INTRODUCTION

The knee is one of the most commonly injured joints. Diagnostic dilemmas arise because of the number of soft tissue structures in and around the knee that are subject to injury.

High-resolution sonography is the modality of choice for imaging superficial soft-tissue structures of the knee, such as tendons, ligaments, and bursae. The advantages of ultrasound include high spatial resolution, low cost and wide availiability. The greatest strength of the method is the dynamic capability which permits examination during movement ***(Friedman et al., 2001).***

Indirect or dynamic techniques are generally applied inconjunction with sonography to diagnose anterior cruciate ligament tears (ACL). In contrast sonography can clearly depict the posterior cruciate ligament (PCL) ***(Grobbelaar and Bouffard, 2000).***

The most common causes of Knee pain and disability are tears in medial or lateral menisci. Meniscal injuries are common in both athletes and the general population. Ultrasound can demonstrate different types of injury in the meniscus ***(Chhem, 2006).***

With high resolution linear ultrasound transducers of at least 7.5 MHZ and preferably 12-15 MHZ variable frequency, we are able to assess the internal structure of tendons and evaluate their integrity. Ultrasound may also show the local extent of a tendon problem such as a focal versus a diffuse tendinopathy ***(Court, 2006).***

Ultrasound is ideal for initial examination of periarticular swelling and mainly used to differentiate cystic from potentially malignant solid periarticular masses ***(Suzuki et al., 2008).***

Ultrasound may provide information that determines the need for other more costly investigations such as CT, MRI or other invasive procedures such as arthrography or biopsy ***(Bruce et al., 2005).***

Aim of the Work

Is to evaluate the usefulness and high light the indications, advantages of high-resolution ultrasound in the assessment of different knee lesions.

Chapter (I): Anatomy of the Knee Joint

The knee is the largest and most complex joint in the body. It is synovial modified hinge joint that joins the femur to the tibia and patella. It includes the tibio-femoral articulation between the medial and lateral femoral condyles and the tibia, and the patello-femoral articulation between the posterior patellar surface and the patellar surface of the femur. The tibio-fibular articulation though often considered as part of the knee, is in the fact not a portion of the true knee joint ***(Platzer, 2004).***

1- Articular surfaces:

The knee joint comprises three articulations: an intermediate one between the patella and the patellar surface of the femur, and lateral and medial articulation between the femoral and tibial condyles.

A- The articular surface of the femur:

- The condylar areas: which are opposed to the tibial end are separated behind by the intercondylar fossa.
- The patellar surface: which unites the condyles in front and is opposed to the patella **(figure 1).**

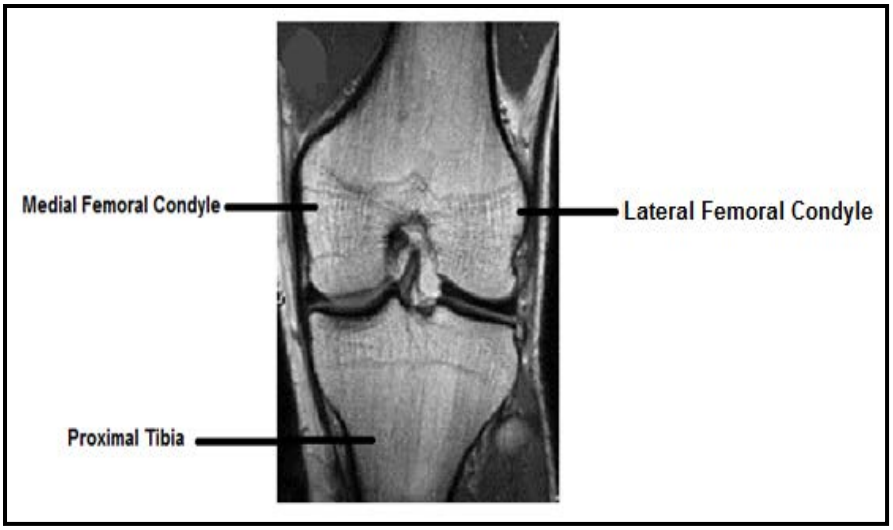

Fig. (1): Coronal knee MRI demonstrating the femoral condyles and the proximal tibia ***(Quoted from Platzer, 2004).***

