INTRODUCTION

Knee joint is the largest and complex joint of the body and also most frequently injured joint due to the lack of bony support. The stability of the joint is highly dependent on its supporting ligamentous structures, therefore injuries of ligaments and menisci are extremely common ***(Biswas and De, 2016).***

Knee joint is one of the most commonly injured joints, as an isolated injury or a frequent component in a multiple trauma patient. Trauma to the knee joint is a significant cause of morbidity in young and active individuals especially amongst sports person, laborers, soldiers and military recruits. Multiple imaging modalities are currently being used to evaluate various pathologic conditions of the knee including conventional radiography, CT scan, sonography, nuclear medicine and MR imaging ***(Gupta et al., 2015).***

The principal intra articular structures in knee are the two menisci, the two cruciate ligaments, and the two collateral ligaments. The injury to these intra articular structures is generally termed as “Internal derangement of knee” which was first coined by British surgeon William Hey in 1784 ***(Manoj et al., 2014).***

Although clinical examination is most important for the diagnosis of ligament injury, painful stress examinations are not always accurate in the acute phase of the injury. For that reason, magnetic resonance imaging (MRI) is indicated for early diagnosis of the acutely injured knee ***(Otani et al., 2001).***

While the use of arthrography and arthroscopy improves the accuracy of the diagnosis, both are invasive and can cause complications ***(Edwin et al., 2003).***

MRI is currently gold standard non-invasive diagnostic imaging modality of choice for nearly all clinical indications concerning the knee. MRI provides excellent visualization of the internal structures of the knee along with soft tissue structures and bone marrow abnormalities ***(Laxman and Chandraprakash, 2013).***

AIM OF THE WORK

The aim of the study is to determine diagnostic role of MRI in studying types of internal knee derangements of the traumatic knee.

Chapter 1

ANATOMY OF KNEE JOINT

The knee is the largest synovial joint in the body. It consists of three functional compartments that collectively form a dynamic, specialized hinge joint ***(Benninger, 2016).***

Osteology

The bony anatomy of the knee joint consists of the articulations among the distal femur, the proximal tibia, and the patella. The height of the femoral condyles is asymmetric, and the medial condyle projects more distally than the lateral femoral condyle. The medial condyle is also larger; however, the lateral condyle projects more anteriorly. The condyles are separated by the femoral groove anteriorly and by the femoral notch at their distal aspect. (Fig 1-1).

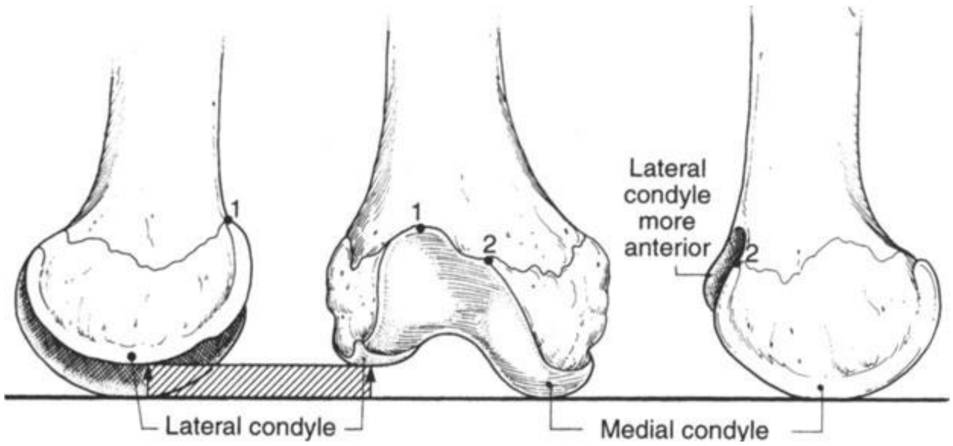

Fig. (1-1): The relationship of the medial and lateral femoral condyles: 1, the high point of the lateral femoral sulcus; 2, the high point of the medial femoral sulcus ***(Tria and Alicea, 1995).***

