A Dissertation on

A COMPARATIVE STUDY OF ARTHROSCOPIC FINDING AND MRI FINDING OF INJURED KNEE

Dissertation submitted in

Partial fulfillment of the regulations required for the award of

M.S. DEGREE in

ORTHOPAEDIC SURGERY

APRIL 2020

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY

COIMBATORE-TAMILNADU

APRIL2020

CERTIFICATE-I

This is to certify that this dissertation titled **"A COMPARATIVE STUDY OF ARTHROSCOPIC FINDING AND MRI FINDING OF INJURED KNEE"** is a bonafide record of work done by **Dr.V.SOMASUNDARAM** during the period of his post graduate study from May 2017 to September 2019 under guidance and supervision in the INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY, Coimbatore Medical College and Hospital, Coimbtore-641018, in partial fulfillment of the requirement for **M.S.ORTHOPAEDIC SURGERY** degree examination of The Tamilnadu Dr. M.G.R. Medical University to be held in April 2020.

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CERTIFICATE – II

This is to certify that this dissertation work titled "**A COMPARATIVE STUDY OF ARTHROSCOPIC FINDING AND MRI FINDING OF INJURED KNEE"** of the candidate **Dr.V.SOMASUNDARAM** with Registration Number **221712258** for the award of **MASTER OF SURGERY** in the branch of **ORTHOPAEDICS**. I personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion 95 pages and result shows 2 % percentage of plagiarism in the dissertation.

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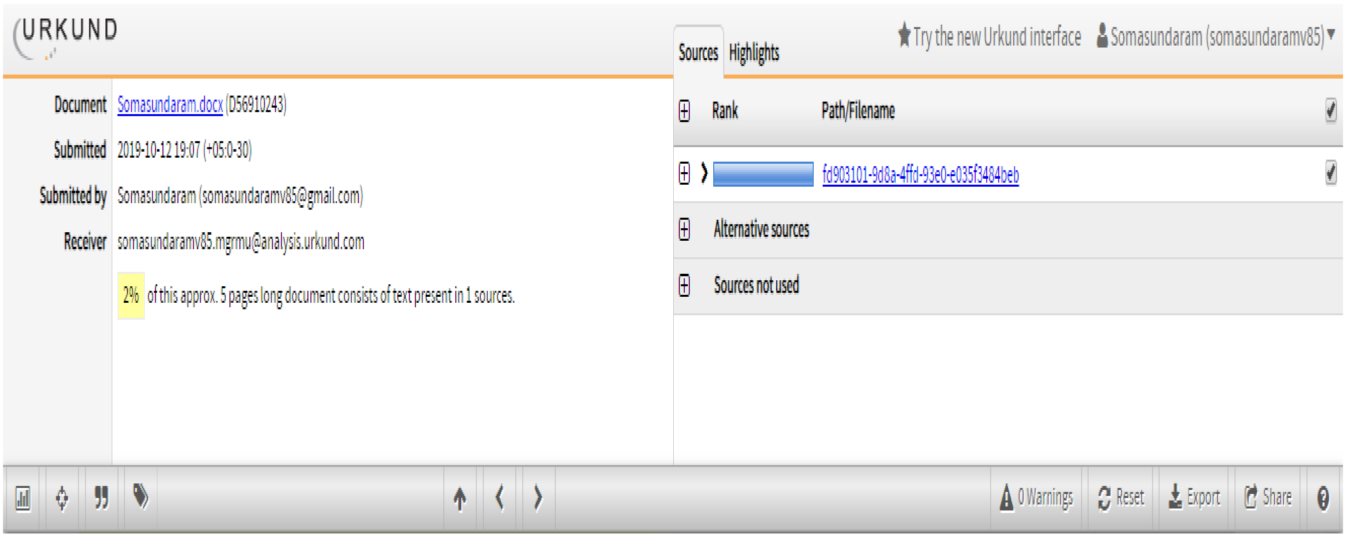

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CERTIFICATE OF APPROVAL

To
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Dear **Dr.Somasundaram V**

The Institutional Ethics Committee of Coimbatore Medical College, reviewed and discussed your application for approval of the proposal entitled **"Comparative Study of Arthroscopic finding and MRI Finding of injured Knee."**No.076/2017.

The following members of Ethics Committee were present in the meeting held on 25.11.2017.conducted at MM - II Seminar Hall, Coimbatore Medical College Hospital Coimbatore-18.

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15	Mr.V.A.Shahul Hameed, +2	Lay-Person

We approve the Proposal to be conducted in its presented form.

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The Institutional Ethics Committee expects to be informed about the progress of the study, and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary, Ethics Committee

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DECLARATION

I declare that the dissertation entitled **"A COMPARATIVE STUDY OF ARTHROSCOPIC FINDING AND MRI FINDING OF INJURED KNEE"** submitted by me for the degree of M.S is the record work carried out by me during the period of **May 2017 to September 2019** under the guidance of **Dr.D.R.RAMPRASATH M.S(ORTHO).,D.ORTHO.,** Associate Professor, Institute of Orthopaedics and Traumatology, Coimbatore Medical College & Hospital, Coimbatore. This dissertation is submitted to The Tamilnadu Dr.M.G.R. Medical University, in partial fulfillment of the University regulations for the award of degree of M.S.ORTHOPAEDICS examination to be held in April 2020.

Place: Coimbatore. **Signature of the Candidate**

Date: **(Dr.V. SOMASUNDARAM)**

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Place : Coimbatore **(Dr.V.SOMASUNDARAM)**

Date :

CONTENTS

INTRODUCTION

The knee joint is more prone to injury especially due to:

i. Trauma

ii. Repetitive activity

iii. Sports activities

iv. Domestic fall

The pathologic conditions of the knee may be assesed by, multiple imaging modalities like -

a) Conventional Radiography

b) Fluoroscopy

c) Ultrasonography

d) Nuclear Medicine

e) MR imaging and

f) Computerised Tomography (CT)

Amidst of them, fluoroscopy and Ultrasonography are used to guide interventional procedures.

Computerised Tomography (CT) are used to weigh up complex fractures.

Magnetic resonance imaging has a better soft tissue contrast and multi-planar slice capability which has revolutionized and has become the ideal modality for imaging complex anatomy of the knee joint.

Another advanced modality in the management of internal derangement of knee joint is Arthroscopy, which can be used in its dual mode, either as diagnostic and/or as therapeutic tool.

ANATOMY OF THE KNEE JOINT

ANATOMY

The knee is a complex joint allowing flexion, extension, anterior-posterior gliding and internal-external rotation. The major articular surfaces are the medial and lateral condyles of the femur, tibia and the patellar surface.

Knee joint is the largest synovial joint of the body.

It consists of (Figure.1):

- ❖ The articulation between the femur and tibia, which is weight bearing.
- ❖ The articulation between the patella and the femur, which allows the pull of the the quadriceps femoris muscle to be, directed anteriorly over the knee to the tibia without tendon wear.
- ❖ Two fibro cartilaginous menisci, one on each side, between the femoral condyles and tibia accommodate changes in the shape of the articular surfaces during joint movements.

Knee joint is basically a hinge joint that allows mainly flexion and extension. Like all hinge joints, the knee joint is reinforced by collateral ligaments, one on each side of the joint. In addition, two very strong ligaments [the cruciate ligaments] interconnect the adjacent ends of the femur and tibia and maintain there opposed position during movement.

The femur, tibia and patella are the major osseous structures of the knee joint. Hematopoietic marrow gradually converts to fatty marrow from childhood to adult life. The patella is a large sesamoid bone with thick articular cartilage. Lateral, medial and anterior muscle groups are seen in the knee region. The lateral group comprises the biceps-femoris, lateral gastrocnemius, popliteus and plantaris. The medial group-semimembranosus, medial gastrocnemius, sartorius and gracilis. The anterior group comprises the vastusintermedius, medialis, medialisobliqui, lateralis and rectus femoris.

There are four major neurovascular structures: the popliteal artery, the vein and the tibial and peroneal nerves.

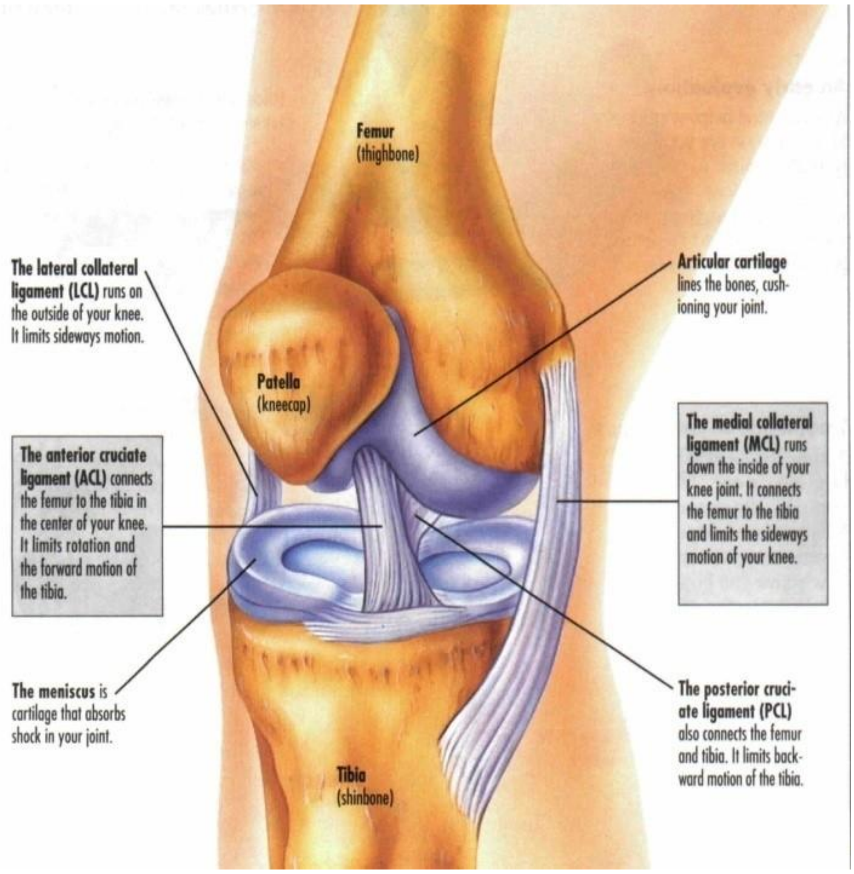


Figure.1.Anatomy of knee joint.

ARTICULAR SURFACE:

The articular surfaces of the bones that contribute to the knee joint are covered by hyaline cartilage.

The major surfaces involved include:

- The two femoral condyles,
- The adjacent surfaces of the superior aspect of the tibial condyles.

The surfaces of the femoral condyles that articulate with the tibia in flexion of the knee are curved or round whereas the surfaces that articulate in full extension are flat. The articular surfaces between the femur and patella are the V-shaped trench on the anterior surface of the distal end of the femur where the two condyles join and the adjacent surfaces on the posterior aspect of the patella.

The joint surfaces are all enclosed in a single articular cavity, as are the intra-articular menisci between the femoral and tibial condyles.

CAPSULE :

The knee capsule is a dual-layered structure that surrounds the knee joint. It is relatively thin anteriorly and posteriorly, thickened laterally by the collateral ligaments.

The outer layer of the knee capsule consists of fibrous connective tissue to hold the joint in place, whereas the inner layer consists of a synovial membrane which secretes synovial fluid and provides lubrication.

The femoral aspect of the capsule is demarcated by:

- The proximal femoral condyles and intercondylar fossa posteriorly
- patellar retinaculum anteriorly
- articular margin of the femur medially
- the femur just proximal to the groove for the popliteus tendon laterally

There is no capsule above the patella, allowing the suprapatellar bursa to communicate with the joint.

The tibial aspect of the capsule is demarcated by:

- The tibial condyles posteriorly and medially
- Patellar retinaculum and tibial tuberosity anteriorly
- Head of the fibula laterally

There is also an aperture for the popliteus tendon at the lateral tibial condyle.

