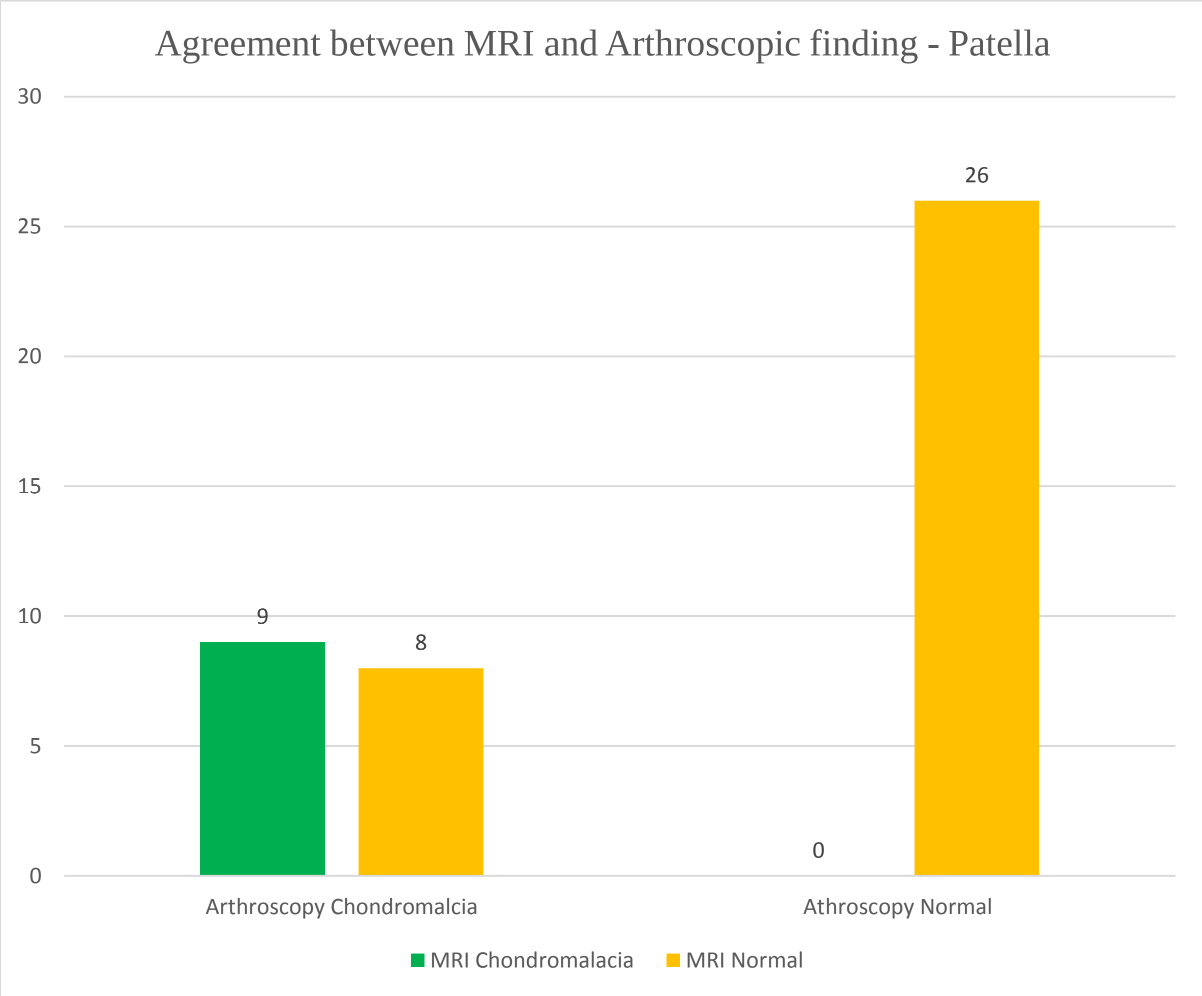
We observed that clinical examination has sensitivity of 88.2%, specificity of 100% and an accuracy of 95.3% in diagnosing patellar cartilage damage.

With regard to MRI findings, we observed that 9 patients had positive MRI and arthroscopic findings that is chondromalacia patella was present on MRI evaluation of affected knee joint and same was correlated on arthroscopy. 08 patients showed discrepancy between MRI and arthroscopy findings.

TABLE NO. 18 - Cross tabulation between MRI and Arthroscopic findings (gold standard) for Patellar injury

Patella		Arthroscopy Chondromalacia	Arthroscopy Normal	Total
MRI finding	**Chondromalacia**	9 (20.9%)	0	9 (20.9%)
	Normal	8 (18.6%)	26 (60.5%)	34 (79.1%)
	Total	17 (39.5%)	26 (60.5%)	43 (100%)
Chi-square value= 17.40 p-value<0.001				
Percentage Agreement = 81.4%				
Kappa value = 0.576		Interpretation: Moderate agreement		

CHART NO. 15- Comparison between MRI and Arthroscopic finding (gold standard) for Patellar injury



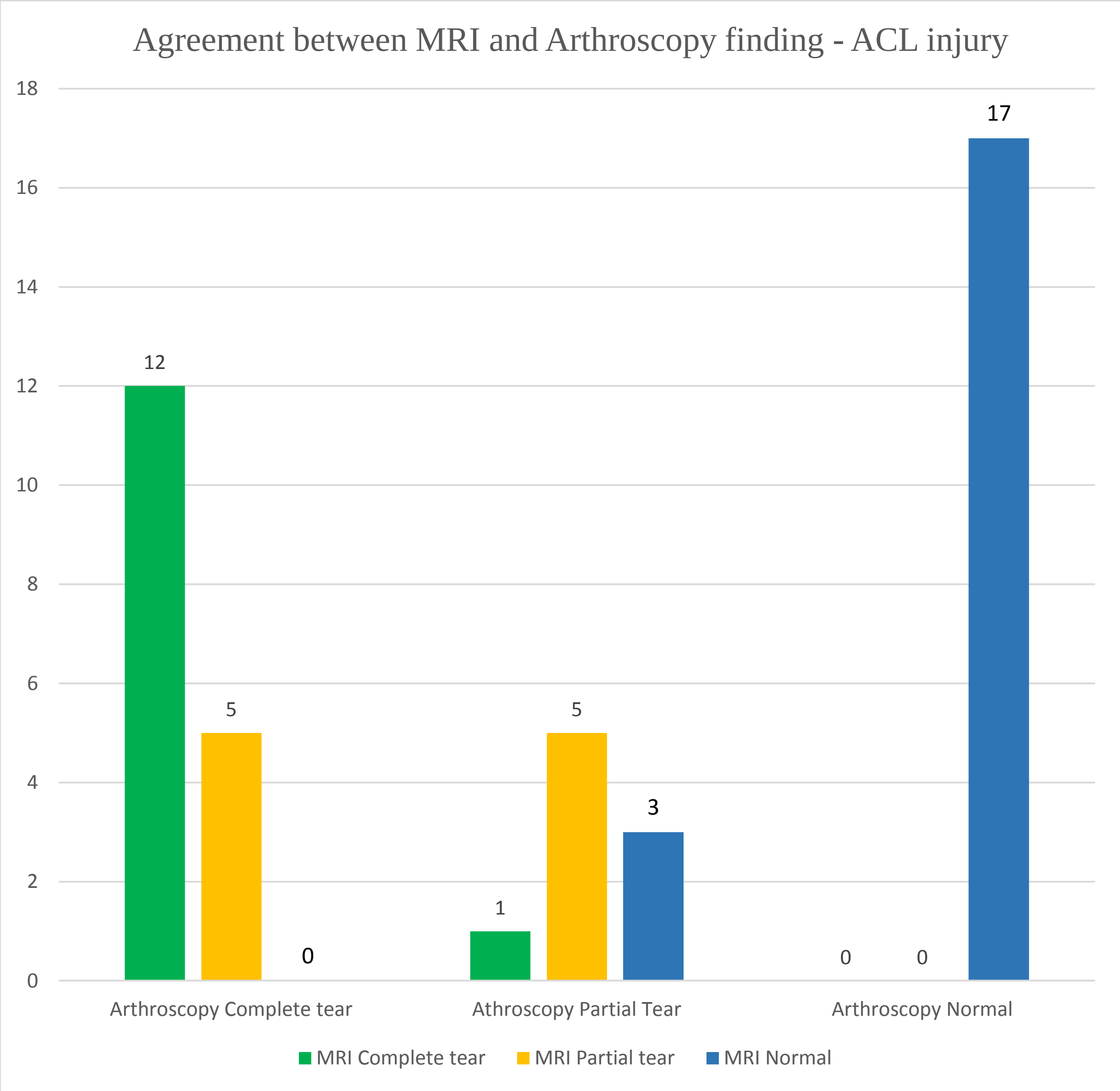
To detect chondromalacia patella, we observed in our study that MRI has a sensitivity of 53%, specificity of 100% and an accuracy of 81.4%.