Patella

Is the largest sesamoid bone in the body, measuring approximately 5 cm in diameter. The articular surface of the patella is the thickest in the body, owing to the normal high joint reactive forces between the femur and the patella. It consists of seven facets ***(Chhabra et al., 2001).***

Superior tibiofibular joint

The superior (proximal) tibiofibular joint is a synovial joint between the lateral tibial condyle and head of the fibula. Though often considered a part of the knee, is in fact not a portion of the true knee joint ***(Amano and Kumazaki, 2002).***

Patellofemoral joint

The patellofemoral joint is a synovial joint and is part of the knee joint.

Articulating surfaces: The articular surface of the patella is adapted to that of the femur.

Patellar ligament sheath:

The patellar ligament is a continuation of the tendon of quadriceps femoris tendon inferior to the patella. It is strong, flat and 6–8 cm in length. proximally; it is attached to the apex of the patella and adjoining margins. Distally, it is attached to the superior smooth area of the tibial tuberosity (Figs 1-2). Its superficial fibers are continuous over the patella with the tendon of quadriceps femoris, the medial and lateral parts of which descend, flanking the patella, to the sides of the tibial tuberosity, where they merge with the fibrous capsule as the medial and lateral patellar retinacula ***(Benninger, 2016).***

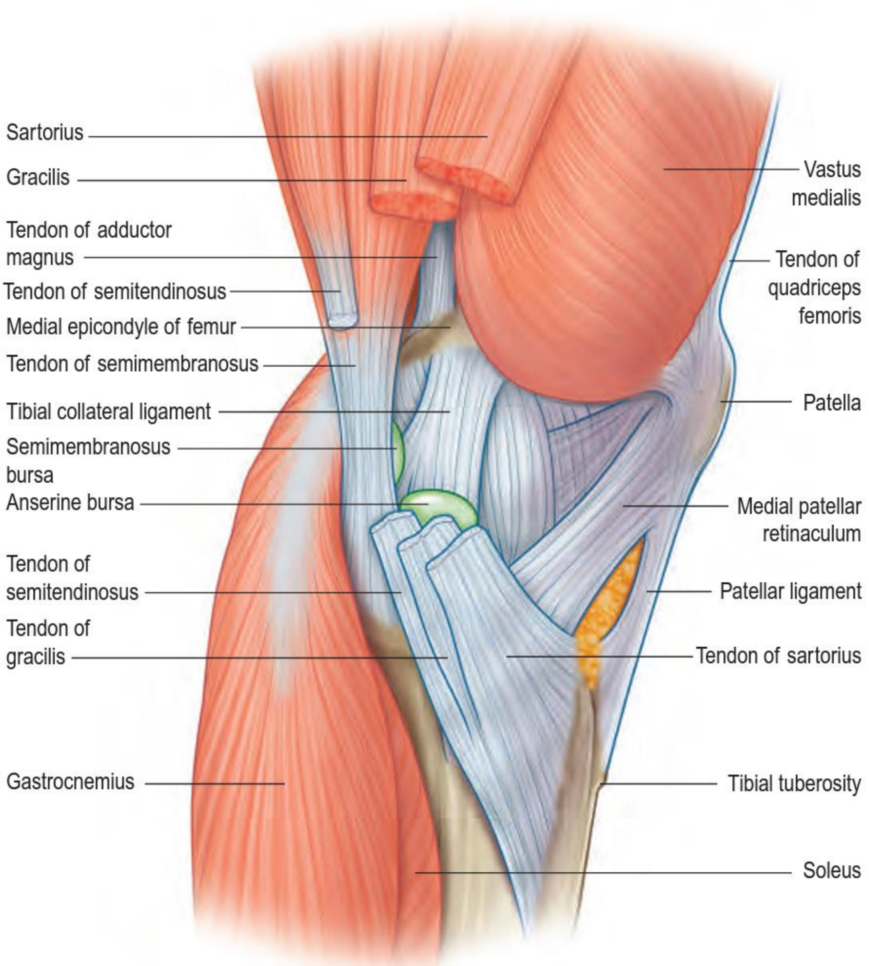

Fig. (1-2): The distal attachment of muscles of the thigh, medial aspect ***(Shoja, 2016).***

Tibiofemoral joint

The tibiofemoral joint is a complex synovial joint and is part of the knee joint.