The fibrous capsule also has a deep component with a thickening on the medial aspect being part of the medial collateral ligament. The deep component also attaches weakly to the menisci, where they are known as the coronary ligaments

Anteriorly, the reflection of the synovial membrane lies on the femur; located at some distance from the cartilage because of the presence of the suprapatellar bursa. Above, the reflection appears lifted from the bone by underlying periosteal connective tissue. In a standing posture, the suprapatellar bursa is seemingly redundant. It is however also referred to as the suprapatellar synovial recess as it gradually unfolds as the knee is flexed; to open up completely when the knee is flexed 130 degrees. The suprapatellar bursa is prevented from being pinched during extension by the articularis genus muscle. On the tibia, the anterior reflection and attachment of the synovial membrane is located near the cartilage.

Anteriorly, the infrapatellar fat pad is inserted below the patella and between the two membranes. It extends from the lower margin of the patella above, to the infrapatellar synovial fold below. With its free upper margin, this fold extends dorsally through the joint space to surround the two cruciate ligaments from the front, thus dividing the surrounding joint space into two chambers. Laterally of this are a pair of alar folds.

Posteriorly, the femoral attachment of the synovial membrane is located at the cartilaginous margin of the lateral and medial femoral condyles, where the joint space has two dorsal extensions. Between these, the synovial membrane passes in front of the anterior and posterior cruciate ligaments, where these ligaments are both intracapsular and extra-articular with their tibial attachment located exactly on the cartilage margin.Both medial and lateral meniscus are however, located within the synovial capsule.

MENISCI:

The menisci are wedge-shaped, semi-lunar (C shaped), fibro cartilage structures composed of thick collagen fibers primarily arranged circumferentially, with radial fibers extending from the capsule, between the circumferential fibers. The medial meniscus is semicircular and the lateral meniscus is almost a complete circle. The superior surface of the meniscus is concave and the inferior surface is flat, allowing for maximal congruency between the femur and tibia. With weight bearing, the curved femoral condylar surfaces radially displace the menisci, creating circumferential hoop stresses. The anterior and posterior horns of the lateral meniscus are equal in size. The medial meniscus has a larger posterior than anterior horn and is firmly attached to the deep aspect of the medial collateral ligament. The menisci are further attached to the tibia at their central and inferior peripheral portions. The anterior horns are attached by the transverse ligament. The posterior horn of the lateral meniscus is traversed by the popliteus tendon, which courses posterior and inferior from the lateral femoral condyle and is intracapsular. The posterior horn of the lateral meniscus is also secured to the medial femoral condyle by the ligament of Wrisberg, which passes posterior to the posterior cruciate ligament (PCL) and less constantly by the ligament of Humphrey, which passes anterior to the PCL.

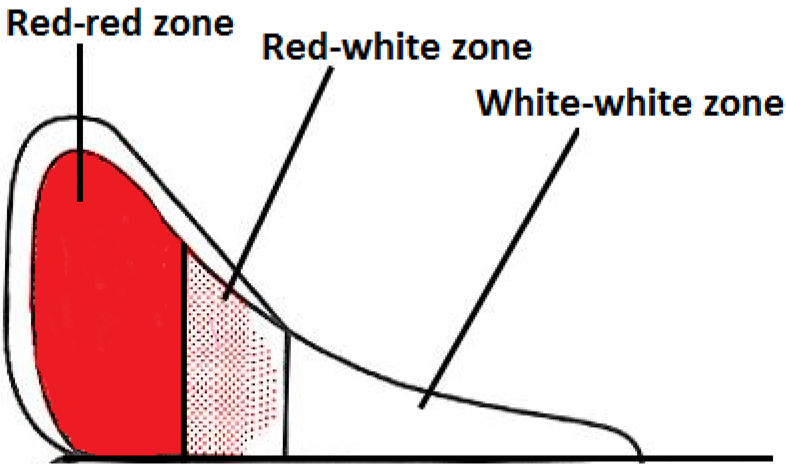


Figure.2. Zones of meniscus

The menisci serve the important function of shock absorption, distribution of nutrient synovial fluid within the joint, load transmission and stability. Various zones of meniscus are described based on the blood supply, (Figure 2).

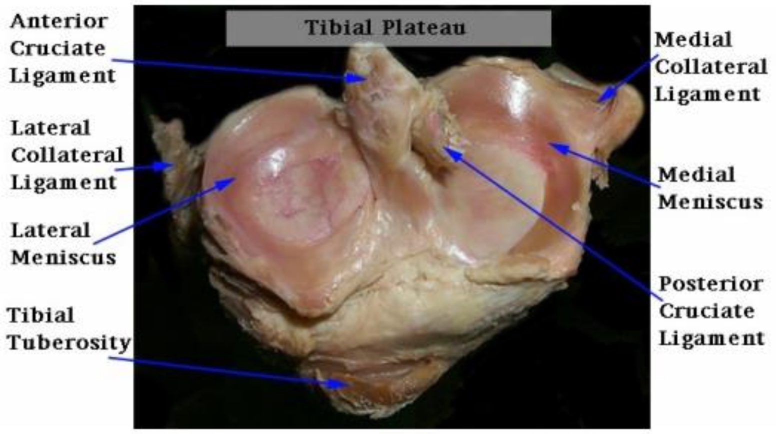


Figure.3. Arrangement of menisci, cruciate and collateral ligaments.

the red zone is the well vascularized periphery, the red-white zone is the middle portion with vascularity peripherally but not centrally, and the white zone is the central avascular portion.

CRUCIATE LIGAMENTS:

The cruciate ligament consists of highly organized collagen matrix. The cruciates are named for their attachment on the tibia viz., anterior and posterior and are essential to the function of the knee joint. They act to stabilize the knee joint and prevent the anteroposterior displacement of the tibia on the femur and assist in control of both medial and lateral rotation of the tibia on the femur. External rotation produces unwinding and internal rotation produce a winding. These ligaments are intra-articular and extra-synovial.

ANTERIOR CRUCIATE LIGAMENT (ACL):

The anatomy of the cruciate ligaments has been studied by Girgis et al., ACL is composed of longitudinally oriented bundles of collagen arranged in fascicular subunits within larger functional bands (Figure 3) . The ligament is surrounded by synovium. The ACL extends from the posteromedial aspect of the lateral femoral condyle to the anteromedial tibial plateau, just anterior to the intercondylar eminence. The femoral attachment is not at the intercondylar notch which is a common misconception. The anterior attachment is straight and the posterior is convex. The ligament courses anteriorly, medially and distally toward tibia. The fibers undergo a slight external rotation. The average length is 38mm,and width is 11mm. The tibial attachment is medial to the insertion of the anterior horn of the lateral meniscus in a depressed area anterolateral to the anterior tibial spine, the insertion is larger and more secure than the femoral attachment. The ligament is intra-articular but extra-synovial.

The ACL is significantly smaller in women, with respect to measurements of volume, mass, area, and length. The apparent difference between men and women, with regard to ACL size and body weight, and intercondylar notch size, is still a controversial topic.

The ACL can be divided into anteromedial bundles (AMB) and posterolateral bundles (PLB) based on function, although there is no histologic separation. The bundles are named by their relative attachment sites on the tibia. The AMB restrains anterior tibial translation relative to the femur, whereas the PLB restrains rotation in near full extension. The AMB rotates laterally around the PLB during knee flexion. Distal fibers of the ACL may extend to the anterior and posterior horns of the lateral meniscus.

The primary blood supply to ACL is through the medial genicular artery, a branch from the anterior aspect of popliteal artery which pierces the posterior oblique ligament. Ligamentous branches arise from this, traverse the synovium and form a plexus of vessels that cover both ACL and PCL and perforate the ligament to anastomose with small vessels, which run parallel to collagen fibrils. Additional blood supply is from the inferior genicular artery. The ACL receives essentially no blood supply from the ligament bone insertion sites.

The posterior articular nerve a branch from posterior tibial nerve innervates ACL. Studies have confirmed the presence of pain transmitting nerves as well as mechanoreceptors in the substance of the ACL.

POSTERIOR CRUCIATE LIGAMENT (PCL):

The PCL is larger and stronger than the ACL and functions to restrain posterior tibial translation relative to the femur. The femoral attachment is along the medial side and medial roof of the intercondylar notch. The tibial attachment is along the midline dorsal aspect of the tibial plateau, between the meniscal roots. It averages 38mm in length and 13mm in width. It is narrowest in its mid portion and fans out on either side.

The PCL tibial attachment also extends over the dorsal rim of the posterior tibial shelf. The PCL can be divided into two functional bundles, the anterolateral bundle (ALB) and the posteromedial bundle (PMB). The bundles are named based on the location of their femoral attachments. The two bundles maintain their anterior and posterior locations during motion of the knee and do not rotate around each other, as is seen with the bundles of the ACL.

The ALB is larger and stronger, but has a co-dominant role with the PMB in stabilizing the knee. Additional posterior oblique fibers of the PCL have been described and can be contused with the posterior menisco-femoral ligament.

The menisco-femoral ligaments extend from the posterior horn of the lateral meniscus to the medial femoral condyle. The menisco-femoral ligament lying posterior to the PCL is also known as the ligament of Wrisberg. The menisco-femoral ligament lying anterior to the PCL is also known as the ligament of Humphrey and may mimic an intact PCL in the presence of a PCL tear.

Although the PCL is slack in the fully extended position, the PMB is relatively taut, compared with the ALB. The PCL shares function with the posterolateral corner structures in providing posterolateral-rotatory stability. In flexion it becomes more taut and functional as the posterolateral corner structures become progressively lax.

A normal joint recess is located just posterior to the PCL, termed the PCL recess. This joint recess communicates with the medial femorotibial compartment and potentially can become isolated from the rest of the joint. An additional small joint recess lies between the ACL and PCL, termed the intercruciate recess. The inter-cruciate recess may communicate with either the medial or lateral femorotibial compartment.

COLLATERAL LIGAMENTS:

The medial collateral ligament (MCL) has superficial and deep components. The more superficial component arises from the medial femoral condyle and inserts on the medial tibial metaphysis just deep to the pes-anserinus. The deep component is firmly attached to the medial meniscus. The two components join together anteriorly to form the medial patellar retinaculum.

The lateral collateral ligament (LCL) arises from the lateral femoral condyle and attaches to the anterior and superior aspect of the fibular head. The biceps femoris tendon attaches just posterior to the lateral collateral ligament. The iliotibial tract attaches to the anterior and lateral tibial tubercle.

MUSCLES AND SOFT TISSUES:

The important tendons around the knee include the quadriceps and patellar tendon. The infrapatellar fat pad is a fibro fatty structure in the space between the patellar tendon and the femur and tibia. Synovium lines the internal surface of the joint. There are several important bursae. The suprapatellar bursa develops as a separate structure and usually communicates with the joint as the suprapatellar pouch following atrophy of the plica from the lateral to medial aspects. The deep infrapatellar bursa is at the junction of patellar tendon with tibial tuberosity. Bursae also are anterior to the patella and patellar tendon. One other bursa is the posterior medial bursa associated with the gastrocnemius and semimembranosus tendons. Communication between the joint and this bursa often produces popliteal cysts.

INTERNAL DERANGEMENT:

The term internal derangement was originated in 1784 by William Hey; it is now loosely applied to a variety of intraarticular and extraarticular disturbances, usually of traumatic origin, that interfere with the function of the joint. The structure that is "deranged" should be identified, which requires a keen sense of clinical judgements, radiographs, MRI, Arthroscopy, and at times, surgical exploration.

MENISCAL TEARS:

The MM facilitates the transmission of 40-50% of the load of the medial compartment, where as the LM may transmit as much as 65-75% of the load on the lateral compartment .The MM is subject to higher stresses than the LM. This has prognostic considerations when treating acute MM tears in the presence of ACL tears. In this situation, it is imperative to repair the meniscal tear while repairing the ACL tear. The MM also acts as secondary stabilizer in anteroposterior stability, becoming more important in ACL deficient knee. The LM may play a role in rotational control, especially in patients with posterolateral instability. The LM causes a greater proportion of the load on the lateral side of the knee when compared with the medial side, where the load is shared equally by the MM and the articular surface.

MECHANISM OF INJURY:

Injuries to the healthy meniscus are usually produced by compressive forces coupled with rotation of the flexed knee as it starts to move into extension. The final type and location of the tear is determined by the direction and magnitude of the force acting on the knee and the position of the knee when injured. Most meniscal tears in sports are non-contact in nature and occur from deceleration, cutting, or landing from a jump. Other mechanisms of injury include twisting of the knee or squatting.