COMPARISON OF MRI AND ARTHROSCOPIC GRADES FOR ACL INJURY

TABLE NO. 19 - Comparison between **Grades** of tear between MRI and Arthroscopic findings for ACL injury

Arthroscopy ACL		**Complete tear**	**Partial tear**	**Normal**
MRI finding	**Complete tear**	12 (27.9%)	1 (2.3%)	0
	Partial tear	5 (11.6%)	5 (11.6%)	0
	Normal	0	3 (7.0%)	17 (39.5%)
Chi-square value= 42.353 p-value<0.001				
Percentage Agreement = 79.1%				
Unweighted Kappa = 0.677 Weighted Kappa = 0.780		Interpretation: Substantial agreement		

CHART NO. 16 – Comparison between **Grades** of tear between MRI and Arthroscopy for ACL injury



Based on the above data, we observed that MRI has an accuracy of 79% in grading ACL tears.

COMPARISON BETWEEN MRI AND ARTHROSCOPIC GRADES FOR MENISCAL INJURY

TABLE NO. 20 - Comparison between **Grades** of tear by MRI and Arthroscopic findings for Lateral Meniscus injury

<table>
<tr><th colspan="2">Arthroscopy Lateral meniscus</th><th>Normal</th><th>Grade 1</th><th>Grade 2</th><th>Grade 3</th></tr>
<tr><td rowspan="4">MRI finding</td><td>Normal</td><td>29 (67.4%)</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Grade 1</td><td>2 (4.6%)</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Grade 2</td><td>2 (4.6%)</td><td>0</td><td>2 (4.6%)</td><td>4 (9.3%)</td></tr>
<tr><td>Grade 3</td><td>0</td><td>0</td><td>1 (2.3%)</td><td>2 (4.6%)</td></tr>
<tr><td colspan="6">Chi-square value= 34.053 p-value<0.001</td></tr>
<tr><td colspan="6">Percentage Agreement = 76.7%</td></tr>
<tr><td colspan="3">Unweighted Kappa = 0.472
Weighted Kappa = 0.704</td><td colspan="3">Interpretation: Substantial agreement</td></tr>
</table>

CHART NO. 17 - Comparison between **Grades** of tear by MRI and Arthroscopic findings for Lateral Meniscus injury

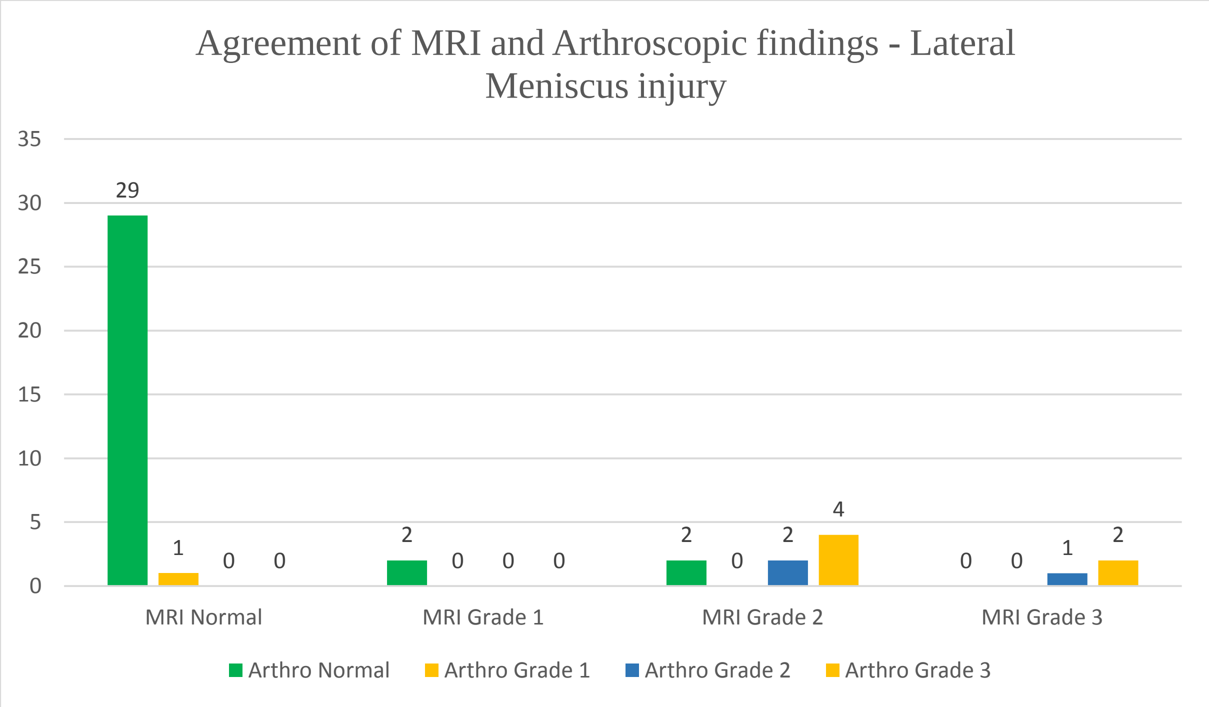
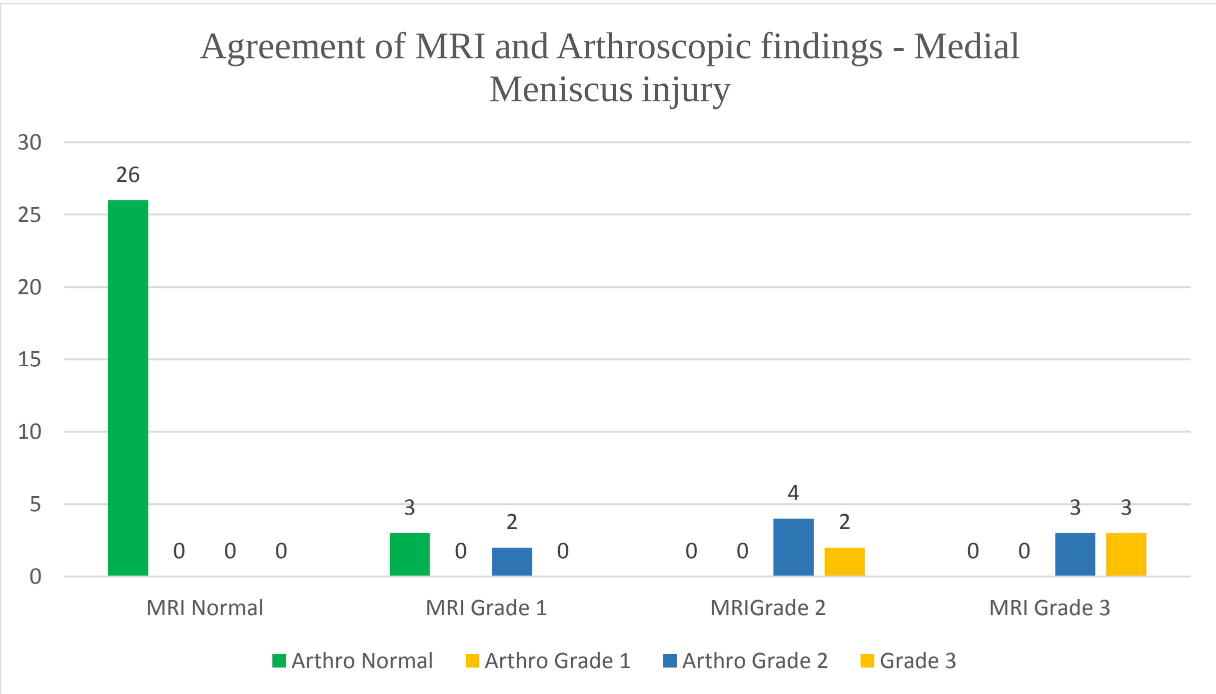


TABLE NO. 21 - Comparison between **Grades** of tear by MRI and Arthroscopy for Medial Meniscus injury

Arthroscopy Medial meniscus		**Normal**	**Grade 1**	**Grade 2**	**Grade 3**
MRI finding	**Normal**	26 (60.5%)	0	0	0
	Grade 1	3 (7.0%)	0	2 (4.6%)	0
	Grade 2	0	0	4 (9.3%)	2 (4.6%)
	Grade 3	0	0	3 (7.0%)	3 (7.0%)
Chi-square value= 40.584 p-value<0.001					
Percentage Agreement = 76.7%					
Unweighted Kappa = 0.575 Weighted Kappa = 0.790			Interpretation: Substantial agreement		

CHART NO. 18 - Comparison between **Grades** of tear by MRI and Arthroscopy for Medial Meniscus injury



Based on the above data, it was observed that MRI has an accuracy of 76.7% in grading both medial and lateral meniscus tears.

COMPARISON BETWEEN MRI AND ARTHROSCOPIC GRADES FOR CHONDROMALACIA PATELLA

TABLE NO. 22: Comparison between **Grades** of tear by MRI and Arthroscopic findings for Patellar injury

Arthroscopy Patella		Normal	Grade 1	Grade 2	Grade 3	Grade 4
MRI finding	**Normal**	26 (60.5%)	6 (13.9%)	1 (2.3%)	0	1 (2.3%)
	Grade 1	0	2 (4.6%)	2 (4.6%)	1 (2.3%)	0
	Grade 2	0	0	1 (2.3%)	1 (2.3%)	0
	Grade 3	0	0	0	0	0
	Grade 4	0	0	0	1 (2.3%)	1 (2.3%)
Chi-square value= 42.747 p-value<0.001						
Percentage Agreement = 69.8%						
Unweighted Kappa = 0.388 Weighted Kappa = 0.556				Interpretation: Moderate agreement		

Based on the above data, we observed that MRI has an accuracy of 69.8% in grading of chondromalacia patella.

