INTRODUCTION

Anterior knee pain is the most common knee complaint seen in adolescents and young adults, in both the athletic and nonathletic population, although in the former, its incidence is higher ***(Collado and Fredericson, 2010).***

The rate is around 9% in young active adults. Its incidence is 5.4% of the total injuries and as high as a quarter of all knee problems treated at a sports injury clinic ***(Witvrouw et al., 2000).***

Pain receptors are present within several knee structures, including the patella, synovium, fat pad, tendon, subchondral bone, and quadriceps retinaculum ***(Biedert et al., 2002).***

Any of these structures, individually or in combination, can cause anterior knee pain. Most causes of anterior knee pain involve the patellofemoral joint and the extensor mechanism of the knee. The term anterior knee pain is often used interchangeably with patellofemoral pain. Patients with anterior knee pain do not necessarily have chondromalacia patella and patients with chondromalacia do not uniformly have pain ***(Duthon et al., 2006).***

Anterior knee pain may be caused by conditions unique to the growing pediatric skeleton including hip disease (slipped capital femoral epiphyses and Perthe's disease) or osteochondrosis

(Osgood-Schlatter disease or Sinding Larsen Johansen disease) ***(Duthon et al., 2006).***

Anterior knee pain is occasionally caused by serious underlying systemic disease including inflammatory conditions and malignancies ***(Biedert et al., 2002).***

Magnetic Resonance Imaging (MRI) has evolved into a useful adjuvant for assessing the soft tissues in and around the knee for a more precise evaluation of the true etiology or severity of anterior knee pain, thereby affecting decisions about appropriate surgical or conservative treatment ***(Hayes and Coggins, 2006).***

AIM OF THE WORK

The purpose of this pictorial essay is to present the characteristic MR features of common and uncommon disorders causing anterior knee pain.

KNEE JOINT ANATOMY

The knee, one of the largest and most complicated joints in the body, is a synovium-lined, articulation consisting of two hinge-type joints between the femoral condyles and the medial and lateral tibial plateaus, and a gliding-type joint between the patella and the trochlear groove of the anterior distal femur. The tibiofibular articulation, although often considered a part of the knee, is in fact not a portion of the true knee joint. The knee is protected anteriorly and posteriorly by muscles with special ligamentous attachments to the capsule ***(Frick et al., 2007).***

Bones forming the knee joint are connected together by the following ligaments:

1- Articular Capsule.

2- Ligamentum Patellæ.

3- Oblique Popliteal.

4- Tibial Collateral.

5- Fibular Collateral.

6- Anterior Cruciate.

7- Posterior Cruciate.

8- Transverse.

9- Coronary.

10- Medial and Lateral Menisci.

(Stadring et al., 2005)

1. *The Articular Capsule (capsula articularis; capsular ligament):Fig (1)*

The knee capsule is composed of two layers: an outer fibrous layer and an inner synovial layer, or synovium (Figs 1 and 2).

The synovium is a thin membrane that lines the knee capsule and attaches to the margins of the articular surfaces and the periphery of the fibro cartilaginous menisci. Often, a small gap exists between the insertion of the synovial membrane/capsule and the nearby articular cartilage, effectively resulting in a ‘‘bare area’’, this area is of significant importance in the pathophysiology and evolution of many arthridites.

On gross inspection, the synovium is a smooth, pink, glistening membrane that contains minute folds, or microvillus, which serve to increase the effective surface area of the joint and allow expansion of the synovial membrane, required for normal joint motion.

Synovial membrane essentially consists of two layers: a thin layer of lining cells, or intima, and the deeper, more vascular tissues of the subsynovium, consisting of loose connective tissue, fat, fibrous elements, and a rich supply of capillaries and venules.

One of the primary functions of the synovium is the secretion of a clear, colorless-to-pale-yellow mucoid substance into the synovial fluid, which facilitates joint lubrication and nutrition ***(Frick et al., 2007).***

Anteriorly, the synovial lining extends superiorly, above the patella and deep to the quadriceps femoris, to form the suprapatellar bursa, held in position by a small muscle, the articularis genus, arising from the vastus intermedius. The synovial membrane envelops the anterior and posterior cruciate ligaments so as to exclude them from the ‘‘synovial cavity’’ (i.e., these structures are intra-articular but extra-synovial).

Posteriorly, the synovial membrane extends caudally on the deep surface of the popliteus tendon (The popliteus is the smallest and most superior muscle of the deep posterior compartment of the leg. Its origin is from: lateral femoral condyle it inserts into the posterior surface of proximal tibia), forming the popliteal bursa.