B- The articular surface of the patella:

It is the posterior surface of the patella, which is the largest sesamoid bone, is situated in front of the knee joint in the tendon of the quadriceps femoris. Its pointed apex gives attachment to the ligamentum patellae. Its thick base gives attachment to that portion of the quadriceps femoris tendon **(figure 2)** ***(Levangie and Norkin, 2005).***

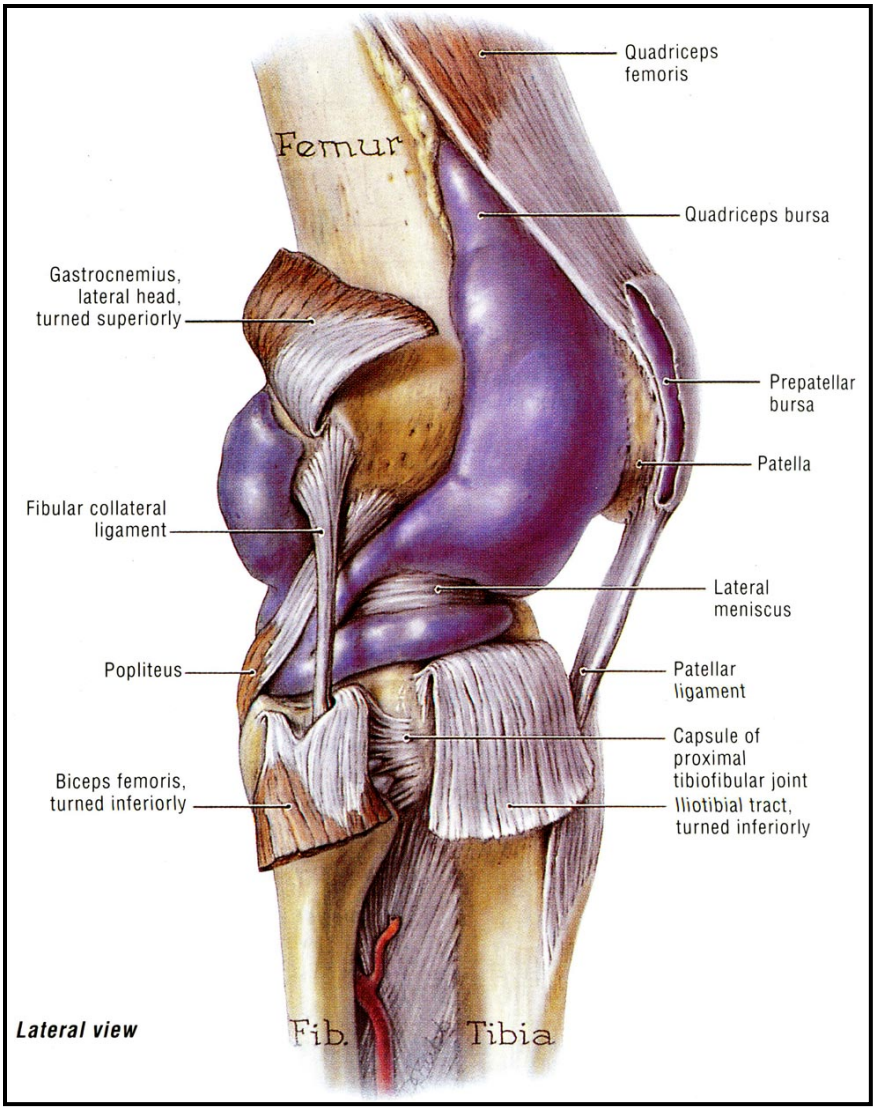

Fig. (2): Lateral view of the knee joint ***(Quoted from Agur, 2005).***

C- The articular surfaces of the tibia:

They are the cartilage-covered areas on the upper surface of each tibial condyle. These condyles are separated byintracondylar areas, which serves for cruciate attachment. The medial articular surface is oval and

concave, while the lateral surface is smaller and more circular. Between the tibial condyles are raised areas, known as the intercondylar eminence, that have medial and lateral tubercles **(figure 1)** ***(De Maeseneer et al., 2000).***

2. Capsule of the Knee Joint

The capsule is a fibrous membrane of variable thickness containing areas of thickening that may be referred to as discrete ligaments ***(figure 3, 4) (Heino et al., 2002).***

a. Posteriorly:

The capsule consists of vertical fibers that are attached: above to margins of the femoral condyles and the posterior margin of the intercondylar fossa, below to the posterior margins of the tibial condyles and the posterior border of the intercondylar area. This part of the capsule is blended above on each side with the origin of the corresponding head of gastrocnemius. Centrally, it is augmented by fibers derived from the tendon of the semimembranosus forming the oblique popliteal ligament.

b. Anteriorly:

The fibrous capsule is completely absent above the patella and over the patellar area. Elsewhere, it blends indistinguishably with expansions from the vastus medialis and lateralis. The expansions are attached to the margins of the patella and ligamentum patellae and extend backwards

on each side as far as the corresponding collateral ligament and downwards to the condyles of the tibia. They form the medial and lateral patellar retinaculae, and the latter is further strengthened by the iliotibial tract.

Above the patella, the deficiency of the fibrous capsule allows the suprapatellar bursa to communicate freely with the cavity of the joint ***(De Abreu et al., 2007).***

c. On its Deep Surface:

The fibrous capsule is attached to the periphery of each meniscus and connects it to the adjacent margin of the head of the tibia. This connection is often termed the coronary ligament **(figure 4)** ***(De Abreu et al., 2007).***

d. Medially:

The fibrous capsule is attached to the medial surfaces of the femoral and tibial condyles beyond the articular margins. **(figure3, 4)** ***(De Abreu et al., 2007).***

e. Laterally:

The fibrous capsule is attached to the femur above the origin of popliteus; they descend over the tendon to the lateral condyle" of the tibia and head of the fibula. The fibular collateral ligament of the joint above the patella, the deficiency of the fibrous capsule allows the suprapatellar bursa to communicate freely with the cavity of the joint **(figure 3, 4)** ***(De Abreu et al., 2007).***