TABLE NO. 23 - SENSITIVITY, SPECIFICITY AND ACCURACY OF CLINICAL EXAMINATION

STRUCTURE	SENSITIVITY (%)	SPECIFICITY (%)	ACCURACY (%)
ACL	96.1	82.3	90
PCL	100	97.5	97.7
LM	90.9	93.7	93
MM	93.3	96.4	95.3
PATELLA CARTILAGE	88.2	100	95.3

TABLE NO. 24 - SENSITIVITY, SPECIFICITY AND ACCURACY OF MRI

STRUCTURE	SENSITIVITY (%)	SPECIFICITY (%)	ACCURACY (%)
ACL	88	76.4	83.7
PCL	100	100	100
LM	90.9	87.5	88.4
MM	100	89.2	93
PATELLA CARTILAGE	53	100	81.4

TABLE NO. 25 – ACCURACY OF MRI GRADING

STRUCTURE	ACCURACY (%)
ACL	79
MENISCUS	76.7
PATELLA CARTILAGE	69.8

DISCUSSION

DISCUSSION

Main aim of our study is to compare accuracy of clinical examination, MRI results and arthroscopy in diagnosis of cartilage defects and internal derangement of knee.

This prospective study was done on 43 patients who were admitted in R. L. Jalappa Hospital, in the Department of Orthopaedics, with cartilage defects and/or internal derangement of knee. We decided to correlate and compare the clinical and MRI findings, considering arthroscopy as gold standard investigation.

Nageswara et al[(63)] showed males are more commonly affected by knee injuries with right more commonly involved than left, which was comparable with our study where males were more commonly affected but left side was more commonly involved.

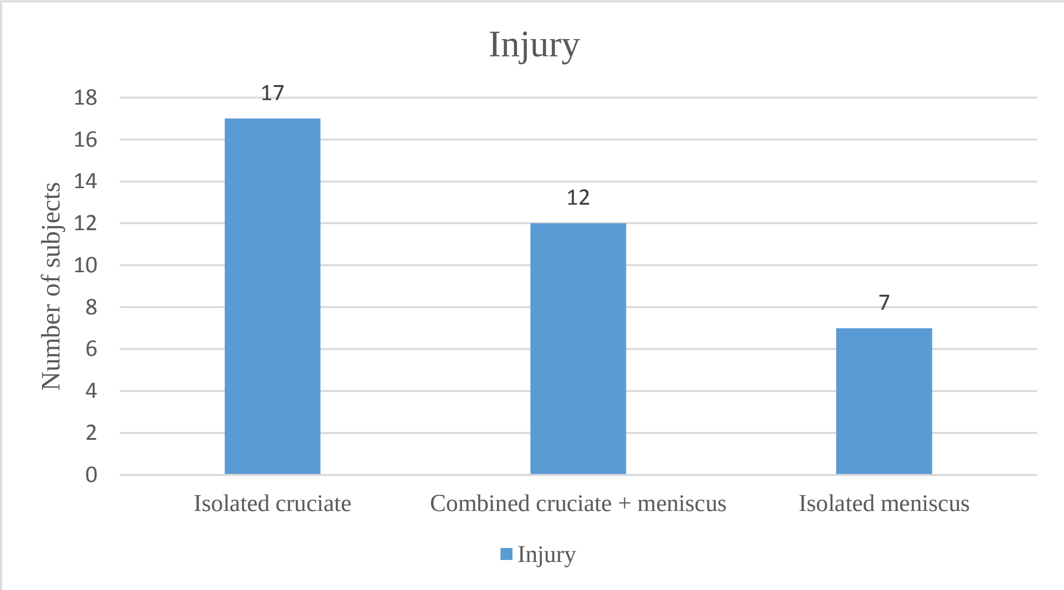
Uppin et al[(64)] conducted a study in which maximum patients were between 20-40 years and most common cause of knee injury was RTA followed by sports injuries. When compared to our study, we also observed that maximum patients were between 19-40 years of age and most common cause of injury was observed to be a twisting force.

We observed that, lateral meniscal injury occurred in a frequency lesser than medial meniscus in our study. 15 patients had medial meniscal injury and 11 patients had lateral meniscal injury.

As depicted in the chart below, we observed that majority of patients had isolated cruciate ligament injury (39.5%), followed by combined cruciate and meniscal injury (27.9%).

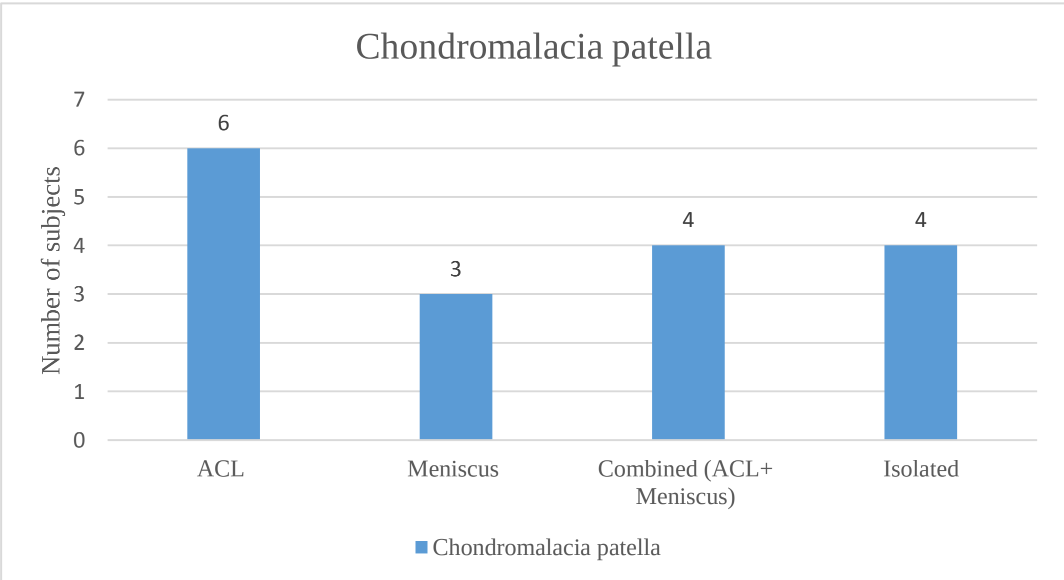
Similar results were obtained in study conducted by **Astur et al**[65], which showed majority of patients with isolated cruciate ligament injury (44.58%) followed by combined injury (30.2%).

CHART NO. 19 – Number of patients with isolated and combined injury



As depicted below, we observed that 17 patients had chondromalacia patella. We also observed that chondromalacia was present in 6 patients with ACL injuries and in 3 patients with meniscal tears.

CHART NO. 20 – Relation between chondromalacia patella and structures involved



Oksman et al[66] conducted a study which showed 28.8% patients had chondromalcia patella in ACL deficient knees, the same of which was comparable to our study which showed 35.2% patients had chondromalacia patella in ACL deficient knees.

Present study showed 17.6% patients had meniscal tears associated with chondromalacia patella whereas, in study conducted by **Resorlu et al**[67] the authors observed 38% patients who had meniscal injury also had chondromalacia patella.

Some authors also proposed that clinical examination and MRI evaluation show no significant differences in diagnostic accuracy of ACL and meniscal injuries.[68–70]

Kocabey et al[12] concluded that there are no real advantages of MRI over clinical examination in diagnosis of meniscal and ACL tears before knee arthroscopy.

Orlando et al[71] in their prospective study on 72 patients, showed that clinical examination had a sensitivity, specificity and accuracy of 88.67%, 94.73% and 90.27% respectively, in diagnosing ACL injuries. The same can be comparable with this study which showed sensitivity, specificity and accuracy of 96.1%, 82.3% and 90% respectively, in diagnosing ACL tears.

Nageswara et al[63] conducted a cross sectional study, which showed clinical examination had sensitivity of 62% and specificity of 48% to diagnose medial meniscal tears. For lateral meniscal tears, clinical examination showed sensitivity of 58% and specificity of 54%. The values greatly vary when compared to present study which showed clinical examination has sensitivity and specificity of 93.3% and 96.4% respectively, for diagnosing medial meniscal tears. For diagnosing lateral meniscal tears, clinical examination showed sensitivity and specificity of 90.9% and 93.7% in the present study.

Shahani et al[72] conducted a study which showed clinical examination findings were having higher sensitivity to diagnose medial meniscus and ACL tears while it shows low sensitivity to lateral meniscus tears. Similar observation was made in the present study. The authors also observed that while specificity for clinical examination to diagnose lateral meniscus and ACL tears was high, it was low for medial meniscus tears. In contrast to above, our study showed high specificity for meniscal tears (both, medial and lateral) but low specificity for ACL tears.