The tibial plateau slopes posteriorly and downwards relative to the long axis of the shaft. (Fig. 1-3)

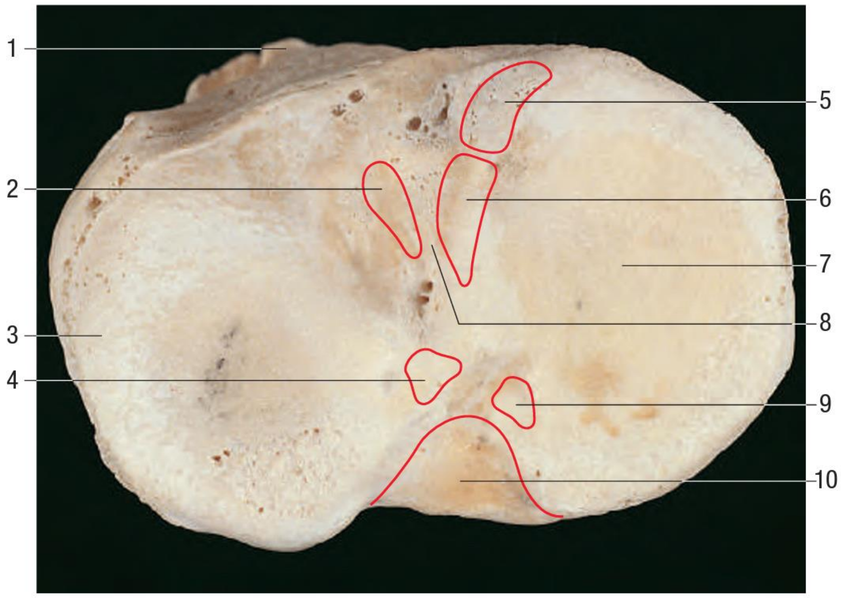

Fig. (1-3): The left tibial plateau. Key: 1, tibial tuberosity; 2, attachment of anterior horn, lateral meniscus; 3, lateral condyle; 4, attachment of posterior horn, lateral meniscus; 5, attachment of anterior horn, medial meniscus; 6, attachment of anterior cruciate ligament; 7, medial condyle; 8, intercondylar eminence; 9, attachment of posterior horn, medial meniscus; 10, attachment of posterior cruciate ligament ***(Benninger, 2016).***

The tibial plateau presents medial and lateral articular surfaces for articulation with the corresponding femoral condyles. The medial articular surface is oval and longer than the lateral articular surface. Around its anterior, medial and posterior margins, it is related to the medial meniscus; the meniscal imprint, wider posteriorly and narrower anteromedially. The lateral tibial condyle overhangs the shaft of the tibia postero-laterally above a small circular facet for articulation with the fibula. The lateral articular surface is more circular and coapted to its meniscus ***(Benninger, 2016).***

Intercondylar area

The rough-surfaced area between the condylar articular surfaces is narrowest centrally where there is an intercondylar eminence and widens behind and in front of the eminence (Fig. 1-3 and Fig. 1-4).