In knees with chronic ACL tears, recurrent episodes of anterior tibial subluxation on the femur occur. Resulting in shearing forces on the menisci.

In skiers with acute LM tears and ACL tears, the mechanism of injury to the meniscus is an anterolateral translation. As the ACL disrupts, excessive anterolateral rotation of the tibia on the femur traps the LM between the posterolateral aspect of the tibial plateau and the central portion of the lateral femoral condyle. The LM is distorted when the tibia reduces, often resulting in a tear.

CLASSIFICATION:

Numerous classifications of tears of the menisci have been proposed on the basis of location or type of tear, etiology, and other factors; most of the commonly used classifications are based on the type of tear found during surgery. These are (1) longitudinal tears, (2) transverse and oblique tears, (3) a combination of longitudinal and oblique tears,(4) tears associated with cystic menisci, and (5) tears associated with discoid menisci(Figure 4).

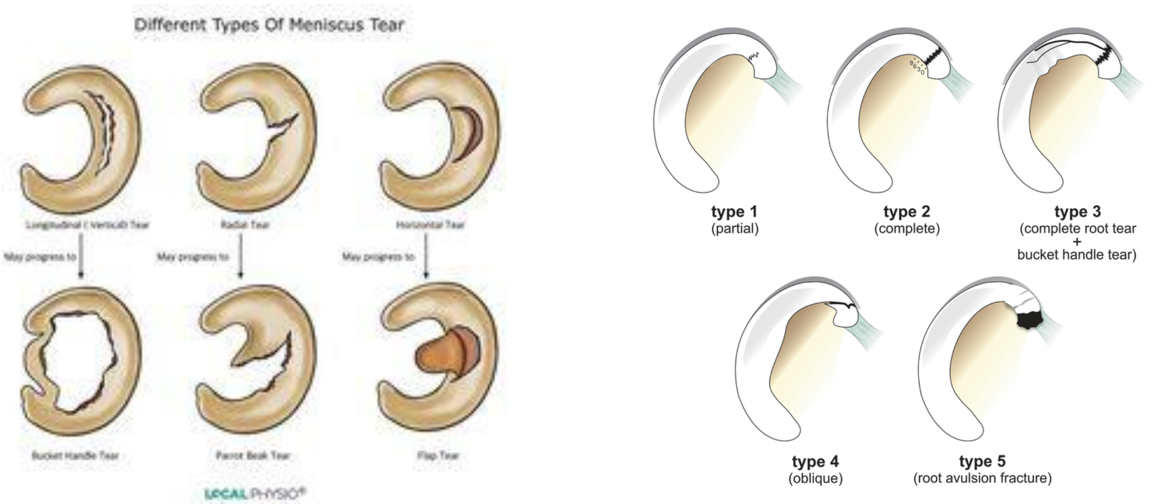


Figure.4. Classification of meniscal tears based on their types.

FINDINGS ON PHYSICALEXAMINATION:

General findings include the following;

- Clicking
- Localised tenderness along the medial or lateral joint line or over the periphery of the meniscus
- Locking of the knee in fixed flexion
- Pseudo-locking, which may be related to muscle spasm
- Limping

TESTS TO EVALUATE THE MENISCI:

- Apley test
- McMurray test
- Bohler test
- Payr test

MAGNETIC RESONANCE IMAGING:

MRI shows many of the essential characteristics of meniscal tears critical to management, such as there location, shape, length and depth. In this way, MRI helps to provide an accurate assessment of stability, the likelihood of tear propagation, and a determination of whether it can be repaired. It is advantageous to know ahead of time if a meniscal tear is repairable; the additional equipment, surgical assistants, and time needed for repair can be anticipated. Patients also benefit from an earlier knowledge for need of surgery. The sensitivity reported in literatures for detecting MM tears varies from 86-96% with a specificity of 84-94%. For LM tears, the sensitivity decreases to 68-86%, and the specificity is 92-

98%.MRI is highly accurate in diagnosing ACL tears, the oblique saggital plane along with coronal and axial imaging is most helpful in diagnosis. The EMPTY NOTCH SIGN on coronal imaging in complete ACL tear. For PCL tears more than 7mm diameter of vertical portion on saggital imaging is indicative of a tear. Meniscal tears is diagnosed in MRI by noting a vertical cleft of increased signal intensity contacting the meniscal surface on coronal images and a blunted or absent meniscus in saggital images.

MISCELLANEOUS LESIONS:

Meniscal contusion:

Meniscal contusion occurs when the meniscus gets trapped between the tibia and femur, usually as a result of trauma. A contused meniscus demonstrates increased signal within its substance that might resemble a tear. The signal is indistinct and amorphous, rather than the sharp and discrete signal seen in a tear. Often, there is an adjacent bone contusion.

Meniscal cysts:

Meniscal cysts occur more frequently in the medial compartment than elsewhere because meniscal tears are more common in the medial meniscus. Medial para-meniscal cysts are more symptomatic than other conditions because of their location adjacent to the MCL. Medial meniscal cysts are most commonly adjacent to the posterior horn.

Lateral meniscal cysts are most commonly located adjacent to the anterior horn or body. Medial meniscus cysts are twice as common as lateral meniscal cysts. The tears are most commonly formed when horizontal tears extend to the meniscus periphery, allowing joint fluid to escape into the para-meniscal soft tissues. The fluid subsequently encapsulates and becomes symptomatic due to mass effect. Occasionally, the cyst can be confined to the meniscus. This is referred to as an intrameniscal cyst.

The MRI appearance is a fluid filled region adjacent to a horizontal meniscal tear.

DISCOID MENISCUS :

Discoid meniscus is a rare human anatomic variant that usually affects the lateral meniscus of the knee. Usually a person with this anomaly has no complaints; however, it may present as pain, swelling, or a snapping sound heard from the affected knee. Strong suggestive findings on magnetic resonance imaging includes a thickened meniscal body seen on more than two contiguous sagittal slices.

The classification of discoid lateral meniscus is: (A) Incomplete, (B) Complete, and C) Wrisberg-ligament variant. Normally, the meniscus is a thin crescent-shaped piece of cartilage that lies between the weight bearing joint surfaces of the femur and the tibia. It is attached to the lining of the knee joint along its periphery and serves to absorb about a third of the impact load that the joint cartilage surface sees and also provides some degree of stabilization for the knee.

Bow-Tie Sign: The bow-tie represents the continuity of the meniscus between the anterior and posterior horns. It is normally seen on 2 contiguous sagittal images. When seen on 3 or more contiguous, 5-mm thick sagittal images, it is indicative of a discoid meniscus.

ANTERIOR CRUCIATE LIGAMENT INJURIES:

Biomechanics:

The anterior cruciate ligament is the primary restraint to anterior tibial translation. According to biomechanical tests by Noyes et al., it accounts for approximately 85% of the resistance to the anterior drawer test when the knee is at 90 degrees flexion and neutral rotation. The anterior cruciate ligament also functions as a secondary restraint on tibial rotation and varus-valgus angulations at full extension.

The anterior cruciate ligament is the primary restraint to anterior tibial translation.

History and physical examination:

The classic history of an anterior cruciate ligament injury begins with a noncontact deceleration, jumping, or cutting action. Obviously, other mechanisms of injury include external forces applied to the knee. The patient often describes the knee as having been hyperextended or popping out of the joint and then reducing. A pop is frequently heard or felt. The patient has usually fallen to the ground and is not immediately able to get up. Resumption of activity usually is not possible, and walking is often difficult. Within a few hours, the knee swells, and aspiration of joint reveals hemarthroses. In this scenario, the likelihood of an anterior cruciate ligament injury is greater than 70%. The Lachman test is the most sensitive test for anterior tibial displacement. Increased excursion relative to the opposite knee and absence of a firm end point suggest an injury to the anterior cruciate ligament. The Lachman test has sensitivity of 95% which was not significantly different from the other methods. Roentgenograms often are normal, however, a tibial eminence fracture indicates an avulsion of the anterior cruciate ligament from its insertion. MRI is the most helpful diagnostic technique. The reported accuracy for detecting tears of the anterior cruciate ligament has ranged from 70-100%. Because the anterior cruciate ligament crosses the knee joint at a slightly oblique angle, the complete ligament rarely is captured in its entirety by a single MRI scan in the true sagittal plane. Vellet introduced the concept of a non-orthogonal plane, which usually shows the entire anterior cruciate ligament in one frame. The non-orthogonal plane is achieved by externally rotating the knee approximately 15 degrees. More recent investigators reported that the accuracy of MRI in evaluating injuries to the anterior cruciate ligament approaches 95-100%.

POSTERIOR CRUCIATE LIGAMENT INJURIES:

Biomechanics:

The posterior cruciate ligament is more vertically than obliquely oriented and is the axis around which rotation of knee occurs. It appears to guide the "screw-home" mechanism of internal rotation of the femur during terminal extension of the knee. Selected cutting of the posterior cruciate demonstrates that it is important in flexion, and when lost, posterior drawer displacement is increased with no change in the anterior drawer sign. Rotational stability is unchanged in extension but is altered in flexion after the posterior cruciate is cut. Posterior cruciate ligament accounts for 89% of the resistance to posterior translation of the tibia on the femur and it acts as a check for hyperextension only after the anterior cruciate ligament has been ruptured

Physical examination:

On physical examination, a posterior cruciate ligament tear results in a positive posterior drawer test. Normally, there should be 5-10mm of anterior offset of tibia relative to the medial femoral condyle. With a posterior cruciate ligament injury, this anterior offset is lost, and the tibia appears in flush with the femoral condyle. Stress roentgenograms assists in the diagnosis of the posterior cruciate ligament injuries. Increased posterior translation of 8mm or more in stress roentgenograms is indicative of complete rupture. MRI studies are more reliable for diagnosis of posterior cruciate ligament tears than for anterior cruciate ligament tears and are routinely obtained.

DOUBLE PCL SIGN:

The double PCL sign is associated with bucket handle tears of medial meniscus that occur in the presence of an intact anterior cruciate ligament(ACL). A bucket handle tear is a longitudinal tear of a meniscus that results in a displaced but attached meniscal fragment.

COLLATERAL LIGAMENT INJURIES:

Both the medial and lateral supporting structures of the knee are complex arrangements of ligaments, fascial layers, and tendon insertions. For this reason, injuries can range from isolated single element injuries to combined multiple element injuries. In addition, injuries can range from strains or partial tears to complete disruptions.

Isolated medial collateral ligament (MCL) injuries result from a valgus stress without a rotary component. Biomechanical studies indicate that the primary function of the MCL as a limit to valgus is crucial only during flexion, therefore, most injuries occur when the knee is flexed.

MCL tears rarely are isolated. More commonly, they are associated with other soft tissue injuries of the knee, such as anterior cruciate ligament (ACL) tears. Other associations include menisco-capsular separations and bone bruises. Isolated injuries of lateral collateral ligament (LCL) result from an abnormal varus stress placed on an internally rotated knee. Posterior lateral corner(PLC) injuries can occur as a result of both direct and nondirect forces that cause hyperextesion or hyperextension and external rotation. Similar to MCL tears, isolated injuries of the LCL are uncommon and typically occur in association with ACL or PCL tears. Injuries of the lateral compartment are complex, usually with injuries to multiple components, and often are more disabling than injuries of the medial structures because of the greater forces to which lateral structures are subjected during normal gait. Individuals with MCL tears often report feeling a pop after a direct lateral blow to the knee.

Clinicians should suspect concomitant cruciate ligament tears if the mechanism of injury was indirect. MCL tears can be classified according to physical examination.

- Grade I tears are not characterized by laxity, only by tenderness upon palpation of the MCL
- Grade II tears demonstrate some laxity upon valgus stress but have a firm endpoint.
- Grade III tears demonstrate increased laxity and no identifiable endpoint.

Individuals with LCL tears rarely report feeling a pop, since their symptoms usually is the most common mechanism of PLC injuries. Patients present with instability, buckling into hyperextension, and posterior lateral pain. The LCL is a completely extra-articular structure, therefore, isolated injuries have little swellings and no effusions.

AIMS AND OBJECTIVES

- To compare the sensitivity of MRl in diagnosis of IDK with Arthroscopy
- To study the feasibility of performing arthroscopy procedure based on clinical judgement alone without MRl in IDK lesions.
- To show if MRl is mandatory in all IDK lesions.