Theofilos K et al[73] found Thessaly test done at 20 degree of flexion had high diagnostic accuracy of 94% to detect medial meniscus tears and 96% in lateral meniscus tears.

MRI has proved reliable, safe and offers advantages over diagnostic arthroscopy, which is currently regarded as standard reference to diagnose knee injuries. Arthroscopy is invasive procedure that carries with it the risks of anaesthesia and risks of surgery such as infection, neurovascular injury and postoperative pain. It is preferably performed only for therapeutic purposes, provided that alternative non-invasive diagnostic imaging modalities such as MRI are available.[74]

In our study, we found that MRI had higher false positives i.e. high sensitivity and low specificity (Table 26) which implies that if MRI is used as the form of pre-operative screening for the condition, then there can be unnecessary arthroscopies performed, which is contradictory to studies saying that MRI prevents unnecessary arthroscopy.[75]

TABLE NO. 26 – False positives in MRI

STRUCTURES	FALSE POSITIVE PATIENTS
ACL	4
LM	4
MM	3

Elvenes et al(76) found that positive predictive value, negative predictive value, sensitivity and specificity of MRI were 71%, 100%, 100% and 77% respectively for medial meniscus tears.

Lundberg M et al(77) found sensitivity and specificity of 74% and 66% respectively, for medial and 50% and 84% for lateral meniscus.

Barronian AD et al(17)found MRI as 100% sensitive to medial meniscal tears and 73% to lateral meniscal tears.

Polly DW et al(78) in comparative study in 54 patients with selective MRI and arthroscopy found sensitivity, specificity and accuracy of 95.8%, 100% and 98% respectively for medial meniscal tear, 66.7%, 95.1% and 90% for lateral meniscal tear, 100%, 96.9% and 97.3% for ACL injuries.

We observed that, positive predictive value, negative predictive value, sensitivity and specificity of MRI to diagnose medial meniscus injuries was 83.3%, 100%, 100% and 89.2% respectively, which correlates with findings of above mentioned studies.

We also observed that MRI had substantial agreement with arthroscopy in diagnosing lateral meniscal tears (accuracy of 88.4%) when compared to almost perfect agreement for medial meniscal tears (accuracy to 93%).

Schneider et al(79) found that MRI was a reliable examination to diagnose knee injuries, with sensitivity of 53% and specificity of 95% for ACL injuries, in comparison with arthroscopy.

In current study, sensitivity and specificity values for MRI compared with arthroscopy are 88% and 76.4% respectively, for ACL injuries.

Severino et al(80) suggested that MRI was an appropriate method to complement physical evaluation in patients with ligament and meniscal injuries of knee and demonstrated sensitivity and specificity of MRI for ACL injuries, medial and lateral meniscus of respectively 82% and 96%, 96% and 66%, 87% and 88%, in comparison with arthroscopy.

In current study, we found that clinical examination had better sensitivity, specificity, predictive values and diagnostic accuracy in comparison to MRI to diagnose ACL tears which was in congruence with a cross sectional study done by **Rayan et al**(14) who concluded that carefully performed clinical examination can give equal or better diagnosis of meniscal and ACL injuries in comparison to MRI scan and recommended that MRI be used to rule out such injuries rather than to diagnose them.

In the present study, 03 cases of PCL tear had been detected both by MRI and arthroscopy, which showed 100% sensitivity, specificity and accuracy. The same result was seen in study conducted by **Fischer et al**(81) in which the authors reported sensitivity, specificity, accuracy, positive predictive value and negative predictive value to be 99-100% for diagnosing PCL tears on MRI.

In a study by **Barile et al**[82] they advocated that weight bearing MRIs showed unstable menisci lesions which are helpful for diagnostic and therapeutic purposes. **Muhle et al**[83] in a study concluded that knee MRIs done at 55° of flexion resulted in better diagnosis of ACL tears when compared to MRIs in knee extension. There was not much difference in diagnosing meniscal injuries. Our hospital didn't have the equipment to perform either weight bearing MRIs or MRIs with knee in flexion.

The table below shows the results of comparison of clinical findings and arthroscopy findings for ACL tears in our study and different studies.

TABLE NO. 27 - The results of clinical findings and arthroscopy findings for ACL tears of our study compared to other studies

Name of study	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Dutka et al[84]	86	90	94	79	88
Rayan et al[14]	77	100	100	95	96
Navali et al[85]	99	92	95	98	96
Nikolaou et al[86]	68	77	80	68	72
Present Study	**96**	**82**	**89**	**93**	**90**

The results of comparison between MRI and arthroscopy findings for ACL tears in our study and different studies are shown below.

TABLE NO. 28 - The results between MRI and arthroscopy findings for ACL tears of our study compared to others

Name of study	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Dutka et al[84]	80	86	90	72	82
Rayan et al[14]	81	96	81	95	93
Navali et al[85]	99	83	90	98	93
Nikolaou et al[86]	83	89	90	86	86
Present Study	**88**	**76**	**85**	**81**	**84**

Results obtained from current study were similar to or equal to results of other studies after comparing clinical, MRI and arthroscopic findings for ACL tears

The table below shows the results of comparison between clinical evaluation and arthroscopy findings for LM tears in our study and different studies.

TABLE NO. 29 - The results between clinical evaluation and arthroscopy findings for LM tears of our study compared to other studies

Name of study	Sensitivity(%)	Specificity (%)	PPV(%)	NPV(%)	Accuracy(%)
Dutka et al[84]	38	100	100	91	91
Rayan et al[14]	56	95	78	87	85
Navali et al[85]	71	89	60	93	79
Nikolaou et al[86]	30	75	50	56	55
Present Study	**91**	**94**	**83**	**97**	**93**

The results of comparison between MRI and arthroscopy findings for LM in current study and different studies are shown below.

TABLE NO. 30 - The results between MRI and arthroscopy findings for LM tears of our study compared to others

Name of study	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Elvenes et al[76]	40	89	33	91	84
Dutka et al[84]	44	93	50	91	86
Rayan et al[14]	61	92	74	88	85
Navali et al[85]	56	93	65	70	86
Nikolaou et al[86]	62	88	81	74	77
Present Study	**91**	**87**	**71**	**97**	**88**

Results obtained by our study were better than or similar to results of other studies after comparing clinical, MRI and arthroscopy findings for LM tears.

The table below shows the results of comparison between clinical examination and arthroscopy findings for MM tears in our study and different studies.

TABLE NO. 31 - The results between clinical examination and arthroscopy findings for MM tears of our study compared to other studies

Name of study	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Dutka et al[84]	65	87	76	80	79
Rayan et al[14]	86	73	76	83	79
Navali et al[85]	95	76	79	94	85
Nikolaou et al[86]	65	50	65	50	60
Present Study	**93**	**96**	**93**	**96**	**95**

The results of comparison between MRI and arthroscopy findings for MM in our study and different studies are shown below.

TABLE NO. 32 - The results between MRI and arthroscopy findings for MM tears of our study compared to others

Name of study	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Elvenes et al[76]	100	77	71	100	84
Dutka et al[84]	88	64	60	90	73
Rayan et al[14]	76	52	57	73	63
Navali et al[85]	84	71	73	83	78
Nikolaou et al[86]	83	69	83	69	81
Present Study	**100**	**89**	**83**	**100**	**93**

Results obtained by our study were better than or similar to results of other studies after comparing clinical, MRI and arthroscopy findings for MM tears.

In current study, we observed that MRI altogether has low positive predictive value meaning it was less likely for patients who had a tear in MRI, to have the same observation in arthroscopy, when compared with clinical examination.

In a study by **Navali et al**[85], clinical examination and MRI had equal efficacy, with clinical examination proving to be slightly better than MRI. In present study, it was found true with regards to ACL injuries. Also we found that clinical examination was equal to or better than MRI in isolated ligament injuries when compared to those with more than one structure involved.

With regard to detection of chondromalacia patellae, according to study conducted by **Harri K et al**[87], positive predictive value of MRI was 75%, negative predictive value was 72%, sensitivity was 60%, specificity was 84%, and diagnostic accuracy was 73%. When compared to present study data, it was noted that results obtained were similar to the above mentioned study. We noted positive predictive value of 100%, negative predictive value of 76%, sensitivity was 53%, specificity was 100% and diagnostic accuracy was 81%.

Mattila et al[88] conducted a study to detect sensitivity of MRI for diagnosing chondromalacia patellae and observed that 64% of patients had grade I articular cartilage lesions of the patella on arthroscopy which were not visible in MRI. In comparison with our study, we observed that 75% of patients had grade I chondromalacia patellae which was not visible on MRI. The same was noted by **Heron et al**[89] in a study that showed MRI can satisfactorily reveal II and III grade chondral defects as well as damages at the patellar articular cartilage, but is not accurate for grade I cartilage defects.

In present study, we observed that accuracy of MRI for grading ACL and meniscal tears is similar that is 79% and 78% respectively, but was slightly low (70%) for grading of chondromalacia patellae.

CONCLUSION

CONCLUSION

Aim of our study is to correlate clinical, MRI and arthroscopic findings in chondral defects and internal derangement of knee and also to compare clinical and MRI findings with arthroscopy findings, which is gold standard investigation of choice for diagnosing the above conditions.