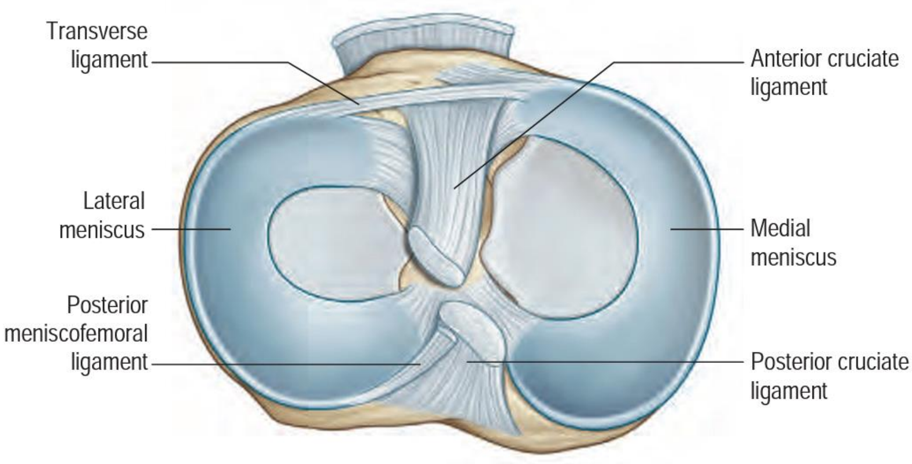

Fig. (1-4): The superior aspect of the left tibia, showing the menisci and the attachments of the cruciate ligaments ***(Drake et al., 2008).***

Anteromedially, anterior to the medial articular surface, a depression marks the site of attachment of the anterior horn of the medial meniscus. Behind this, a smooth area receives the anterior cruciate ligament. The anterior horn of the lateral meniscus is attached anterior to the intercondylar eminence, lateral to the anterior cruciate ligament.

The posterior horn of the lateral meniscus is attached to the posterior slope of the intercondylar area. The posterior intercondylar area inclines down and backwards behind the posterior horn of the lateral meniscus. A depression behind the base of the medial intercondylar tubercle is for the attachment of the posterior horn of the medial meniscus. The rest of the area is smooth and provides attachment for the posterior cruciate ligament, spreading back to a ridge to which the capsule is attached ***(Benninger, 2016).***

Femoral surface

The femoral condyles, bearing articular cartilage, are almost wholly convex. Tibiofemoral congruence is improved by the menisci ***(Benninger, 2016).***

Menisci

The menisci (semilunar cartilages) are crescentic, intracapsular, fibrocartilaginous laminae (Fig. 1-4 and Fig. 1-5). They serve to widen, deepen and prepare the tibial articular surfaces that receive the femoral condyles. Their peripheral attached borders are thick and convex, and their free, inner borders are thin and concave. Their peripheries are vascularized by capillary loops from the fibrous capsule and synovial membrane, while their inner regions are less vascular.

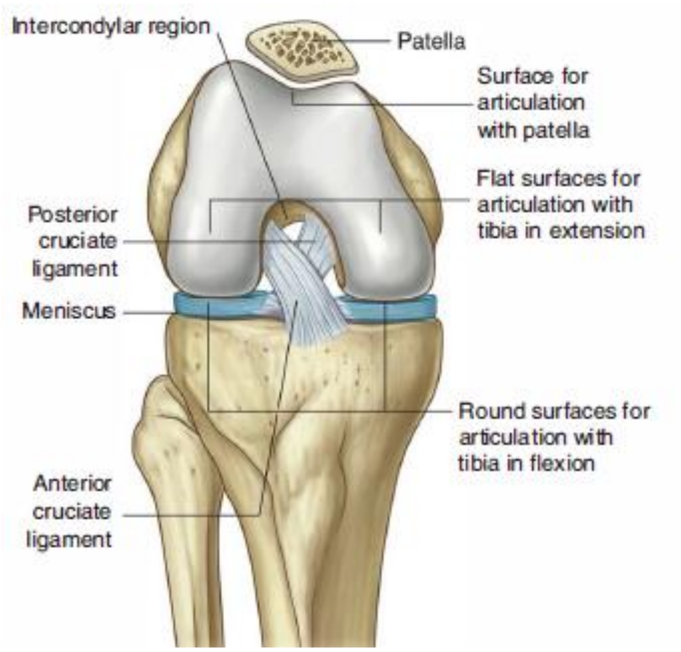

Fig. (1-5): Anterior view of articular surface of knee joint ***(Drake et al., 2014).***

Each covers approximately two-thirds of its tibial articular surface.