REVIEW OF LITERATURE

The term internal derangement is loosely applied clinically to describe a variety of intra-articular disturbances with or without extra-articular disturbances, usually of traumatic origin. It comprises of injuries to menisci, cruciate ligaments, collateral ligaments and other structures of the knee joint.

Clinical tests used in the diagnosis of meniscal and cruciate ligament damage have limitations and it may not be possible to elicit objective signs repeatedly, more so in a busy orthopaedic clinic and being painful in acute and subacute presentation. An accurate clinical diagnosis requires experience although difficult to quantify.

Magnetic resonance imaging (MRI) has revolutionized the diagnosis of intraarticular pathologies. Arthroscopy being more sensitive and specific procedure in both diagnostic and therapeutic aspects. Pioneering work in the field of arthroscopy began as early as the 1920s with the work of arthroscopy of the knee for diagnostic procedures. After diagnosing torn tissue through arthroscopy, Bircher used open surgery to remove or repair the damaged tissue. Initially, he used an electric Jacobaeus thoraco-laparoscope for his diagnostic procedures, which produced a dim view of the joint. Later, he developed a double contrast approach to improve visibility.

Bircher gave up endoscopy in 1930, and his work was largely neglected for several decades.

While Bircher is often considered the inventor of arthroscopy of knee, the Japanese surgeon Masaki Watanabe, MD receives primary credit for using arthroscopy for interventional surgery.Watanabe was inspired by the work of Dr Richard O' Connor.

Later, Dr Heshmat shahnaree began experimenting with ways to excise fragments of menisci.

The first operating arthroscope was jointly designed by these men, and they worked together to produce the first high quality color intra-articular photography.The field benefited significantly from technological advances, particularly advances in flexible fiber optics during the 1970s and 1980s.

MRI is an accurate and cost-effective means of evaluating a wide spectrum of knee injuries ranging from cruciate-collateral ligament injuries to cartilage deficiencies. For interpreting radiologists and clinicians, evaluation of an injured knee using MRI requires knowledge of the proper imaging techniques, normal and aberrant anatomy, and clinical significance of detected abnormalities.

- A study done by Fritz and others proved that MRI of the traumatic knee is a useful alternative modality to investigate traumatic knee. MRI is accepted as a useful non-invasive diagnostic tool for the detection of cruciate ligament lesions.

- Kojima and colleagues evaluated 202 patients with coronal fat suppression fast spin echo images of the knee and later with arthroscopy, showed a good correlation between MRI knee and arthroscopic findings.

- Boden and associates in an analysis of financial impacts of diagnostic methods used to evaluate the acutely injured knee concluded that arthroscopy is more cost effective to MRI, if 78% or more of scanned patients undergo arthroscopy.

- Noble emphasized the need to avoid unnecessary arthroscopy, indicating that the results of MRI of knee in some patients augment the clinical judgment, leaving the arthroscope to bring about a practical solution for the patient's demonstrable (&verified) problem. But a diagnostic test, such as MRI, is not indicated if treatment will not be affected by the result, no matter what the result might be. Furthermore owing to the occurrence of positive findings on MRI of knee in asymptomatic patients, the results on MRI examination must be correlated with those from careful clinical assessment.

- Ilasan and colleagues showed that MRI is the modality of choice for noninvasive evaluation of reconstructed ligaments, menisco-capsular structures and soft tissues. Magnetic resonance imaging is considered the best imaging modality to evaluate the postoperative knee because it permits direct evaluation of the reconstructed ligament and any associated complications.

- Huegli and associates concluded that MR imaging allows reliable grading of the extent of an isolated injury of the trochlear groove articular cartilage and assists in directing surgical diagnosis and treatment.
- Reicher and coworkers initiated a bright future for MRI of the knee in 1985 with their initial description of MRI used for meniscal tear detection and other knee disorders.

Although MRI is unlikely to replace arthroscopy as the standard examination for internal derangements of the knee, it is important in the evaluation of meniscal tears, discoid meniscus, cruciate and collateral ligaments injuries, occult bone trauma, chondromalacia, ACL reconstruction andmasses.·

- Kean & Coworkers , Moon & associates' and Li & collaborators " were the first to describe the potential of MRI" in assessing the knee. Reicher and coworkers provided further evidence of this potential using close imaging pathologic correlation in cadaveric knees & imaging-arthroscopic correlation in knees of symptomatic patients. With technical advances in the field, MR imaging of the knee became sharper and findings more definite. Three dimensional gradient echo imaging, reformatted/ reconstructed images & innovative and faster imaging methods for assessing the knee were given attention. Furthermore, as many of MR imaging abnormalities were seen more easily in presence of knee effusion, the added benefit of using MRI.

- The work of Hajek and coworkers in 1987 gave birth to the concept of Gadolinium enhanced MR arthrography. However it is time consuming and invasive and may require access to fluoroscopy room for injection of contrast. Then the question came about whether MR imaging is needed as a supplement to clinical assessment in an age in which diagnostic and therapeutic arthroscopy is being used increasingly. Gadolinium enhanced MRI of cartilage (GEMRIC) has extensively been used to identify pre-radigraphic cartilage changes in osteoarthritis. The concentration of contrast agent is lower in healthy meniscus but tend to increase in unhealthy menisci.
- Spiers & Coworkers in a study of 58 patients with internal derangements of knee concluded that MRI studies on all patients scheduled for arthroscopy, would lead to modest increase in cost of treatment but one that represented "a small price to pay for a reduction in morbidity associated with arthroscopy, &liberation of theatres and surgeons for other work".
- MRI is a common accurate & cost-effective diagnostic study in the evaluation of internal derangements of the knee. Within a decade of its introduction MRI became the imaging method of choice for meniscal pathology in knee. Several large MRl studies have found sensitivity ranges from 51-91% for medial meniscal tears & 69-92% for LM tears; Specificity ranges from 82-91% medial and 91 -98% lateral.
- Elvenes et al in their study found that sensitivity, specificity, positive and

negative predictive value of MRl for MM were 100%, 77%, 71 %&100% respectively, while values for LM were 40%, 89%, 33 %, & 91% respectively. Overall accuracy of MRl for MM & LM combined was 84%. On basis of high negative predictive value, they concluded that MRl is useful to exclude patients from unnecessary arthroscopy.

- The sensitivity of MR imaging of meniscal tears compared with arthroscopy has been reported to be between 80-100% by Crues et al. For excluding tears on normal MR examination of menisci negative predictive value of MRI approaches 100% as described by Reicher et al MRI currently appears to be more sensitive for detection of tears in medial meniscus but more specific for tears in lateral meniscus.
- Reicher et al" in their study showed that of the menisci rated as definitely or probably torn on MRI, 80% were found to be torn at arthroscopy. The predictive value of negative MRI was 100%, MRI was 92% accurate in predicting, the clinical outcome in patients with suspected meniscal tears who did not undergo surgery.

RESOURCES AND TECHNIQUE

Nature of Study	:	PROSPECTIVE STUDY
No of Patients in the Study	:	30
Institute	:	INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY
College	:	GOVERNMENT COIMBATORE MEDICAL COLLEGE & HOSPITAL
Period of Study	:	MAY 2017 TO SEPTEMBER 2019

SOURCES OF DATA

30 Cases of injured knee who got admitted in the Institute of Orthopaedics and Traumatology Coimbatore Medical College Hospital . MRI of the knee was done after admission and clinical examination in Institute of Orthopaedics and Traumatology Coimbatore Medical College Hospital. However, all the patients were subjected to clinical assessment tracked by MRI and arthroscopy after required investigations and subsequent to their written informed consent.

MATERIALS AND METHODS

STUDY DESIGN

Comparative study

PLACE OF STUDY

Study was carried out at the Institute of Orthopaedics and Traumatology Coimbatore Medical College Hospital.

STUDY POPULATION

Patients who reported with knee symptoms after knee injury ,who were indicative of Internal derangement and underwent arthroscopy procedure following a detailed clinical examination and imaging with MRI were the subject of the study.

PERIOD OF STUDY

May 2017 to September 2019

INCLUSION CRITERIA

1. Patients with knee signs like pain, unsteadiness.
2. Patients with recent problems of locking of knee or effusion,
3. Patients who have undergone MRI for any other suggestion which prove Internal derangement of knee.
4. Patients with an acute knee pain and suspicious knee injury.
5. Patients aged between 18-60yrs.

EXCLUSION CRITERIA

Following patients were expelled from our study,

1. Patients with symptoms and signs of acute infections.
2. Patients with severe comorbid illness like diabetes mellitus, epilepsy, bronchial asthma, Rheumatoid arthritis.
3. Patient with cardiac pacemakers, metal implants.
4. Cases with severe osteoarthritis of knee.
5. Cases with knee ankylosis.
6. Cases treated for chronic septic arthritis or with ATT as doubtful TB ARTHRITIS OF KNEE.
7. Patients below the age of 18 yrs and above 60yrs.

METHODS OF ASSESSMENT

1. Before surgery

a) Presenting complaints

b) History of present, illness

c) Any medical/surgical co-morbid illness

d) General physical examination

e) Complete examination of knee was carried out with particular emphasis on tests for meniscal tears like:

1) Medial joint line tenderness,
2) Mc-murray's test,
3) Apley's grinding tests,

4) Tests for cruciate ligament tears like

    a) Lachman test,

    b) Anterior and Posterior drawer tests,

5) Pivot shift tests,

6) Tests for Collateral ligament injuries like Valgus/ Varus stress tests.

f) Pre- Operative workup

   i. X ray of involved knee:

      1) Anterioposterior view

      2) Lateral views

      3) schuss view PA view weight bearing knee radiograph taken in 30 degrees of knee flexion to visualise the intercondylar notch of the femur.

   ii. a) Complete blood count

       b) renal function test

       c) urine routine examination

       d) ECG

       e) chest x ray

   iii. MRI KNEE-The protocol for imaging the injured knee to identify any soft tissue injury included the following sequences

      a. Localizer sequences in sagittal, coronal and axial plane

      b. Fat suppressed T2 axial turbo spin-echo

c. Tl spin-echo sagittal

iv. Pre- anaesthetic check-up and ASA grading for fitness for surgery

2. **Surgery**

The arthroscopic procedures were performed only under spinal anesthesia.

Per operative findings the anatomical structure involved :

1) Presence or absence of any ligamentor meniscal tears,
2) Location of the ligament and meniscal tear,
3) Status of the articular cartilage,
4) Additional details when available were documented in the operation theatre.

PATIENT POSITIONING

When the patient is anaesthetised, and a tourniquet and a leg holder/ lateral post were applied, the limb from the ankle to the tourniquet was thoroughly scrubbed and surgically prepared.

Stryker arthroscope of our hospital was used. Drapes that isolate the foot and lower leg and the distal thigh just below the tourniquet and leg holder were used. Waterproof gowns for the surgeon and the assistant were used to prevent contamination.

The patient was placed supine with the prepared and draped limb angled off the lateral aspect of the table, so that the limb dangled at 90 degrees (Figure 5).

Figure. 5. Patient Positioning

PORTAL PLACEMENT

The standard portals for diagnostic arthroscopy i.e anterolateral and anteromedial portals were used in all cases. A 4-mm- diameter, 30 degrees oblique forelens arthroscope through the anterolateral portal was used through which almost all the structures within the joint could be seen. This portal was located approximately 1cm above the lateral join line and approximately 1 cm lateral to the margin of the patellar tendon(Figure 6).

The anteromedial portal was most commonly used for additional viewing of the lateral compartment and for insertion of a probe for palpation of the medial and lateral compartment structures. This portal was located similarly to the anterolateral portal l cm above the medial joint line, 1cm inferior to the tip of the patella, and 1cm medial to the edge of the patellar tendon.

Figure. 6. Portal Placement

Figure.7. Portal Placement

IRRIGATION SYSTEMS

Joint distension was maintained by normal saline during arthroscopy. The inflow and outflow passed directly through the arthroscopic sheath.

ARTHROSCOPIC EXAMINATION OF THE KNEE

The knee was divided routinely into the following compartments for arthroscopic examination:

1. Suprapatellar pouch and patellofemoral joint
2. Medial gutter
3. Medial compartment
4. Intercondylar notch
5. Posteromedial compartment
6. Lateral compartment
7. Lateral gutter and posterolateral compartment.