In the current prospective study of 43 patients with knee injuries, majority of patients gave history of twisting force injury to the affected knee and presented with complaints of pain and instability. Males were more commonly affected with left knee preponderance.

Anterior cruciate ligament is most commonly injured structure followed by medial meniscus.

Clinical examination has great value when compared to MRI in diagnosing cruciate ligament injuries especially isolated injuries. It also shows excellent specificity in diagnosing patellar articular cartilage defects.

MRI shows average specificity in diagnosing anterior cruciate ligament tears, meniscal tears and chondral defects, with more false negatives due to subjective errors. It shows excellent sensitivity and specificity to diagnose posterior cruciate ligament tears. It also shows excellent specificity for diagnosing chondral defects.

We observed that MRI is a non-invasive modality having moderate sensitivity, specificity and accuracy to diagnose meniscal and anterior cruciate ligament injuries. Reports of earlier studies, showing MRI superior to arthroscopy in diagnosis of meniscal and anterior cruciate ligament tears, were not substantiated by this study.

In our study, we observed that accuracy of clinical examination was higher in meniscal and anterior cruciate ligament tears when compared to MRI, which showed fairly low accuracy to diagnose tears of above mentioned structures.

In the existing bibliography, accuracy of MRI reaches 90% in diagnosing medial meniscal and anterior cruciate ligament injuries but is significantly less for diagnosing lateral meniscal tears unlike in present study, where, accuracy of magnetic resonance imaging is low in diagnosing anterior cruciate ligament and lateral meniscal tears, when compared to accuracy of MRI to diagnose medial meniscal tears, which was significantly high.

With reference to chondral defects, in agreement with most of the studies, MRI has low accuracy but excellent specificity. It was also observed that it is less sensitive to detect anterior cruciate ligament injuries and chondral defects.

In our study, in comparison with arthroscopy, clinical examination and MRI show less specificity to diagnose internal derangement of knee. This can be attributed to the **current limitations** of the study which include, the study being a prospective, non-randomized study with a relatively small sample size. Since, posterior cruciate ligament injury was seen only in 3 patients, the results obtained cannot be implied to be significant. Medial collateral and lateral collateral ligaments injury were rarely seen in the study population hence, it has not been included for statistical analysis. Our study has not included the time at which MRI should be done to reduce the number of false positive cases. We have also not considered inter-observer variation in terms of reporting of the MRIs performed.

It was also observed that in our study, MRI has low accuracy in grading anterior cruciate ligament tears, meniscal tears and chondral defects.

Following diagnostic arthroscopy, we observed that inferior surface meniscal tears are sometimes difficult to identify, hence MRI can play a major role in diagnosing these tears.

The effect of these results can greatly improve procedural time by planning with more specificity and thereby reduce surgical risks and unnecessary financial burden on the patient.

SUMMARY

SUMMARY

The need to accurately evaluate knee injuries is very crucial for proper management, outcome and to prevent chronic debility to patient.

Magnetic resonance imaging (MRI) is a great help in diagnosing knee injuries. Most studies comparing MRI and arthroscopy have shown good diagnostic ability in identifying lesions of cruciate ligaments and menisci.

Although MRI is being used with increasing frequency, it is unlikely to replace clinical diagnosis. MRI must be used in connection with history and clinical examination to give a complete diagnosis. It is slightly difficult to assess the structures involved in a multi-ligamentous knee injury by clinical examination hence, MRI is the reliable method for diagnosing these conditions.

In situations of chronic instabilities with clinically positive signs, MRI may not be of significant value and can be avoided in clinically proven cases of knee instability.

The present study found that accuracy of MRI to diagnose ligament injuries in decreasing order is as follows, PCL, ACL and meniscal tears, thus concluding that MRI is less reliable for meniscal lesions.

To conclude, the present study supports both clinical and MRI in diagnosing internal derangement of knee and chondral defects. The routine use of MRI for confirmation of diagnosis is not indicated for all lesions and MRI is less reliable in grading ACL tears, meniscal tears and chondral injuries, thus stating that grading of injury should be done by arthroscopy.

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ANNEXURE

PROFORMA

- Name:
- IP No.:
- Age:
- Address:
- Sex:
- DOA:
- DOD:

- HISTORY OF INJURY:
    - Date of injury:
    - Mechanism of injury:
    - Any other associated injuries:
    - Details of treatment received:
- PAST HISTORY:
    - Any co-existing systemic illness:
- On examination
- GENERAL EXAMINATION:
- LOCAL EXAMINATION:

Inspection

Palpation

Measurements

Movements

KNEE SPECIAL TESTS	Right	Left
McMurray test		
Apley's test		
Lachman test		
Anterior drawer test		
Posterior drawer test		
Varus stress test		
Valgus stress test		
Patella tests		

- INVESTIGATIONS
- Hb
- X-ray of affected knee
- MRI examination

- Diagnosis
- TREATMENT:
- Surgery
- Date of surgery

ARTHROSCOPY FINDINGS

Name: IP No:
Age: Sex:

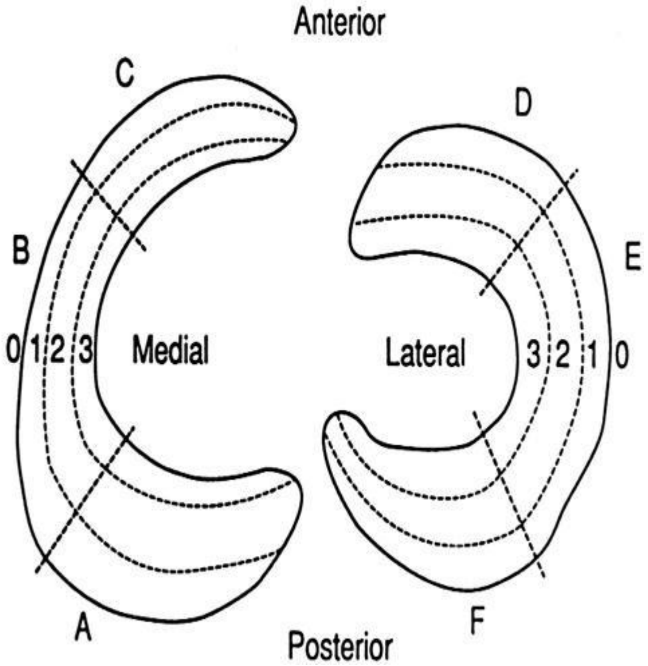
MEDIAL COLLATERAL LIGAMENT:

LATERAL COLLATERAL LIGAMENT:

ANTERIOR CRUCIATE LIGAMENT:

POSTERIOR CRUCIATE LIGAMENT:

MENISCUS:



CARTILAGE DEFECTS:

INFORMED CONSENT FORM

I, ____________________ aged ______, after being explained in my own vernacular language about the purpose of the study and the risks and complications of the procedure, hereby give my valid written informed consent without any force or prejudice for Comparison of Clinical, Magnetic Resonance imaging(MRI) and Arthroscopic findings in assessment of cartilage defects and Internal derangement of knee_or any other procedure deemed fit, which is a diagnostic & / or therapeutic procedure / biopsy / operation to be performed on me or _______ under any anaesthesia deemed fit. The nature and risks involved in the procedure (surgical and anaesthetical) have been explained to me to my satisfaction. I have been explained in detail about the Clinical Research on “Comparison of Clinical, Magnetic Resonance imaging(MRI) and Arthroscopic findings in assessment of cartilage defects and Internal derangement of knee” being conducted. I have read the patient information sheet and I have had the opportunity to ask any question. Any question that I have asked, have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research. I hereby give consent to provide my history, undergo physical examination, undergo the injection procedure, undergo investigations and provide its results and documents etc. to the doctor / institute etc.

For academic and scientific purpose, the operation / procedure, etc. may be video graphed or photographed. All the data may be published or used for any academic purpose. I will not hold the doctors / institute etc. responsible for any untoward consequences during the procedure / study.