Two structurally different regions of the menisci have been identified:

The inner two-thirds of each meniscus consist of radially organized collagen bundles, and the peripheral one-third consists of larger circumferentially arranged bundles ***(Ghadially et al., 1983).***

Medial meniscus

The medial meniscus is broader posteriorly and is almost a semicircle in shape (Fig. 1-4). It is attached by its anterior horn to the anterior tibial intercondylar area in front of the anterior cruciate ligament; the posterior fibers of the anterior horn are continuous with the transverse ligament of the knee (when present). The anterior horn is in the floor of a depression medial to the upper part of the patellar ligament. The posterior horn is fixed to the posterior tibial intercondylar area, between the attachments of the lateral meniscus and posterior cruciate ligament.

Its peripheral border is attached to the fibrous capsule and the deep surface of the tibial collateral ligament ***(Benninger, 2016).***

Lateral meniscus

The lateral meniscus forms approximately four-fifths of a circle and covers a larger area than the medial meniscus (Fig. 1-4). Its breadth, except at its short tapered horns, is more or less uniform. It is grooved postero-laterally by the tendon of popliteus, which separates it from the fibular collateral ligament. Its anterior horn is attached in front of the intercondylar eminence, posterolateral to the anterior cruciate ligament. Its posterior horn is attached behind this eminence, in front of the posterior horn of the medial meniscus.

More laterally, part of the tendon of popliteus is attached to the lateral meniscus, and so mobility of its posterior horn may be controlled by the meniscofemoral ligaments and by popliteus ***(Benninger, 2016).***

Discoid lateral meniscus

A discoid lateral meniscus occasionally occurs, often bilaterally. The distinguishing features of a 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 but it does not completely cover the tibial plateau.

A complete discoid meniscus appears as a biconcave disc with a rolled medial edge and covers the lateral tibial plateau. The Wrisberg type of meniscus has the same shape as a complete discoid meniscus but its only peripheral posterior attachment is by the meniscofemoral ligaments as a result, this 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 become caught between the femur and tibia ***(Watanabe et al., 1979).***

A discoid medial meniscus is extremely rare ***(Benninger, 2016).***

Transverse ligament of the knee

The transverse ligament of the knee connects the anterior convex margin of the lateral meniscus to the anterior horn of the medial meniscus (Fig. 1-4). It varies in thickness and is often absent ***(Tubbs et al., 2008).***

Meniscofemoral ligaments

The two meniscofemoral ligaments connect the posterior horn of the lateral meniscus to the inner (lateral) aspect of the medial femoral condyle. The anterior meniscofemoral ligament (ligament of Humphrey) passes anterior to the posterior cruciate ligament. The posterior meniscofemoral ligament (ligament of Wrisberg) passes behind the posterior cruciate ligament and attaches proximal to the margin of attachment of the posterior cruciate.

Anatomical studies found that at least one meniscofemoral ligament was almost always present in the cadaveric knees examined, while both sometimes coexisted ***(Gupte et al., 2003).***

Soft tissues

Medial soft tissues

The medial soft tissues (Fig. 1-6) are arranged in three layers.

Layer 1: is the most superficial and mainly consists superficially of the sartorius muscle and posteriorly of fatty tissue. More deeply one can find the gracilis and the semitendinosus tendons. A condensation of tissue passes from the medial border of the patella to the medial epicondyle of the femur (the medial patellofemoral ligament), the anterior horn of the medial meniscus (the meniscopatellar ligament), and the medial tibial condyle (the patellotibial ligament).

Layer 2: is the plane of the superficial MCL made of parallel and oblique bundles of connective tissue fibers. The anterior part consists of parallel fibers from the medial femoral epicondyle to the medial surface of the tibia posterior to the pes anserinus. Posterior oblique fibers are connected to layer 3 fibers and form the posteromedial capsule of the knee joint.