After performing a thorough arthroscopy of the knee, the pathological lesion was identified and further surgery was carried out accordingly (partial/subtotal meniscectomy for meniscal tears, ACL reconstructions for ACL tears)

Figure.8.Arthroscopic Instruments

Figure.9. Arthroscopes

Figure.10.Camera

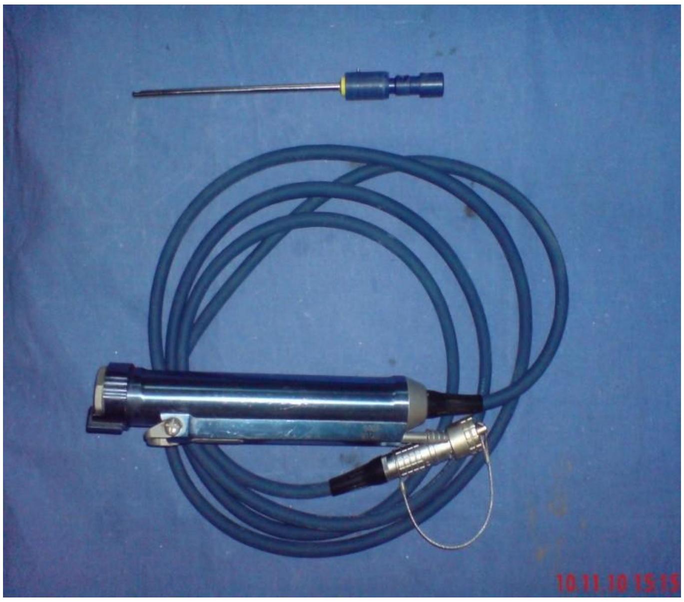


Figure.11. Arthroscopy shaver and burr

Figure.12. Shows Meniscectomy scissor

Figure.13. Shows Meniscectomy punch

Figure.14 . Arthroscopic bipolar radiofrequency ablation system

Figure .15. Arthroscopic tower

DOCUMENTATION:

Purposive random technique was used to select 30 patients with history of knee trauma admitted and treated in the Institute of Orthopaedics and traumatology. All the patients admitted were examined clinically and associated injuries were recorded. X-ray of the knee joint was done routinely to look for any fractures. MRI was done in all the patients with clinical findings suggestive of internal derangement of the knee joint.

MRI images were studied for evidence of injuries to menisci, cruciate ligaments, collateral ligaments, articular cartilage, loose bodies, meniscal cysts and bony contusions, evidence of soft tissue injuries around the knee joint. These patients were then taken for diagnostic and therapeutic arthroscopy. The findings of the diagnostic arthroscopy were noted.

Carefully constructed drawings were made to depict the pathological process as the operative procedure was performed. These were attached to the patient's record for easy reference.

Photographs and videos were taken and stored for later retrieval.

Operative findings were documented in the operation theatre, which included the survey of the entire joint and anatomical structure, lesions involved with the presence or absence of tear, its location, status of the articular cartilage and others. The composite data was tabulated and studied for correlation with MRI findings and grouped into four categories-

1. **True-positive**-if the MRI diagnosis was confirmed by arthroscopic evaluation.
2. **True-negative** -when MRI negative for lesion and confirmed by arthroscopy.
3. **False-positive**- when MRI shows lesion but the arthroscopy was negative
4. **False- negative**-when MRI showed negative findings but arthroscopy was positive

Statistical analysis was used to calculate the sensitivity, specificity, positive predictive value (PPV) and the negative predictive value (NPV), in order to assess the reliability of the MRI results.

METHOD OF ANALYSIS OF DATA

Collected data was presented in the form of tables and diagrams. Sensitivity, specificity and predictive values were calculated- Data was analysed for the significant correlation between MRI knee and arthroscopic findings by kappa statistics.The software used to study the statistical analysis of data is SSPS-IBM (NO.19).

Table.1.Interpretation of sensitivity

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

Table.2. Interpretation of Kappa Statistics

0.00	Poor agreement
0.01 - 0.20	Slight agreement
0.21-0.40	Fair agreement
0.41-0.60	Moderate
0.61-0.80	Substantial
0.81-1.00	Almost perfect

Interpretation of 'P' value

$P < 0.05$ - Significant

$P<0.01$ - Highly significant

$P>0.05$ - Not significant

ANALYSIS AND RESULTS

SEX DISTRIBUTION

The study had 30 patients, of which 24 were males and 6 were females.

Table.3. Sex distribution

Sex	Number of cases	Percentage
Male	24	80%
Female	6	20%

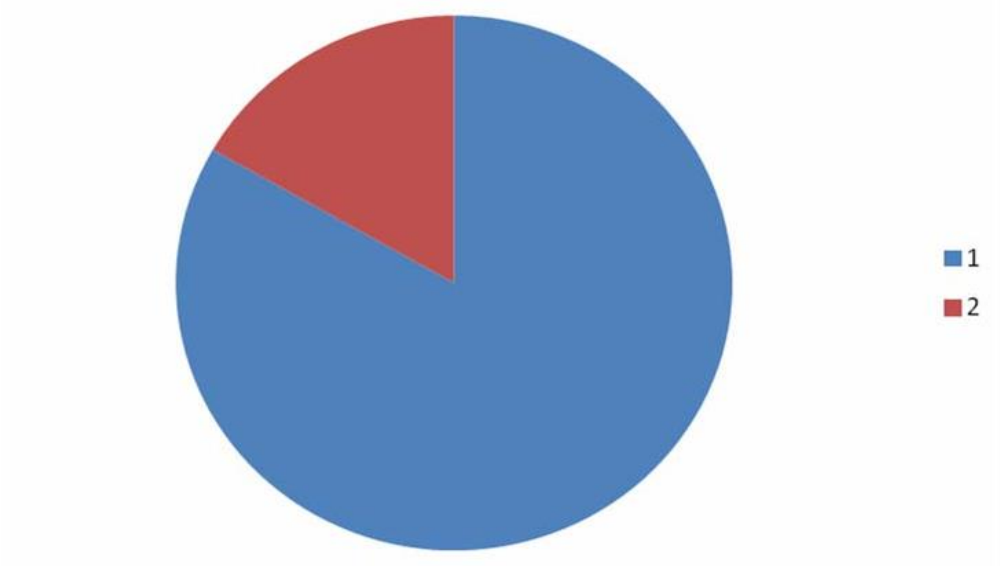


Figure.16. Sex distribution in knee injuries

Significant number of patients were males.

AGE DISTRIBUTION

The Patients who suffered the injury, were ranging from 18 to 60 years.

Table. 4 . Age distribution

Age	Number of cases	%
21-30	12	40
31-40	10	33
41-50	8	27

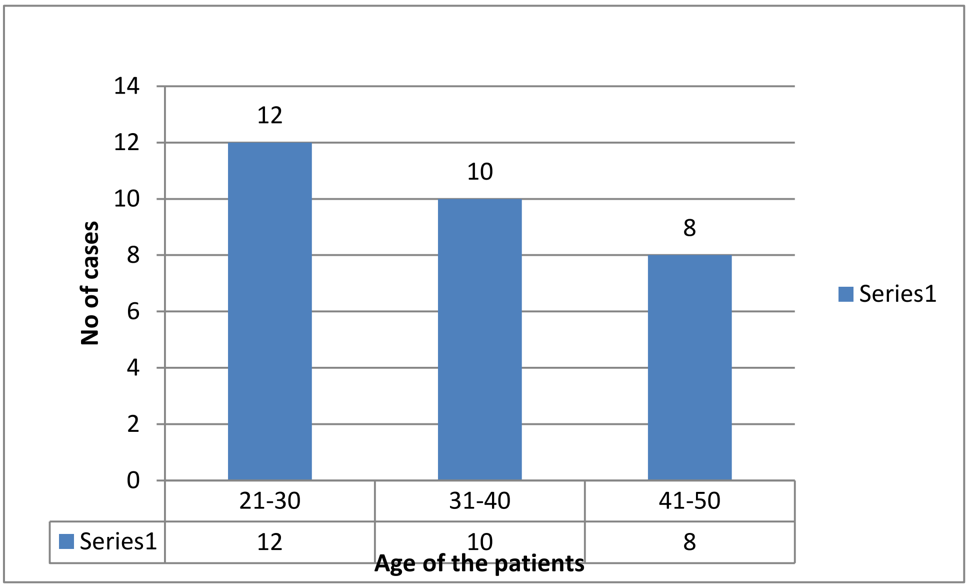


Figure.17. Age distribution in knee injuries.

The maximum number of patients, who suffered knee injuries were aged between 21- 30 yrs

SIDE INVOLVED

Table.5.Sides of the knee joint involved

Side	Number of cases	Percentage
Right knee	24	80%
Left knee	6	20%

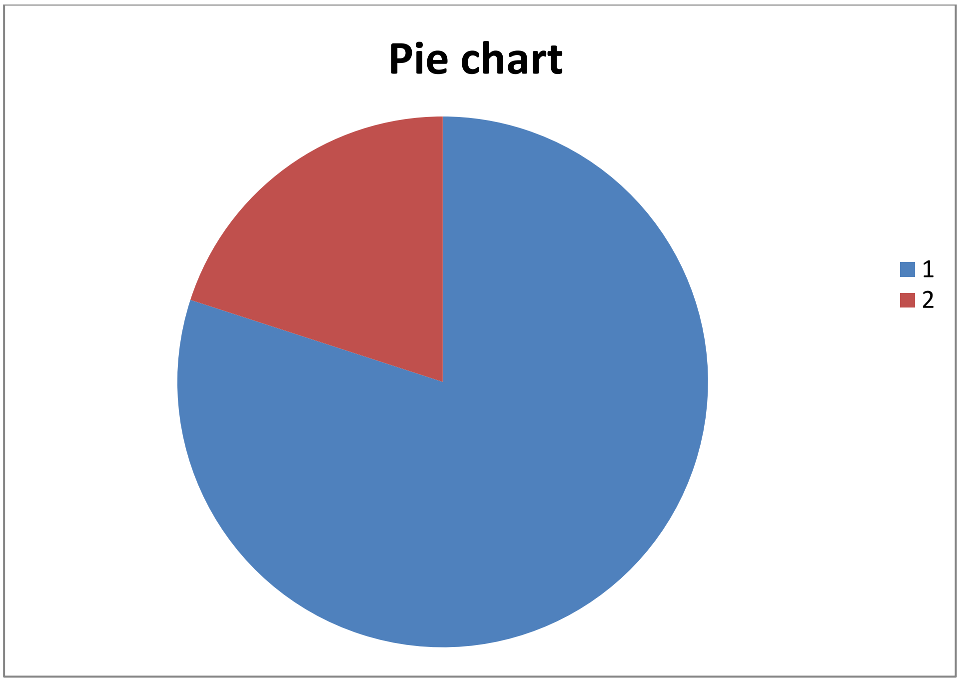


Figure.18. Percentage of involvement of right and left knee in knee injuries

The right knee joint was involved, more commonly than the left knee joint.