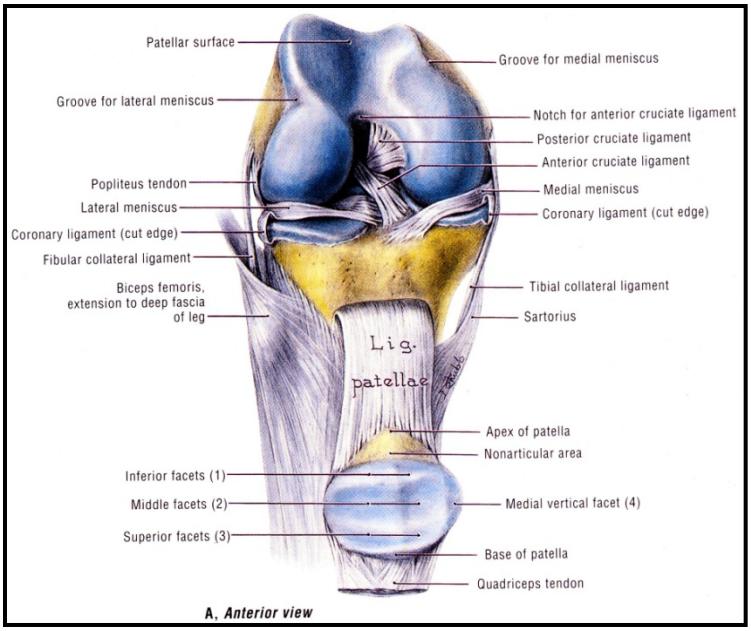

Fig. (3): Anterior view of the knee ***(Quoted from Agur, 2005)*.**

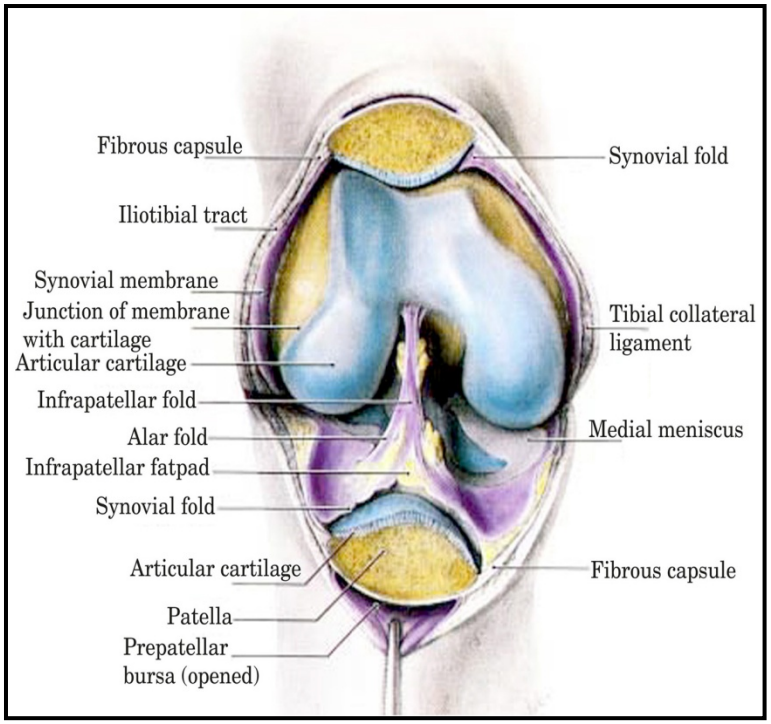

Fig. (4): Anterior view of the knee (capsule is opened) ***(Quoted from Agur, 2005).***

Attachement of Synovial Membrane:

This does not coincide with the capsular attachements. On the femur, it lines the intercondylar notch and on the lateral condyle is separated from the capsule by the attachement of the popliteus tendon, which lies between the two. On the tibia, it is attached to the articular margins of the medial and lateral condyles, and is reflected forwards over the anterior cruciate ligament from these margins. A fold extending from here to the inferior margin of the patella is known as the infrapatellar fold. Communications with bursae characterize the synovial cavity of the knee joint ***(Beaman et al., 2007).***

3- Bursal extension:

There are many bursae in the region of the knee, some of which are continuous with the joint capsule. The most important include the following:

Anteriorly:

Subcutaneous prepatellar bursa between the lower patella and skin allows movement of the skin over the patella during flexion and extension.

Infrapatellar bursa between the tibia and patellar ligament reduces friction between these two surfaces.

Subcutaneous infrapatellar bursa between the distal part of the tibial tuberosity and skin may become irritated by kneeling or by direct trauma.

Suprapatellar bursa between the femur and quadriceps femoris is continuous with the joint capsule ***(Beaman et al., 2007).***

Laterally:

Small bursae lie:

Between the lateral collateral ligament and the tendon of biceps femoris.

Between the lateral collateral ligament and the tendon of Popliteus.

Between the tendon of popliteus and the lateral femoral condyle, usually an extension from the joint ***(Beaman et al., 2007).***

Medially:

Between the medial head of gastrocnemius and fibrous Capsule.

Between the medial collateral ligament and the tendons of sartorius, gracilis and semitendinosus ***(Beaman et al., 2007).***

Various bursae deep to the medial collateral ligament between the capsule, femur, medial meniscus, tibia or tendon of semimembranosus.

Between the tendon of semimembranosus and the medial tibial condyle ***(Beaman et al., 2007).***

4. Ligaments of the Knee:

a. The Oblique Popliteal Ligament

It is an expansion from the tendon of the semimembranosus close to its insertion into the tibia **(Fig 2, 3).** It partially blends with the fibrous capsule; passes upwards and laterally to be attached above to the lateral part of the intercondylar line and to the lateral condyle of the femur. It consists of fasciculi separated from one another by apertures for the passage of vessels and nerves. It forms part of the floor of the popliteal fossa and the popliteal artery rests upon it ***(Levangie and Norkin, 2005).***

b. The Arcuate Popliteal Ligament:

It consists of a y-shaped system of capsular fibers **(figure 2).** The stem of which is attached to the head of the fibula. The posterior limb arches medially over the emerging tendons of the popliteus to be attached to the posterior border on the intercondylar area of the tibia.

The anterior limb, which is sometimes absent, extends to the lateral epicondyle of the femur where it is connected with the lateral head of the gastrocnemius. This is often termed the short lateral ligament ***(Levangie and Norkin, 2005).***

c. The Tibial Collateral Ligament:

Sometimes it is termed medial collateral ligament. It consists of two parts anterior or "superficial part" and posterior or "deep part" **(Fig. 4, 5).** It is a broad flat band situated nearer to the back than to the front of the joint ***(De Maeseneer et al., 2000).*** The anterior or parallel fibers arise from the medial epicondyle of the femur and consists of heavy and vertically oriented fibers running distally to an insertion on the medial surface of the tibia about 4.6 cm inferior to the tibial articular surface.