Layer 3: is the capsule of the knee joint and can be separated from layer 2 everywhere except anteriorly close to the patella. Deep to the superficial part of the tibial collateral ligament, it is thick and has vertically orientated fibers that make up the deep medial part of the tibial collateral ligament ***(Warren and Marshall, 1979).***

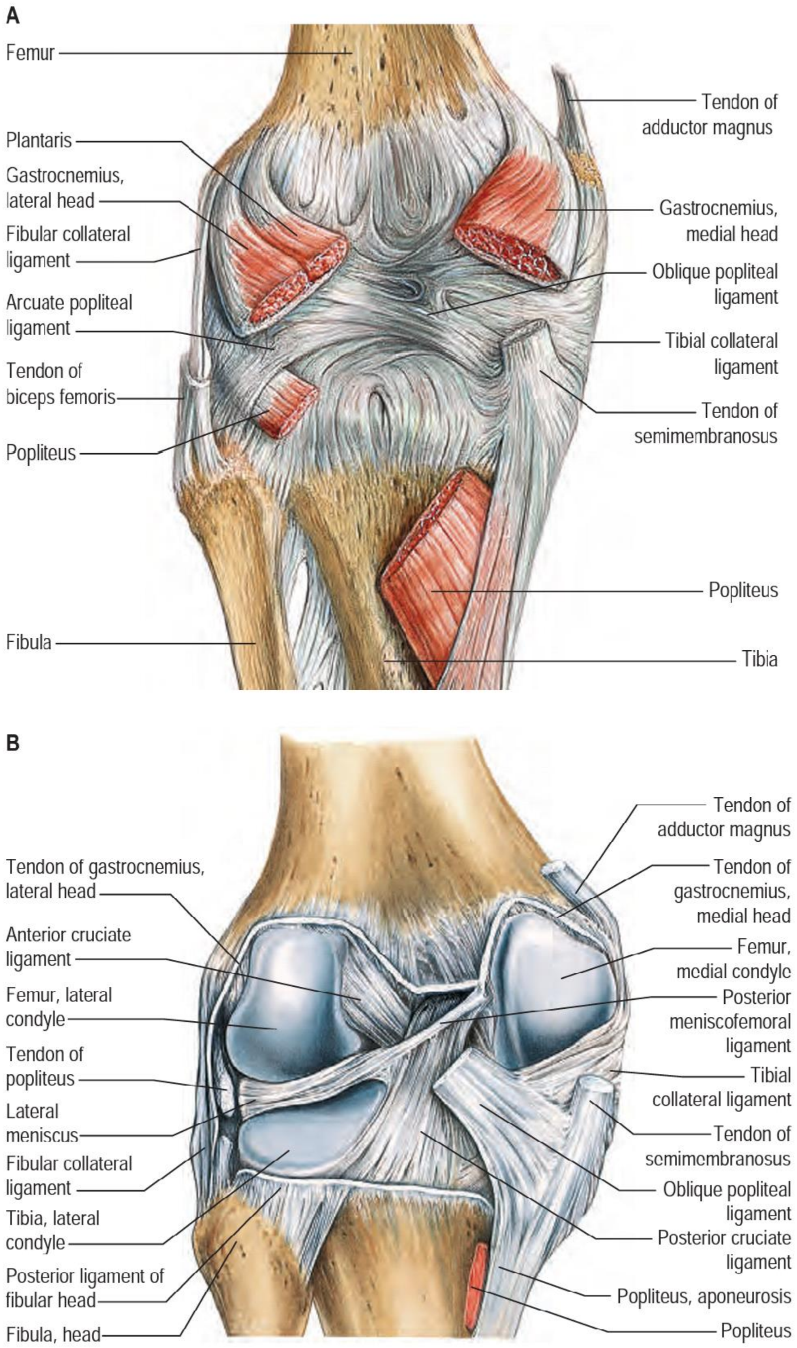

Fig. 1-6): A posterior dissection of the knee. (**A)**Capsule intact, (**B)** Capsule removed ***(Waschke and Paulsen, 2013).***