MODE OF INJURY

Table.6. Mode of injury

Mode of injury	Number of cases
Motor vehicle accident	12
Sports Injury	4
Domestic falls	8
Others	6

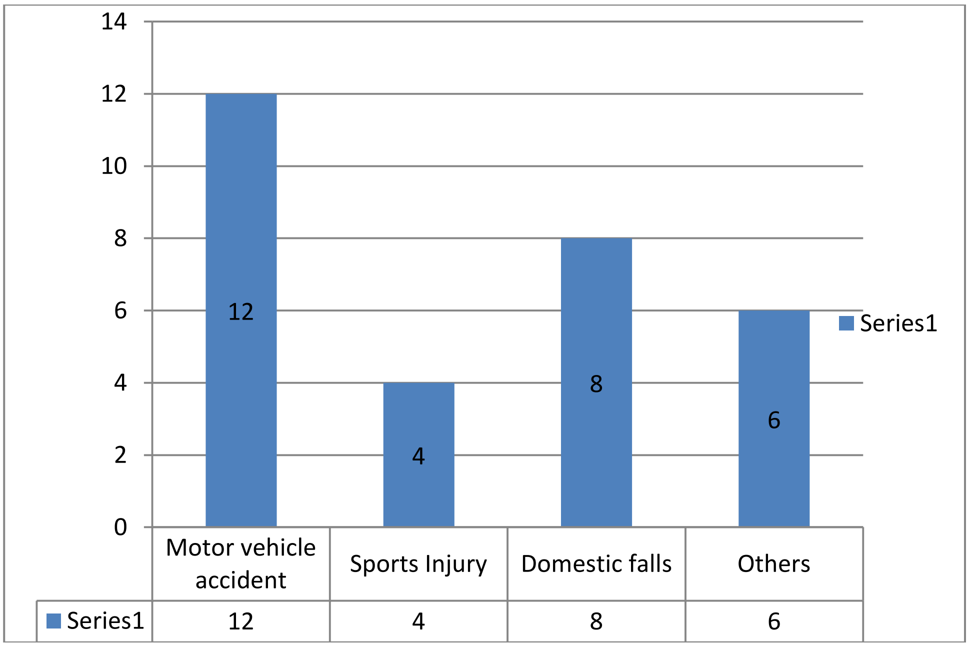


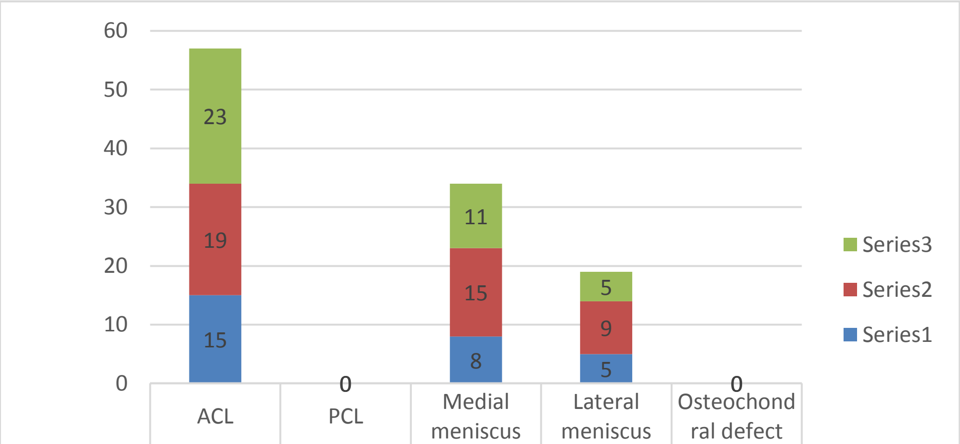
Figure.19. Mode of injury

Motor vehicle accident injury was the most widespread means of injury.

STRUCTURES INJURED

Table.7. Structures involve in the injury

Structures injured	Clinical Exam	MRI	Arthroscopy
ACL	15	19	23
PCL	0	0	0
Medial meniscus	8	15	11
Lateral meniscus	5	9	5
Osteochondral defect	0	0	0



	ACL	PCL	Medial meniscus	Lateral meniscus	Osteochondral defect
Series3	23	0	11	5	0
Series2	19	0	15	9	0
Series1	15	0	8	5	0

Figure.20. Structures involved in the injury

From the study we excavate the related data, we calculated true positive, true negative, false positive and false negatives values. The accuracy, sensitivity, specificity, negative predictive value (NPV), and positive predictive value (PPV) were calculated using the subsequent equations:

1) PPV = TP/(TP + FP)
2) NPV = TN/(TN + FN)
3) Sensitivity = TP/(TP + FN)
4) Specificity = TN/(FP + TN)
5) Accuracy= (TP + TN)/(TP + TN + FP +FN).

ANTERIOR CRUCIATE LIGAMENT (ACL) TEARS

Table.8. Statistical analysis of data of ACL injuries

MRI	**ARTHROSCOPY**		**Total**
	Positive	**Negative**	
Positive	19	0	19
Negative	4	7	11
Total	23	7	30

Sensitivity of MRI - 82%

Specificity of MRI- 100%

Positive predictive value of MRI - 100%

Negative predictive value of MRI - 63%

Accuracy of MRI-86%

Kappa - 0.712 – substantial

P value - 0.001 – significant

The sensitivity and specificity of MRI with respect to Arthroscopy in ACL tear is 82% and 100%.

COMPARISON OF MRI &ARTHROSCOPY

ILLUSTRATIVE CASE

Patient Name	:	Mr. Pandiyan
Age	:	35 Years
Sex	:	Male
Date of Injury	:	15.05.2018
Date of MRI	:	17.05.2018
Date of Diagnostic Arthroscopy	:	22.05.2018

MRI IMAGES

PARTIAL THICKNESS ACL TEAR

ARTHROSCOPY IMAGE

FULL THICKNESS ACL TEAR

MRI IMAGE

FIGURE SHOWING
PARTIAL THICKNESS
ACL TEAR

ARTHROSCOPY IMAGE

FIGURE SHOWING ACL TEAR
FULL THICKNESS
ACL TEAR

POSTERIOR CRUCIATE LIGAMENT (PCL) TEARS

Table.9. Statistical analysis of data of PCL injuries

MRI	ARTHROSCOPY		Total
	Positive	**Negative**	
Positive	0	0	0
Negative	0	30	30
Total	0	30	30

Sensitivity of MRI-100%

Specificity of MRI-100%

Positive predictive value of MRI - 100%

Negative predictive value of MRI- 100%

Accuracy of MRI -100%

Kappa = 1 - almost perfect

P value - 0.0238 – significant

The sensitivity and specificity of MRI with respect to Arthroscopy in PCL tear is 100% and 100% correspondingly.

MEDIAL MENISCUS TEARS

Table.10. Statistical analysis of data of medial meniscal tears

MRI	ARTHROSCOPY		Total
	Positive	**Negative**	
Positive	11	4	15
Negative	0	15	15
Total	11	19	30

Sensitivity of MRI-100%

Specificity of MRI-78%

Positive predictive value of MRI - 73.3%

Negative predictive value of MRI - 100%

Accuracy of MRI - 86.66%

Kappa = 0.716-substantial

P value - 0.024 - significant

The sensitivity and specificity of MRI with respect to Arthroscopy in MEDIAL MENISCAL tears is 100% and 78% correspondingly

COMPARISON OF MRI &ARTHROSCOPY

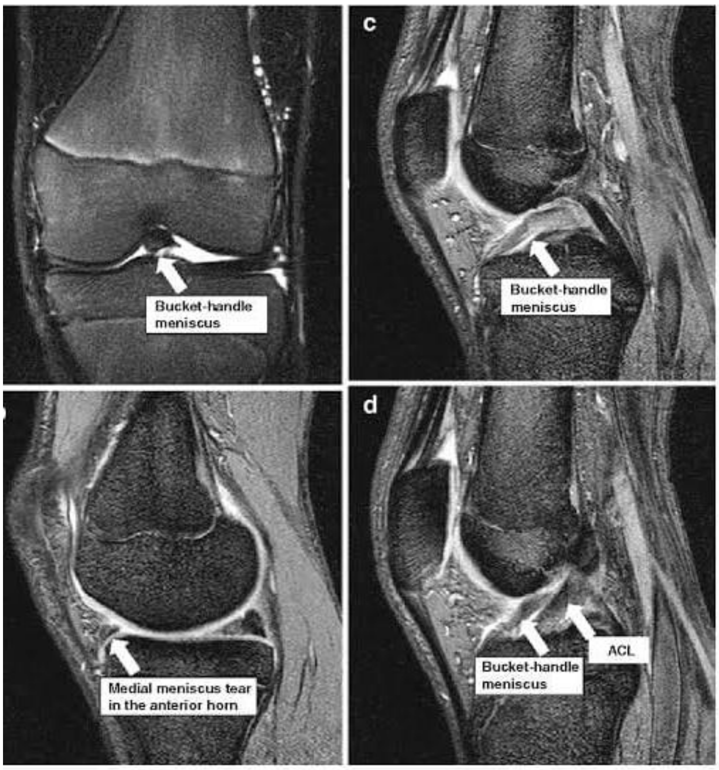
MEDIAL MENISCUS TEAR

ILLUSTRATIVE CASE

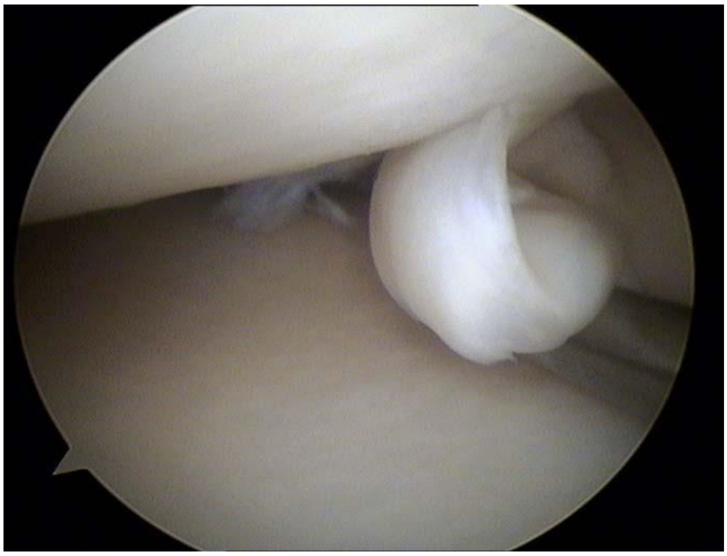
Patient Name	:	Mr. Pandiyan
Age	:	35 Years
Sex	:	Male
Date of Injury	:	15.05.2018
Date of MRI	:	17.05.2018
Date of Diagnostic Arthroscopy	:	22.05.2018

BUCKET HANDLE TEAR OF MEDIAL MENISCUS

MRI IMAGES



ARTHROSCOPY IMAGE OF BUCKET HANDLE TEAR OF MEDIAL MENISCUS



LATERAL MENISCUS TEARS

Table.11. Statistical analysis of data of lateral meniscal tears.

MRI	ARTHROSCOPY		Total
	Positive	**Negative**	
Positive	5	4	9
Negative	0	21	21
TOTAL	5	25	30

Sensitivity of MRI -100%

Specificity of MRI -84%

Positive predictive value of MRI - 55.55%

Negative predictive value of MRI - 100%

Accuracy of MRI - 83.3%

Kappa = 0.746 - substantial

P value - 0.0001 -significant

The sensitivity and specificity of MRI with respect to Arthroscopy for LATERAL MENISCAL tears is 100% and 84% correspondingly.

ACCURACY OF MRI

Table.12. Accuracy of MRI

Structure	Sensitivity	Specificity	Accuracy
ACL	82%	100%	86%
PCL	100%	100%	100%
Medial meniscus	100%	78%	86.66%
Lateral meniscus	100%	84%	83.33%
Osteochondral defect	100%	100%	100%

DISCUSSION

The main purpose of this study was to compare the precision of MRI with ARTHROSCOPY in diagnosing the most frequent injuries of the knee i.e Internal derangements of the knee. This is a prospective study involving 30 patients with account of knees injuries who were admitted in the Institute of Orthopaedics and Traumatology, Coimbatore Medical college and Hospital. MRI of the knee joint was done for all the patient and they underwent an diagnostic and therapeutic arthroscopy in the Institute of orthopaedics and Traumatology, Coimbatore Medical College and Hospital.

MRI images were screened for the confirmation of injuries of:

1) menisci,
2) cruciate ligaments,
3) collateral ligaments,
4) articular cartilage,
5) loose bodies,
6) meniscal cysts,
7) bony contusions,
8) evidence of soft tissue injuries around the knee joint.

Arthroscopy was performed to verify the findings given in MRI.

In the present study of 30 patients, 24 were males and 6 were females. The age groups of these patients ranged from 18 to 60 years. The youngest male patient was aged 21 yrs and the oldest male was 50yrs and the youngest female was aged 29yrs and the oldest female was aged 49 yrs. This showed that males got injured and were operated at the earlier age. This fact shows that the men are most liable to suffer knee injuries since they are energetic in sports and the right knee was are more commonly injured than left.

In the present study males encompass the predominant number of patients who suffered knee injuries who met with road traffic accidents.

Young patients of age group 20 - 30yrs report for the maximum who suffered knee injuries and in our study, 32 patients i.e, 40 % of the patients were below this age group.

Right knee was involved in 24 cases and left was involved in 6 cases and no bilateral association.