A copy of this Informed Consent Form and Patient Information Sheet has been provided to the participant

(Signature & Name of Pt. Attendant) (Signature/Thumb impression (Relation with patient) --------- & Name of patient)

Witness: --------------------------

(Signature & Name of Research person /doctor) -------------

ತಿಳಿವಳಿಕೆಯ ಸಮ್ಮತಿ ನಮೂನೆ

ನಾನು, ____ ವಯಸ್ಸಿನ _____________, ನನ್ನ ಸ್ವಂತ ಭಾಷೆಯಲ್ಲಿ ವಿವರಿಸಲ್ಪಟ್ಟ ನಂತರ ಅಧ್ಯಯನದ ಉದ್ದೇಶ ಮತ್ತು ಕಾರ್ಯವಿಧಾನದ ತೊಂದರೆಗಳು ಮತ್ತು ತೊಡಕುಗಳ ಬಗ್ಗೆ ವಿವರಿಸಿದ ನಂತರ, ಮುಚ್ಚಿದ ಕಡಿತ ಮತ್ತು ಆಂತರಿಕ ಸ್ಥಿರೀಕರಣ / ಯಾವುದೇ ಬಲದ ಅಥವಾ ಪೂರ್ವಾಗ್ರಹವಿಲ್ಲದೆ ನನ್ನ ಮಾನ್ಯವಾದ ಲಿಖಿತ ವಿರೋಧಿ ಸಮ್ಮತಿಯನ್ನು ನೀಡಿ ನನ್ನ ಮೇಲೆ ನಡೆಸಬೇಕಾದ ರೋಗನಿದಾನ ಮತ್ತು / ಅಥವಾ ಚಿಕಿತ್ಸಕ ಪ್ರಕ್ರಿಯೆ / ವರ್ಗಾವಣೆ / ಕಾರ್ಯಾಚರಣೆ ಅಥವಾ ಯಾವುದೇ ಅರಿವಳಿಕೆ ಅಡಿಯಲ್ಲಿ ಆರ್ತ್ರೋಸ್ಕೋಪಿಕ್ ನಂತಹ / ಸಂಪ್ರದಾಯವಾದಿ ನಿರ್ವಹಣೆಯೊಂದಿಗೆ / ಸಂಪ್ರದಾಯವಾದಿ ನಿರ್ವಹಣೆಗೆ ಒಳಪಡಿಸುವುದು ಯೋಗ್ಯವಾದವು. ಕಾರ್ಯವಿಧಾನದಲ್ಲಿ (ಶಸ್ತ್ರಚಿಕಿತ್ಸಾ ಮತ್ತು ಅನಾಸ್ಥೆಟಿಕಲ್) ಒಳಗೊಂಡಿರುವ ಸ್ವಭಾವ ಮತ್ತು ಅಪಾಯಗಳು ನನ್ನ ತೃಪ್ತಿಗೆ ನನಗೆ ವಿವರಿಸಲಾಗಿದೆ.

"ಕಾರ್ಟಿಲೆಜ್ ದೋಷಗಳ ಕ್ಲಿನಿಕಲ್, ಎಂಆರ್ಐ ಮತ್ತು ಆರ್ತ್ರೋಸ್ಕೋಪಿಕ್ ಮೌಲ್ಯಮಾಪನಗಳ ಹೋಲಿಕೆ ಮತ್ತು ಮೊಣಕಾಲಿನ ಆಂತರಿಕ ವಿಘಟನೆ" ಕುರಿತು ಕ್ಲಿನಿಕಲ್ ರಿಸರ್ಚ್ ಕುರಿತು ನಾನು ವಿವರಿಸಿದ್ದೇನೆ. ನಾನು ರೋಗಿಯ ಮಾಹಿತಿ ಹಾಳೆಯನ್ನು ಓದಿದ್ದೇನೆ ಮತ್ತು ಯಾವುದೇ ಪ್ರಶ್ನೆ ಕೇಳಲು ನನಗೆ ಅವಕಾಶವಿದೆ. ನಾನು ಕೇಳಿದ ಯಾವುದೇ ಪ್ರಶ್ನೆಯನ್ನು ನನ್ನ ತೃಪ್ತಿಗೆ ಉತ್ತರ ಮಾಡಲಾಗಿದೆ. ಈ ಸಂಶೋಧನೆಯಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳುವವರಾಗಿ ಭಾಗವಹಿಸಲು ನಾನು ಸ್ವಯಂಪ್ರೇರಣೆಯಿಂದ ಸಮ್ಮತಿಸುತ್ತೇನೆ. ನನ್ನ ಇತಿಹಾಸವನ್ನು ಒದಗಿಸಲು, ದೈಹಿಕ ಪರೀಕ್ಷೆಗೆ ಒಳಗಾಗಲು, ಇಂಜೆಕ್ಷನ್ ಪ್ರಕ್ರಿಯೆಗೆ ಒಳಗಾಗಲು, ತನಿಖೆಗೆ ಒಳಗಾಗಬೇಕು ಮತ್ತು ಅದರ ಫಲಿತಾಂಶಗಳು ಮತ್ತು ದಾಖಲೆಗಳನ್ನು ವೈದ್ಯರಿಗೆ / ಇನ್ಸ್ಟಿಟ್ಯೂಟ್ಗೆ ನೀಡುವಂತೆ ನಾನು ಒಪ್ಪಿಗೆ ನೀಡುತ್ತೇನೆ.

ಶೈಕ್ಷಣಿಕ ಮತ್ತು ವೈಜ್ಞಾನಿಕ ಉದ್ದೇಶಕ್ಕಾಗಿ ಕಾರ್ಯಾಚರಣೆ / ವಿಧಾನ, ಇತ್ಯಾದಿ ವೀಡಿಯೊವನ್ನು ಗ್ರಾಂಪ್ಡ್ ಅಥವಾ ಛಾಯಾಚಿತ್ರ ಮಾಡಬಹುದು. ಎಲ್ಲಾ ಡೇಟಾವನ್ನು ಯಾವುದೇ ಶೈಕ್ಷಣಿಕ ಉದ್ದೇಶಕ್ಕಾಗಿ ಪ್ರಕಟಿಸಬಹುದು ಅಥವಾ ಬಳಸಬಹುದು. ಕಾರ್ಯವಿಧಾನ / ಅಧ್ಯಯನದ ಸಮಯದಲ್ಲಿ ಯಾವುದೇ ಕೆಟ್ಟ ಪರಿಣಾಮಗಳಿಗೆ ನಾನು ವೈದ್ಯರು / ಇನ್ಸ್ಟಿಟ್ಯೂಟ್ ಇತ್ಯಾದಿಗಳನ್ನು ಹೊಂದುವುದಿಲ್ಲ.

ಈ ಮಾಹಿತಿಯುಕ್ತ ಸಮ್ಮತಿಯ ಫಾರ್ಮ್ ಮತ್ತು ರೋಗಿಯ ಮಾಹಿತಿ ಹಾಳೆಯನ್ನು ಪ್ರತಿಸ್ಪರ್ಧಿಗೆ ಒದಗಿಸಲಾಗಿದೆ.

_____________________________   __________________

(ರೋಗಿಯಪರಿಚಾರಕನಸಹಿ&ಹೆಸರು)   (ರೋಗಿಯ/ಗಾರ್ಡಿಯನ್ನಸಹಿ ಹೆಬ್ಬೆಟ್ಟಿನಗುರುತು&ಹೆಸರು)

(ರೋಗಿಯಸಂಬಂಧ)

(ಸಂಶೋಧಕನ / ವೈದ್ಯರಸಹಿ&ಹೆಸರು)

PATIENT INFORMATION SHEET

Study title: Comparison of Clinical, MRI and Arthroscopic assessments of Cartilage defects and internal derangement of knee

Study site: R.L Jalappa hospital, Tamaka, Kolar.

Aim- Comparison of Clinical, Magnetic Resonance imaging(MRI) and Arthroscopic findings in assessment of cartilage defects and Internal derangement of knee

Patients with knee injury will be selected. Please read the following information and discuss with your family members. You can ask any question regarding the study. If you agree to participate in this study, we will collect information (as per proforma) from you. Routine (CBC, CRP, ESR) and Relevant blood investigations, radiological investigation will be carried out if required. This information collected will be used for dissertation and publication only. All information collected from you will be kept confidential and will not be disclosed to any outsider. Your identity will not be revealed. This study has been reviewed by the Institutional Ethics Committee and you are free to contact the member of the Institutional Ethics Committee. There is no compulsion to agree to this study. The care you get will not change if you don't wish to participate. You are required to sign/ provide thumb impression only if you voluntarily agree to participate in this study.

For any further clarification you can contact the study investigator:

Dr. Nandini Sanjay

Mobile no: 7204486125

E-mail id: nandinisanjay3@gmail.com

ರೋಗಿಯ ಮಾಹಿತಿ ಹಾಳೆ

ಅಧ್ಯಯನದ ಶೀರ್ಷಿಕೆ: ಕಾರ್ಟಿಲೆಜ್ ದೋಷಗಳ ಮತ್ತು ಮೊಣಕಾಲಿನ ಆಂತರಿಕ ವಿರೂಪತೆ, ಕ್ಲಿನಿಕಲ್ ಎಂಆರ್ಐ ಮತ್ತು ಆರ್ತ್ರೋಸ್ಕೊಪಿಕ್ ಮೌಲ್ಯಮಾಪನಗಳ ಹೋಲಿಕೆಯ ಅಧ್ಯಯನ

ಸ್ಥಳ: ಆರ್.ಎಲ್ ಜಲಪ್ಪ ಆಸ್ಪತ್ರೆ, ತಮಾಕಾ, ಕೋಲಾರ.