The posterior-oblique fibers run from the femoral epicondyle and blend with the underlying capsule. They are attached immediately inferior to the posterior tibial articular surface and to the medial meniscus. The fibers are augmented by contributions from the semimembranosus tendon sheath ***(Antonio et al., 2004).***

d. The Lateral Collateral Ligament:

Sometimes it is termed fibular collateral ligament **(Fig. 4, 5)**. It is a strong rounded cord, attached above to the lateral epicondyle of the femur, immediately above the groove for the tendon of the popliteus and, below, to the head of the fibula, in front of its apex. It is largely hidden by the tendon of biceps femoris, which embraces and is partly attached to the ligament. Deep to the ligament are the tendon of popliteus muscle and the inferior lateral genicular vessels and nerve. The ligament is not attached to the lateral meniscus ***(De Abreu et al., 2005).***

e. The Cruciate Ligaments:

The cruciate ligaments consist of a pair of very strong ligaments connecting tibia to femur and they lie within the capsule of the knee joint, but not within the synovial membrane. It is as thought they had been herniated into the synovial membrane from behind, carrying forward over themselves a fold which invests their anterior and lateral surfaces but leaves their posterior surface uncovered. They are named from their tibial origins **(Fig. 4, 5)** ***(De Abreu et al., 2005).***

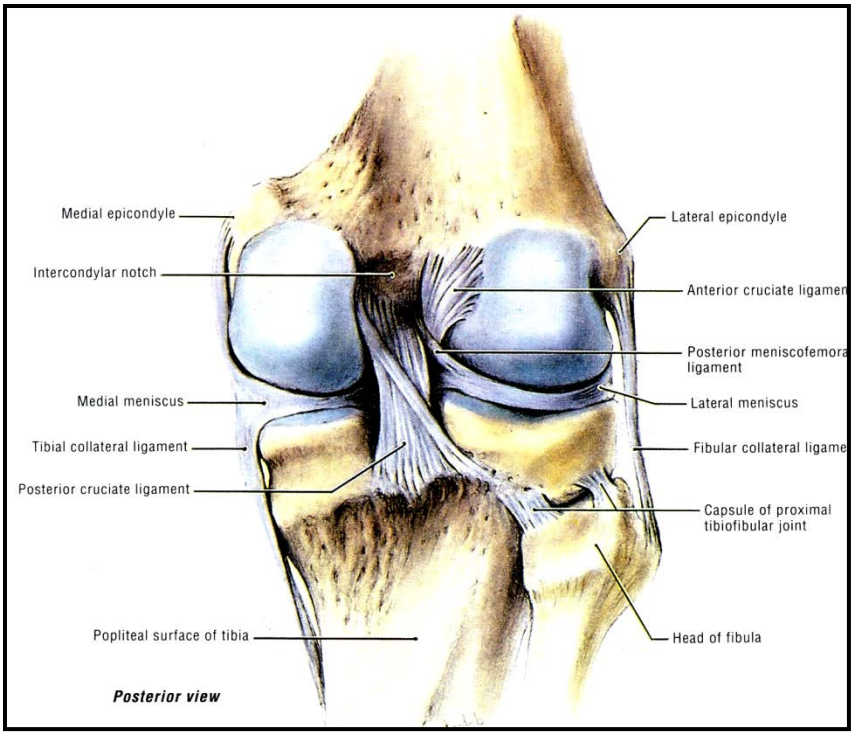

Fig. (5): Posterior view of the knee ***(Quoted from Agur, 2005).***

1. The Anterior Cruciate Ligament (ACL)

Femoral Attachment

It is attached to a fossa on the posterior aspect of the medial surface of the lateral femoral condyle. The femoral attachment is in the form of a segment of a circle with its anterior border straight and its posterior border convex. Its long axis is tilted slightly forward from the vertical, and the posterior convexity is parallel to the posterior articular margin of the lateral femoral condyle ***(Levangie and Norkin, 2005).***