Meniscal tears were grouped into two categories such as torn or not torn. Anterior cruciate ligaments (ACL) and posterior cruciate ligaments were both completely torn or not.

Any other knee pathologies including osteochondral defects, bone edema, chondral lesions were grouped together as additional pathology.

False positives and false negatives

MRI studies resulted in higher false positive than false negative results. We also establish this to be true when probing the combined results from meniscal lesions and ACL tears.

Meniscal Injuries:

Medial meniscus injury and lateral meniscus injury occurred with equal frequency.

A study by Pappenport et al showed accuracy rate of 90% for MRI in the detection of Meniscal tears compared with the arthroscopy.

Elvenes et al in their study found the sensitivity, specificity, positive and negative predictive value of MRI for medial meniscus tears were 100%, 77%, 71% & 100% respectively.

In our study MRI showed 15 cases of medial menisci injury in which arthroscopic procedure confirmed only 11 case. Sensitivity and specificity of MRI with respect to Arthroscopy is 100% and 78 % respectively showing an standard relationship with arthroscopy in diagnosing medial meniscal injuries.

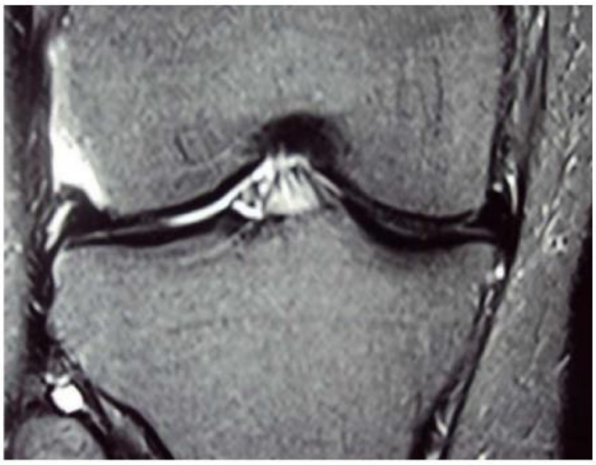


Figure.21. Medial Meniscal tear in MRI

Figure.22. Medial meniscal tear in MRI

In the present study sensitivity, specificity, positive and negative. predictive values were 100%, 78%, 73.33% and 100 % respectively.

Elvenes et al in their study found that sensitivity, specificity, positive and negative predictive value of MRI for MM were 100%, 77%, 71 % & 100% respectively, while values for LM were 40%, 89%, 33 %, & 91% respectively.

Overall accuracy of MRI for MM & LM combined was 84%.

Arthroscopy has a higher sensitivity (100%) than specificity (78%) and a higher NPV (100%) than the PPV (73.33%). In our study we found that sensitivity, specificity, positive and negative predictive value of MRI compared to arthroscopy was less compared to the other studies.

In our study MRI detected 9 cases of lateral meniscal injury and arthroscopy positive cases are 5 out of 30 cases.

Sensitivity and specificity of MRI in relation to Arthroscopy is 100% and 84%. It had a fair correlation with Arthroscopy in diagnosing lateral meniscal injuries. Positive predictive value of MRI in detecting lateral meniscus injuries is 55.55 % with negative predictive value of 100%.

Overall, MRI has a higher specificity (84%) than sensitivity (100%), and a higher NPV (100) than the PPV (55.55%).

Overall accuracy of MRI for MM & LM combined was 84%.

In our study, MRI showed false results in major proportion. For example as far as medial meniscus is disturbed there were more false positive and false negative diagnosis while for lateral meniscus there were less false positive and false negative diagnosis.

There are numerous explanation for the confusing results of MRI regarding the menisci. Firstly, by bountiful high signals within the meniscus, meniscal tears and meniscus degenerative changes have the similar look in MRI . Diagnosis is totally dependant on the extension of the high signal line towards meniscus articular surface.

Moreover, the misreading of the signal coming from the inferior genicular artery is one of the most common causes for false positive MRI concerning the lateral meniscus. Often, the popliteal bursa or Humphreys' ligament may imitate posterior lateral meniscal tears as well. Reason for false positive diagnosis was recapitulate into three most common reasons.

i. Wrong diagnosis is due to up-and-down anatomic structures
ii. Over evaluation of pathology countered as meniscus tear (for example chondral injuries that imitate meniscus tears),
iii. The false negative results, on the other hand seem to occur wholly from misreading of MRI.

False positive MRI scans seen in the posterior horn of the medial meniscus which may reflect an inability to completely visualize the area. The occurrence of the false positive and false negative meniscal tears at MRI imaging has been noted earlier. There are explanations for this apparent discrepancy between findings at MR Imaging and arthroscopy Mink et al,.

1) Misinterpretation of normal anatomy like menisco-femoral ligaments etc.

2) Osteochondral flap avulsion lesions-mimic meniscal tears

3) The observer dependency of MRI

4) The presence of loose bodies.

5) Radial meniscal tears are not easy to visualize on MRI, hence, they account for a large number of tears missed by MRI.

Table.13. Comparison of statistics of various studies with our study for medial meniscal injuries

PARAMETERS	PAPPENPORT ET AL	ELVENES ET AL	OUR STUDY
SENSITIVITY	-	100%	100%
SPECIFICITY	-	77%	78%
PPV	-	71%	73.33%
NPV	-	100%	100%
ACCURACY	90%	-	86.66%

Table.14 .Comparison of Statistics of various studies with our study for lateral meniscal injuries.

PARAMETERS	PAPPENPORT ET AL	ELVENES ET AL	OUR STUDY
SENSITIVITY	-	40%	100%
SPECIFICITY	-	89%	84%
PPV	-	33%	55.55%
NPV	-	91%	100%
ACCURACY	84%	-	83.33%

Cruciate ligament lesions:

Among the structure involved in knee injuries ACL injury is the most common accounting for 19 cases in MRI out of which arthroscopy detected 23 of the 30 cases Sensitivity and Specificity of MRI with respect to Arthroscopy is 82% and 100% substantial correlation with Arthroscopy in diagnosing ACL tears. Positive predictive value of MRI is 100%. Negative predictive value is 63%.

MRI is accurate in identification of ACL tears, ranging from 93% to 97%. In one of our IDK knee MRI shows ACL incompetence but intact fibres, however clinically patient had instability and at arthroscopy showed a tear fully healed by fibrosis which was inefficient and required a reconstruction.

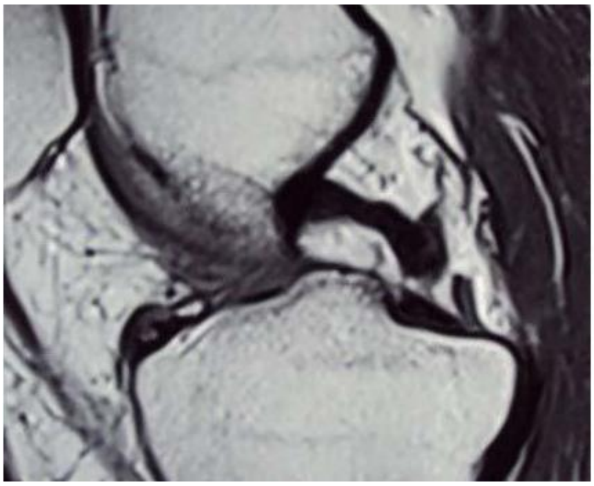


Figure.23. ACL Tear in MRI

Figure.24. ACL Tear in MRI

The sensitivity and specificity in various studies have shown to range between 92% and 100%.

In our study the positive predictive value and negative predictive value of MRI was 100% and 64 % respectively.

Figure.25. ACL Tear in MRI

Additionally, ruptures near ligament insertion may be missed and MRI examination reveals an intact ACL. On contrary, false positive ACL ruptures occur in cases of intra-body mucosal or eosinophilic degeneration of ACL.

The accuracy, sensitivity and specificity values for knee lesions vary widely in literature. Rubin et al reported 93% sensitivity for diagnosing isolated ACL tears. Similarly several prospective studies have shown a sensitivity of 92-100% and specificity of 93-100% for the MR imaging diagnosis of ACL tears.

Rose et al found that clinical examination is as accurate as MRI in diagnosing meniscal tears and ACL ruptures, so they concluded that MRI because of its high cost is not necessary in patients with clinical suspicion of meniscus and cruciate ligament tears. Similar conclusion was reported by Boden et al who supported that when clinical examination sets the diagnosis of meniscus damage, MRI will not change treatment decisions.

In none of the cases PCL was torn so it is intact in both MRI and Arthroscopy. The use of MRI to identify PCL tears has proven to be extremely accurate. This might be expected in light of the fact that the PCL is usually very easily visualized as a homogenous, continuous low-signal structure. Several studies have reported sensitivity, specificity, accuracy, positive predictive value and negative predictive value to be 99-100%**.** In our study too the sensitivity, specificity, accuracy, positive predictive value and negative predictive value was 100%.

Disruption of the anterior cruciate ligament, a major stabilizer of the knee, leads to loss of stability of the knee and potentially significant dysfunction The ACL is the most commonly torn ligament of the knee and the ACL tear stays clinically vague. A large number of referral to hospitals is due to these injuries. The evaluation of these lesions remains a difficult clinical problem. The MRI is a frequently used diagnostic modality for these internal derangements because of being non-invasive, painless and unassociated with the hazard of radiation.

In adding up to this, ruptures near ligaments' insertion may be missed and MRI examination reveals an intact ACL. In converse, false positive ACL ruptures occur in cases of intra-body mucosal or eosinophilic degeneration of ACL.

Table.15. Comparison of statistics of various studies with our study for acl injuries

PARAMETERS	ROSE ET AL	RUBIN ET AL	OUR STUDY
SENSITIVITY	92%	93%	82%
SPECIFICITY	-	93%	100%
PPV	-	-	100%
NPV	-	-	63%
ACCURACY	-	-	86%

Table.16. Comparison of statistics of various studies with our study for pcl injuries

PARAMETERS	ROSE ET AL	OUR STUDY
SENSITIVITY	99%	100%
SPECIFICITY	99%	100%
PPV	99%	100%
NPV	99%	100%
ACCURACY	99%	100%

Articular cartilage Injuries:

So when Arthroscopy is used as the merely diagnostic tool the degree of cartilage abnormality cannot be hidden. This also shows that arthroscopic evaluation is more useful than radiographs or MRI to grade osteoarthritis and to assess the surface cartilage abnormalities.

There are studies that support the view that the diagnostic accuracy of the MRI could affect in a critical way the treatment pathway of knee injuries.

The menisci contain fibrocartilage and appear as low signal structures on all pulse sequences.

In the knee, simultaneous injury to a number of supporting structures is relatively common.

Ochi et al who showed that the sensitivity of MRI increased (from 40%-71%) when MRI reading was done retrospectively, after the arthroscopic findings were registered.Especially,in chondral lesions with full thickness loss of cartilage and large deep erosions the retrospectively calculated MRI sensitivity was 100% and 75% respectively. On the other hand, surface injuries , fibrilization or shallow small cuts were not well described, not even arthroscopically. Furthermore, according to Mori et al usage of modern, improved techniques, cannot only reveal the size of chondral lesions but to distinguish partial from full depth chondral damages as well.

The accuracy, sensitivity and specificity values for knee lesions vary broadly in literature.

In many cases, subchondral bone bruises that are frequently described in MRI, are mistaken with chondral defects, leading to false positive results. They remain though important cause of pain and morbidity. Additionally, one must not at all overlook that preoperative MRI mainly focuses on meniscal and cruciate ligament injuries. As a result, chondral lesions are often underestimated and misdiagnosed by MRI.

Postoperative new examination with MRI that focus on chondral defects leads to improvement of the diagnostic results.

MRI can adequately disclose the 2nd and 3rd grade chondral defects as well as damages at the patellar articular cartilage, but is not precise for smaller injury like fibrilization or small fissuring in articular hyaline cartilage.

There is no doubt that the radiologist experience and training are very important factors in interpretation of MRI. The reliable statistical data of the diagnostic value of the MRI are also related to the independent base of reference. In most of the studies and in our study as well, regarding the knee MRI, the base of reference is arthroscopy. This shows that arthroscopy is 100% accurate and allows for the diagnosis of every possible knee pathology.