ಗುರಿ- ಕಾರ್ಟಿಲೆಜ್ ದೋಷಗಳ ಕ್ಲಿನಿಕಲ್, ಎಂಆರ್ಐ ಮತ್ತು ಆರ್ತ್ರೋಸ್ಕೊಪಿಕ್ ಮೌಲ್ಯಮಾಪನ ಮತ್ತು ಮೊಣಕಾಲು ಗಾಯಗೊಂಡ ರೋಗಿಗಳನ್ನು ಆಯ್ಕೆ ಮಾಡಲಾಗುತ್ತದೆ. ದಯವಿಟ್ಟು ಈ ಕೆಳಗಿನ ಮಾಹಿತಿಯನ್ನು ಓದಿ ಮತ್ತು ನಿಮ್ಮ ಕುಟುಂಬ ಸದಸ್ಯರೊಂದಿಗೆ ಚರ್ಚಿಸಿ. ಅಧ್ಯಯನಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ನೀವು ಯಾವುದೇ ಪ್ರಶ್ನೆಯನ್ನು ಕೇಳಬಹುದು. ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಲು ನೀವು ಒಪ್ಪಿದರೆ ನಾವು ನಿಮ್ಮಿಂದ ಮಾಹಿತಿಯನ್ನು ಸಂಗ್ರಹಿಸುತ್ತೇವೆ (ಪ್ರೊಫಾರ್ಮಾದ ಪ್ರಕಾರ). ವಾಡಿಕೆಯಂತೆ (ಸಿಬಿಸಿ, ಸಿಆರ್‌ಪಿ, ಇಎಸ್‌ಆರ್) ಮತ್ತು ಸಂಬಂಧಿತ ರಕ್ತ ತನಿಖೆ, ಅಗತ್ಯವಿದ್ದರೆ ವಿಕಿರಣಶಾಸ್ತ್ರದ ತನಿಖೆ ನಡೆಸಲಾಗುವುದು. ಸಂಗ್ರಹಿಸಿದ ಈ ಮಾಹಿತಿಯನ್ನು ಪ್ರಬಂಧ ಮತ್ತು ಪ್ರಕಟಣೆಗೆ ಮಾತ್ರ ಬಳಸಲಾಗುತ್ತದೆ. ನಿಮ್ಮಿಂದ ಸಂಗ್ರಹಿಸಲಾದ ಎಲ್ಲಾ ಮಾಹಿತಿಯನ್ನು ಗೌಪ್ಯವಾಗಿಡಲಾಗುತ್ತದೆ ಮತ್ತು ಯಾವುದೇ ಹೊರಗಿನವರಿಗೆ ಬಹಿರಂಗಪಡಿಸುವುದಿಲ್ಲ. ನಿಮ್ಮ ಗುರುತು ಬಹಿರಂಗಗೊಳ್ಳುವುದಿಲ್ಲ. ಈ ಅಧ್ಯಯನವನ್ನು ಸಾಂಸ್ಥಿಕ ನೈತಿಕ ಸಮಿತಿಯು ಪರಿಶೀಲಿಸಿದೆ ಮತ್ತು ನೀವು ಸಾಂಸ್ಥಿಕ ನೈತಿಕ ಸಮಿತಿಯ ಸದಸ್ಯರನ್ನು ಸಂಪರ್ಕಿಸಲು ಮುಕ್ತರಾಗಿದ್ದೀರಿ. ಈ ಅಧ್ಯಯನವನ್ನು ಒಪ್ಪಿಕೊಳ್ಳಲು ಯಾವುದೇ ಬಲವಂತವಿಲ್ಲ. ನೀವು ಭಾಗವಹಿಸಲು ಬಯಸದಿದ್ದರೆ ನೀವು ಪಡೆಯುವ ಕಾಳಜಿಯು ಬದಲಾಗುವುದಿಲ್ಲ. ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಲು ನೀವು ಸ್ವಯಂಪ್ರೇರಣೆಯಿಂದ ಒಪ್ಪಿಕೊಂಡರೆ ಮಾತ್ರ ನೀವು ಹೆಬ್ಬೆರಳು ಅನಿಸಿಕೆಗೆ ಸಹಿ / ಒದಗಿಸುವ ಅಗತ್ಯವಿದೆ. ಯಾವುದೇ ಹೆಚ್ಚಿನ ಸ್ಪಷ್ಟೀಕರಣಕ್ಕಾಗಿ

ನೀವು ಅಧ್ಯಯನ ತನಿಖಾಧಿಕಾರಿಯನ್ನು ಸಂಪರ್ಕಿಸಬಹುದು: ಡಾ.ನಂದಿನಿ ಸಂಜಯ್

ಮೊಬೈಲ್ ಸಂಖ್ಯೆ: 7204486125

ಇ-ಮೇಲ್ ಐಡಿ: nandinisanjay3@gmail.com

INTERPRETATION OF SENSITIVITY

<60%	**Poor**
60-70%	**Average**
70-80%	**Good**
80-90%	**Very good**
90-100%	**Excellent**

INTERPRETATION OF KAPPA STATISTICS

0.81-1.00	**Almost perfect**
0.61-0.80	**Substantial**
0.41-0.60	**Moderate**
0.21-0.40	**Fair agreement**
0.001-0.20	**Slight agreement**
0.00	**Poor agreement**

INTERPRETATION OF ‘p’ VALUE

<0.05	**Significant**
<0.01	**Highly Significant**
>0.05	**Not significant**

KEY TO MASTER CHART

S. NO.	Serial number
UHID NO.	Unique Hospital Identification number
MRI	Magnetic Resonance Imaging
ACL	Anterior Cruciate Ligament
PCL	Posterior Cruciate Ligament
LCL	Lateral collateral Ligament
MCL	Medial collateral Ligament
MM	Medial meniscus
LM	Lateral meniscus
Spl test	Special test
LAD	Lachman and Anterior Drawer test
Arthrograde	Arthroscopic grade
PD	Posterior Drawer test
MM_LM	McMurray’s test for lateral meniscus
MM_MM	McMurray’s test for medial meniscus
VS_LCL	Varus Stress test for lateral collateral ligament
VS_MCL	Valgus Stress test for medial collateral ligament
RPTCT_PF	Retropatellar tenderness and Clarke’s test for patella facet

Clinical grade for ACL tear	
Grade 1	2-5mm tibial translation
Grade 2	5-10mm tibial translation
Grade 3	>10mm tibial translation
Arthroscopic grade for meniscus	
Grade 1	No tear
Grade 2	Tear involving one articular surface
Grade 3	Tear involving both superior and inferior articular surface
MRI grade for meniscus	
Grade 1	Small focal area of hyper intensity
Grade 2	Linear areas of hyper intensity, not extending to articular surface
Grade 3	Abnormal hyper intensity extending to atleast 1 articular surface

GRADING FOR ARTICULAR CARTILAGE

(MODIFIED OUTERBRIDGE CLASSIFICATION)

GRADE	MRI	ARTHROSCOPY
1	Focal areas of hyper-intensity with normal contour	Softening of cartilage, easily indented with probe
2	Blister-like swelling or fraying of articular cartilage extending to the surface	Surface fibrillation
3	Partial thickness cartilage loss with focal ulceration, 'crab meat' appearance	Full thickness fissuring or splitting of cartilage
4	Full thickness cartilage loss with underlying bone reactive changes	Complete loss of cartilage with exposed subchondral bone

MASTER CHART

S.NO	UHID	AGE	SEX	SIDE	MECHANISM OF INJURY	STRUCTURE	SPL_TEST_ACL	LAD_ACL	MRI_ACL	ARTHROSCOPY_ACL	clinicalgrade_ACL	arthrograde_ACL	mrigrade_ACL
1	938917	24	MALE	RIGHT	FALL	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	NORMAL	NORMAL	-	-	-
2	671829	24	FEMALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	NORMAL	NORMAL	-	-	-
3	934312	30	MALE	LEFT	RTA	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	COMPLETE	COMPLETE
4	862239	22	MALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 3	COMPLETE	COMPLETE
5	858320	30	MALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 1	PARTIAL	PARTIAL
6	822222	19	MALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	SPRAIN	NORMAL	-	-	-
7	783394	20	FEMALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	COMPLETE	PARTIAL
8	486717	27	MALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	COMPLETE	PARTIAL
9	874768	29	FEMALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	NORMAL	NORMAL	-	-	-
10	887239	25	MALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	NORMAL	NORMAL	-	-	-
11	926174	42	MALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 3	COMPLETE	PARTIAL
12	744050	25	MALE	RIGHT	FALL	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	NORMAL	GRADE 1	NORMAL	PARTIAL
13	726555	49	MALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	COMPLETE	PARTIAL
14	751296	50	FEMALE	RIGHT	DIRECT TRAUMA	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	NO TEAR	TEAR	GRADE 1	PARTIAL	NO TEAR
15	860143	30	MALE	LEFT	DIRECT TRAUMA	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	PARTIAL	PARTIAL
16	852239	28	MALE	LEFT	RTA	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 3	COMPLETE	COMPLETE
17	864841	20	FEMALE	RIGHT	DIRECT TRAUMA	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	COMPLETE	COMPLETE
18	805349	27	FEMALE	LEFT	FALL	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	NORMAL	NORMAL	-	-	-
19	818600	47	MALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 1	PARTIAL	PARTIAL
20	850683	40	MALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	PARTIAL	PARTIAL
21	866248	23	MALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 3	COMPLETE	COMPLETE
22	849443	24	MALE	LEFT	RTA	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	NO TEAR	GRADE 1	NO TEAR	PARTIAL
23	781201	26	MALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 3	COMPLETE	COMPLETE
24	795525	19	MALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	COMPLETE	COMPLETE
25	768946	20	MALE	RIGHT	RTA	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	COMPLETE	COMPLETE
26	600250	30	FEMALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	NO TEAR	GRADE 1	NO TEAR	PARTIAL
27	751921	22	MALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	NORMAL	NORMAL	-	-	-
28	788832	50	MALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	PARTIAL	PARTIAL
29	753932	29	FEMALE	LEFT	RTA	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	COMPLETE	COMPLETE
30	743496	35	MALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	NORMAL	NORMAL	-	-	-
31	834145	22	MALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	COMPLETE	COMPLETE
32	850808	27	MALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	NORMAL	NORMAL	-	-	-
33	860468	27	MALE	LEFT	FALL	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	NO TEAR	TEAR	GRADE 2	PARTIAL	NO TEAR
34	848084	26	MALE	LEFT	FALL	ACL	LACHMAN, ANTERIOR DRAWER	**NEGATIVE**	TEAR	NO TEAR	-	NO TEAR	PARTIAL
35	844021	24	MALE	RIGHT	FALL	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	NORMAL	NORMAL	-	-	-
36	858199	48	MALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 3	COMPLETE	PARTIAL
37	837286	50	MALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	NORMAL	NORMAL	-	-	-
38	807447	42	FEMALE	RIGHT	RTA	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	NORMAL	NORMAL	-	-	-
39	935595	23	FEMALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	NEGATIVE	NORMAL	NORMAL	-	-	-
40	935579	43	FEMALE	LEFT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**NEGATIVE**	TEAR	TEAR	-	COMPLETE	COMPLETE
41	824462	24	MALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 2	PARTIAL	COMPLETE
42	686251	25	MALE	RIGHT	TWISTING INJURY	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	TEAR	TEAR	GRADE 3	COMPLETE	COMPLETE
43	831839	21	MALE	RIGHT	FALL	ACL	LACHMAN, ANTERIOR DRAWER	**POSITIVE**	NO TEAR	TEAR	GRADE 2	PARTIAL	NO TEAR