Nowadays, the overall accuracy of arthroscopy varies between 90-100% depending on the surgeon's experience and this inevitably raises questions regarding the reliability of the MRI results classification on true or false.

In the everyday practice, based on clinical examination that comes first, surgeons decide whether they should proceed to further laboratory tests, MRI, conservative or surgical treatment. But on considering the precision on clinical examination, there seems to be disagreement regarding the answer to this question. Investigations support that the accuracy of clinical examination compared with arthroscopic findings ranges between 64-85% . MRI Costs high but necessary in patients with clinical suspicion of meniscus and cruciate ligament tears, but MRI will not change treatment decisions.

Table.17. Comparison of statistics of various studies with our study for articular cartilage injuries

PARAMETERS	OCHI ET AL	OUR STUDY
SENSITIVITY	71%	100%
SPECIFICITY	-	100%
PPV	-	100%
NPV	-	100%
ACCURACY	-	100%

SUMMARY

In the present prospective study of 30 patients with knee injuries, the subsequent result were accomplished

- Pain and instability was the most common complaint of IDK while Males commonly suffered knee injuries with right knee predominance. ACL tear was most common and meniscal injury being 2^{nd}.

MRI shows high sensitivity in detecting meniscal and ACL injuries.

- MRI shows excellent sensitivity and specificity in cases of PCL tears and articular cartilage injuries.

Thus in this study and from the reports of several earlier series that arthroscopy is gold standard and finer when compared to MRI in the diagnosis of meniscal and cruciate ligament tears. MRI is a useful non-invasive modality having moderate sensitivity, specificity and accuracy in the diagnosis of menisci and cruciate ligament injuries.

Mainstream of patients were in the age group of 20-30 years and this included 24 men and 6 women. Commonest lesions diagnosed in our study was ACL tear and medial meniscal tears.

The accurateness of MRI in medial and lateral meniscal tear was 86.66 percent and 83.3 percent correspondingly, while for ACL and PCL rupture was 86 percent and 100 percent correspondingly.

In our study, MRI results shows less specificity in diagnosing IDK in comparison with the arthroscopy. This can be accredited to the boundaries of the present study, which is a probable non randomized study with comparatively little number of patients. However it is our belief that our findings mirror the reality that the average orthopaedic surgeon will face during his everyday clinical practice.

In conditions like peripheral meniscal tears and inferior surface tears, arthoscopy is advantageous in conditions where MRI is not useful because arthoscopy is more sensitive in detection of multiple meniscal tears that may be overlooked on MRI.

While MRI is less sensitive than arthroscopy in detecting ACL tears, many anatomic variants may mimic tears on MRI.

MRI should not be done in every patient of suspected ligamentous injury, especially if the clinical signs are obvious.

CONCLUSION

Knee joint injuries are more frequent. The need to precisely evaluate the knee injuries is very vital for the proper management and outcome, otherwise it will lead to chronic debility to the patient.

In various studies Arthroscopy has remained the reference standard for the diagnosis of internal derangements of the knee, against which alternative diagnostic modalities should be compared. The sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of MRI were estimated to conclude if possible, to evade MRI and carry out frankly an arthroscopy in suspected cases subsequent to clinical examination.

Moreover while using arthroscopy through a key hole thorough inspection can be made over the meniscus , ligament ,cartilage. But in non invasive imaging like MRI the normal anatomic variant may mimic as a tear. This affects the interpretation in the management by using MRI results alone.

We can come to the exact conclusion and can acquire a better knowledge using arthroscopy as it clearly describes the type and pattern of tear whereas in MRI, tears are at times over diagnosed or normal anatomic variant diagnosed as tears. Exact knowledge about pattern of the tear is not published in MRI reports (radiologist dependant).

In non invasive imaging like MRI, probability of intra-observer and inter-observer variation, diagnosing a critical lesion is purely a radiologist dependent which when misinterpreted in a MRI report can change the entire treatment plan. In order to avoid all these confusions diagnostic arthroscopy is necessary and also act as a gold standard for investigating the IDK lesion and thereby planning the management.

Although therapeutic scopy needs more specialized instrumentation, diagnostic arthroscopy can be done with minimal instrumentation in a small OT set up. Where as MRI set up needs more space and expense. The major drawbacks of routine MRI usage are the time and expense of the procedure. It may be uncomfortable for some people who had cardiac pacemakers and suffering an acute knee injuries. MRI set ups can also produce claustrophobia.

This study shows that MRI have an tendency to over diagnose or miss a lesion in concomitant knee injuries. So Arthroscopy should not be denied when MRI report is normal. Due to this type of drawback in MRI it is concluded that arthroscopy can be carried out after thorough clinical examination bypassing the MRI.

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ANNEXURE 1

CASE PROFORMA

INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY, COIMBATORE MEDICAL COLLEGE HOSPITAL, COIMBATORE KNEE MRI & ARTHROSCOPY OPERATIVE DETAILS RECORD

Patient's Name: Admission date:

Admission : Date of surgery:

Age/Sex: Discharge date:

Hospital IP/OP No. :

History of present illness:

H/o locking,

H/o buckling ,

H/o click and crepitus,

H/o giving away,

H/o swelling and effusion.

Mode of injury;

1) sports injuries

2) trauma

3) domestic fall

4) repetitive activities

Limitation of RDL(routine daily activities)

PAST HISTORY:

PERSONAL & OCCUPATIONAL HISTORY:

GENERAL PHYSICAL EXAMINATION

EXAMINATION:

ROM:

SPECIAL TESTS:

Tests :

Anterior drawer test: Posterior drawer test:

Lachman test : Pivot shift test:

Apley's grinding test : Mc Murray's test:

Patellofemoral grinding :

Varus test: Valgus test:

Effusion:

EXAMINATION OF THE RELATED REGION:

PROVISIONAL CLINICAL DIAGNOSIS :

GENERAL TESTS & ROUTINE INVESTIGATIONS:

SPECIAL INVESTIGATIONS:

MRI Findings

a) Joint effusion :

b) ACL TEAR :

Partial/Complete

c) PCL tear : Present/Absent,

Partial/Complete

d) MCL tear : Present/Absent

Grade- 1/2/3

e) LCL tear : Present/Absent

Grade- 1/2/3

f) Medial Meniscal Tear : Present/Absent

Location & Type

g) Lateral Meniscal Tear : Present/Absent

Location & Type

h) Osseous / Osteochondral lesions : Present/Absent

Location & Type

4.Final Impression of MRI

Operative Details :

Operating surgeon : Date of surgery :

Tourniquet time :

Operative procedure :

Anaesthesia :

Knee : RIGHT/LEFT

Arthroscopic findings :

Portals used :

Plica :

Synovium :

Ligaments :

ACL :

PCL :

MCL :

LCL :

Menisci :

Medial :

Lateral :

Articular surfaces :

Femur :

Tibia :

Patella :

Patellofemoral tracking :

Other findings:

CONSENT FORM

I Mr/Mrs. ________________________ S/D/W/of ________________hereby volunteer to participate in the study "**A COMPARATIVE STUDY OF ARTHROSCOPIC FINDING AND MRI FINDING OF INJURED KNEE”**. I was explained about the nature of the study by the Doctor, knowing which I fully give my consent to participate in this study. I also give consent to take clinical photographs for the purpose of the study.

Date :

Place :

Signature of the patient

ஒப்புதல் படிவம்

பெயர்:-

பாலினம்:-

வயது:-

முகவரி:-

கோவை அரசு மருத்துவக் கல்லூரியில், எலும்பு முறிவு மருத்துவ துறையில் பட்ட மேற்படிப்பு பயிலும் மாணவர் .மரு.வ.சோமசுந்தரம் மேற்கொள்ளும் "**A COMPARATIVE STUDY OF ARTHROSCOPIC FINDING AND MRI FINDING OF INJURED KNEE"** என்ற சோதனையின் அனைத்து விவரங்களையும் கேட்டுக் கொண்டதுடன், எனது அனைத்து சந்தேகங்களையும் தெளிவுப்படுத்திக் கொண்டேன் என்பதை தெரிவித்துக் கொள்கிறேன்.

நான் இந்த ஆய்வில் முழு சம்மதத்துடன், சுய சிந்தனையுடன் கலந்து கொள்ள சம்மதிக்கிறேன்.

இந்த ஆய்வில் நான் அனைத்து விவரங்களும் பாதுகாக்கப்படுவதுடன் இதன் முடிவுகள் ஆய்விதழில் வெளியிடப்படுவதில் ஆட்சேபண இல்லை என்பதை தெரிவித்துக் கொள்கிறேன். எந்த நேரத்திலும் இந்த ஆய்விலிருந்து நான் விலகிக் கொள்ள எனக்கு உரிமை உண்டு என்பதையும் அறிவேன்.

நோயாளியின் கையொப்பம்/ரேகை

இடம்:-

தேதி:-

KEY TO MASTER CHART

Sn.No	**Serial no**
IP.No	In patient number
Pr	Presentation
S	Side
MRI	Magnetic resonance imaging
PCL	Posterior cruciate ligament
MM	Medial meniscus
LM	Lateral meniscus
OCD	Osteochondral defects
P	Procedure
DS	Diagnostic-scopy
Y	Yes
N	No
R	Right
L	Left

MASTER CHART

S.No	Name	Age	Sex	I.P.No	S	MRI					ARTHROSCOPY				
						ACL	PCL	MM	LM	OCD	ACL	PCL	MM	LM	OCD
1	Sivaraj	34	M	211506	L	Y	N	Y	Y	N	Y	N	Y	Y	N
2	Subramani	27	M	167749	R	Y	N	Y	Y	N	Y	N	Y	Y	N
3	Sakthivel	32	M	189624	R	Y	N	Y	N	N	Y	N	N	N	N
4	Pandiyan	35	M	206168	L	N	N	Y	N	N	Y	N	Y	N	N
5	Shanthi	48	F	211707	R	Y	N	Y	N	N	Y	N	N	N	N
6	Karupathal	49	F	175038	R	N	N	Y	Y	N	Y	N	Y	N	N
7	Mahendran	48	M	176962	R	Y	N	N	Y	N	Y	N	N	N	N
8	Rajendran	36	M	17625	R	N	N	N	N	N	Y	N	N	N	N
9	Balakrishnan	35	M	213996	R	Y	N	N	N	N	Y	N	N	N	N
10	Manimegalai	43	F	205333	L	N	N	Y	N	N	Y	N	Y	N	N
11	Vishnu	24	M	179004	R	Y	N	N	N	N	Y	N	Y	N	N
12	Jayaraman	25	M	177049	R	Y	N	N	N	N	Y	N	N	N	N
13	Velathal	48	F	172017	R	Y	N	N	N	N	Y	N	N	N	N
14	Manikandan	50	M	182982	R	N	N	N	N	N	N	N	N	N	N
15	Jakriya Mohammed	38	M	190439	L	Y	N	Y	N	N	Y	N	Y	N	N

16	Mareeswaran	23	M	191521	R	N	N	Y	Y	N	Y	N	Y	N	N
17	Venkatesh	44	M	179149	R	Y	Y	N	Y	N	Y	N	N	Y	N
18	Manju	34	F	17083	R	N	N	N	Y	N	Y	N	N	N	N
19	Subban	38	M	174262	R	Y	N	N	Y	N	Y	N	N	N	N
20	Madhan	37	M	179297	R	Y	N	Y	Y	N	N	N	N	N	N
21	Sasi kumar	40	M	205576	R	Y	N	Y	N	N	Y	N	Y	N	N
22	Papathy	42	F	185066	R	Y	N	Y	N	N	Y	N	Y	N	N
23	Durai	48	M	179367	R	Y	N	N	N	N	Y	N	N	N	N
24	Gopal	22	M	180828	R	N	N	N	N	N	Y	N	N	N	N
25	Kandhasamy	44	M	1426328	R	Y	N	N	N	N	Y	N	N	N	N
26	Balakrishnan	21	M	179129	R	N	N	Y	N	N	Y	N	Y	N	N
27	Sachin	24	M	183885	L	Y	N	Y	N	N	N	N	N	N	N
28	Aravind	39	M	182989	R	N	N	N	Y	N	N	N	N	N	N
29	Gokul	37	M	181950	L	Y	N	N	N	N	N	N	N	N	N
30	Chandrasekar	28	M	182041	R	N	N	Y	N	N	N	N	N	N	N