S.NO	PD_PCL	MRI_PCL	ARTHROSCOPY_PCL	clinicalgrade_PCL	arthrograde_PCL	mrigrade_PCL	MM_LM	MRI_LM	ARTHROSCOPY_LM	clinicalgrade_LM	arthrograde_LM	mrigrade_LM	MM_MM	MRI_MM	ARTHROSCOPY_MM	clinicalgrade_MM	arthrograde_MM	mrigrade_MM
1	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
2	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	ANTERIOR TEAR	ANTERIOR TEAR	-	GRADE 2	GRADE 2
3	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	ANTERIOR TEAR	ANTERIOR TEAR	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
4	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	NORMAL	-	-	GRADE 2	NEGATIVE	NORMAL	NORMAL	-	-	-
5	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
6	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	TEAR	NORMAL	-	-	GRADE 1	NEGATIVE	TEAR	NORMAL	-	-	GRADE 1
7	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
8	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	-	-
9	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 3	GRADE 2	**POSITIVE**	TEAR	TEAR	-	GRADE 2	GRADE 2
10	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 3	GRADE 2	NEGATIVE	NORMAL	NORMAL	-	-	-
11	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
12	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
13	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
14	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
15	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
16	**POSITIVE**	TEAR	TEAR	-	COMPLETE	COMPLETE	**POSITIVE**	TEAR	TEAR	-	GRADE 3	GRADE 2	NEGATIVE	NORMAL	NORMAL	-	-	-
17	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
18	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 3	GRADE 2	**POSITIVE**	TEAR	TEAR	-	GRADE 2	GRADE 2
19	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 2	GRADE 2	**POSITIVE**	TEAR	NO TEAR	-	NO TEAR	GRADE 1
20	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 3	GRADE 3
21	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 2	GRADE 3	**POSITIVE**	TEAR	TEAR	-	GRADE 3	GRADE 3
22	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
23	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
24	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
25	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 2	GRADE 2	NEGATIVE	NORMAL	NORMAL	-	-	-
26	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 3	GRADE 2
27	**POSITIVE**	NO TEAR	NO TEAR	GRADE 1	NO TEAR	NO TEAR	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
28	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
29	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 3	GRADE 2
30	**POSITIVE**	TEAR	TEAR	GRADE 2	COMPLETE	COMPLETE	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 2	GRADE 1
31	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 3	GRADE 3	NEGATIVE	NORMAL	NORMAL	-	-	-
32	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
33	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
34	NEGATIVE	NORMAL	NORMAL	-	-	-	**NEGATIVE**	TEAR	NO TEAR	-	NO TEAR	GRADE 2	**POSITIVE**	TEAR	TEAR	-	GRADE 2	GRADE 3
35	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**NEGATIVE**	TEAR	NO TEAR	-	NO TEAR	GRADE 1
36	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
37	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**NEGATIVE**	TEAR	TEAR	-	GRADE 2	GRADE 1
38	**POSITIVE**	TEAR	TEAR	GRADE 2	PARTIAL	PARTIAL	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 2	GRADE 2
39	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	NO TEAR	-	NO TEAR	GRADE 1	NEGATIVE	NORMAL	NORMAL	-	-	-
40	NEGATIVE	NORMAL	NORMAL	-	-	-	**NEGATIVE**	NO TEAR	TEAR	-	GRADE 1	NO TEAR	**POSITIVE**	TEAR	TEAR	-	GRADE 3	GRADE 3
41	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 2	GRADE 3
42	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 2	GRADE 3
43	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	TEAR	-	GRADE 3	GRADE 3	NEGATIVE	NORMAL	NORMAL	-	-	-

S.NO	VS_LCL	MRI_LCL	ARTHROSCOPY_LCL	clinicalgrade_LCL	arthrograde_LCL	mrigrade_LCL	VS_MCL	MRI_MCL	ARTHROSCOPY_MCL	clinicalgrade_MCL	arthrograde_MCL	mrigrade_MCL	RPTCT_PF	MRI_PF	ARTHROSCOPY_PF	clinicalgrade_PF	arthrograde_PF	mrigrade_PF
1	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	CHONDROMALACIA PATELLA	CHONDROMALACIA PATELLA	-	GRADE 2	GRADE 2
2	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	NORMAL	CHONDROMALACIA PATELLA	-	GRADE 1	NORMAL
3	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	NORMAL	CHONDROMALACIA PATELLA	-	GRADE 4	NORMAL
4	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
5	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
6	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	CHONDROMALACIA PATELLAE	-	GRADE 1	-
7	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
8	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	NORMAL	CHONDROMALACIA PATELLA	-	GRADE 2	-
9	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	CHONDROMALACIA PATELLAE	CHONDROMALACIA PATELLAE	-	GRADE 1	GRADE 1
10	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
11	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
12	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**NEGATIVE**	NORMAL	CHONDROMALACIA PATELLA	-	GRADE 1	ABSENT
13	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	CHONDROMALACIA PATELLA	CHONDROMALACIA PATELLA	-	GRADE 3	GRADE 2
14	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	CHONDROMALACIA PATELLA	CHONDROMALACIA PATELLA	-	GRADE 3	GRADE 1
15	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
16	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	NORMAL	CHONDROMALACIA PATELLA	-	GRADE 1	NORMAL
17	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	TEAR	NORMAL	-	NORMAL	PARTIAL	**POSITIVE**	CHONDROMALACIA PATELLA	CHONDROMALACIA PATELLA	-	GRADE 2	GRADE 1
18	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
19	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	NORMAL	CHONDROMALACIA PATELLA	-	GRADE 1	NORMAL
20	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	CHONDROMALACIA PATELLA	CHONDROMALACIA PATELLA	-	GRADE 1	GRADE 1
21	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
22	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
23	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
24	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
25	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
26	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	CHONDROMALACIA PATELLA	CHONDROMALACIA PATELLA	-	GRADE 4	GRADE 4
27	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
28	**POSITIVE**	TEAR	NO TEAR	-	NO TEAR	PARTIAL	**POSITIVE**	TEAR	NO TEAR	-	NO TEAR	PARTIAL	NEGATIVE	NORMAL	NORMAL	-	-	-
29	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
30	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
31	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
32	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	CHONDROMALCIA PATELLA	CHONDROMALCIA PATELLA	-	GRADE 3	GRADE 4
33	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
34	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
35	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
36	**POSITIVE**	TEAR	NO TEAR	-	NO TEAR	PARTIAL	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
37	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
38	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
39	**POSITIVE**	NO TEAR	NO TEAR	-	NO TEAR	NO TEAR	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	CHONDROMALACIA PATELLA	CHONDROMALCIA PATELLA	-	GRADE 2	GRADE 1
40	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
41	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-
42	**POSITIVE**	TEAR	TEAR	-	PARTIAL	PARTIAL	NEGATIVE	NORMAL	NORMAL	-	-	-	**POSITIVE**	NORMAL	CHONDROMALACIA PATELLA	-	GRADE 1	NORMAL
43	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-	NEGATIVE	NORMAL	NORMAL	-	-	-