An additional bursas, the semimembranosus bursa, lies between the medial head of the gastrocnemius and the medial femoral condyle, and also communicates frequently with the synovial cavity of the joint. The prepatellar bursa is found anteriorly, and as the name suggests, in front of the patella. It is made up of 3 components, viz., prepatellar subcutaneous bursa, prepatellar subfascial bursa and prepatellar subaponeurotic bursa ***(Aguiar et al. 2003)*.**

The Pesanserine bursa lies behind the medial hamstring, which is composed of the tendons of the Sartorius, gracilis and semitendinosus (SGT) muscles ***(Zaffagnini et al., 2003).***

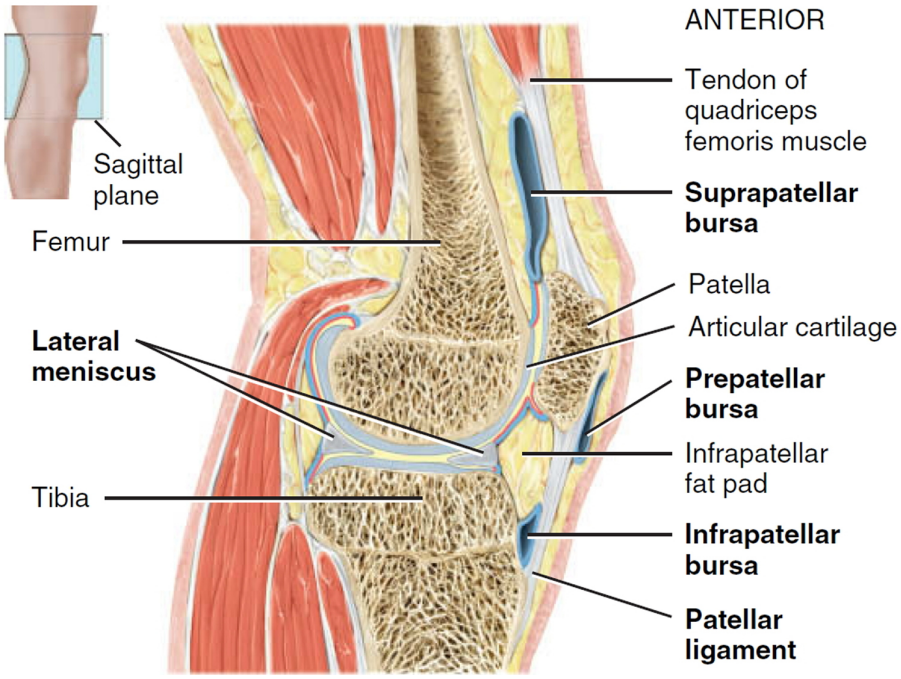


Fig. (1): The knee capsule and synovium: sagittal illustrations demonstrate the relationship between the knee capsule, the synovium and the supporting structures of the knee.. Quoted from ***(Stadring et al., 2005).***

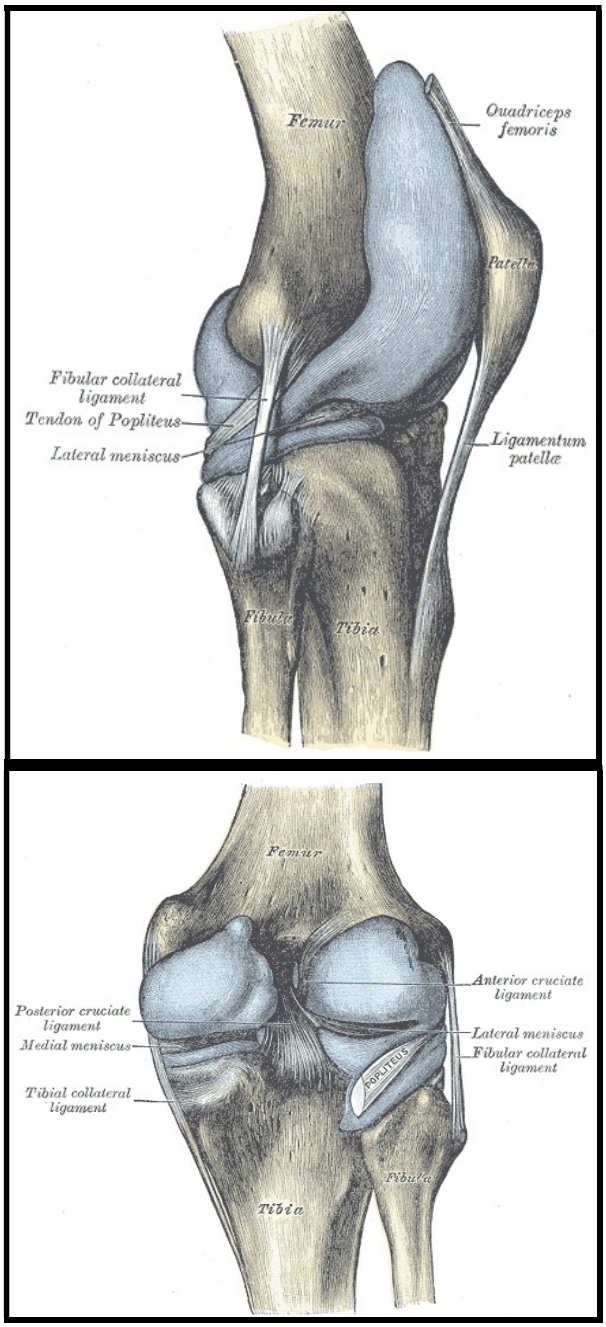
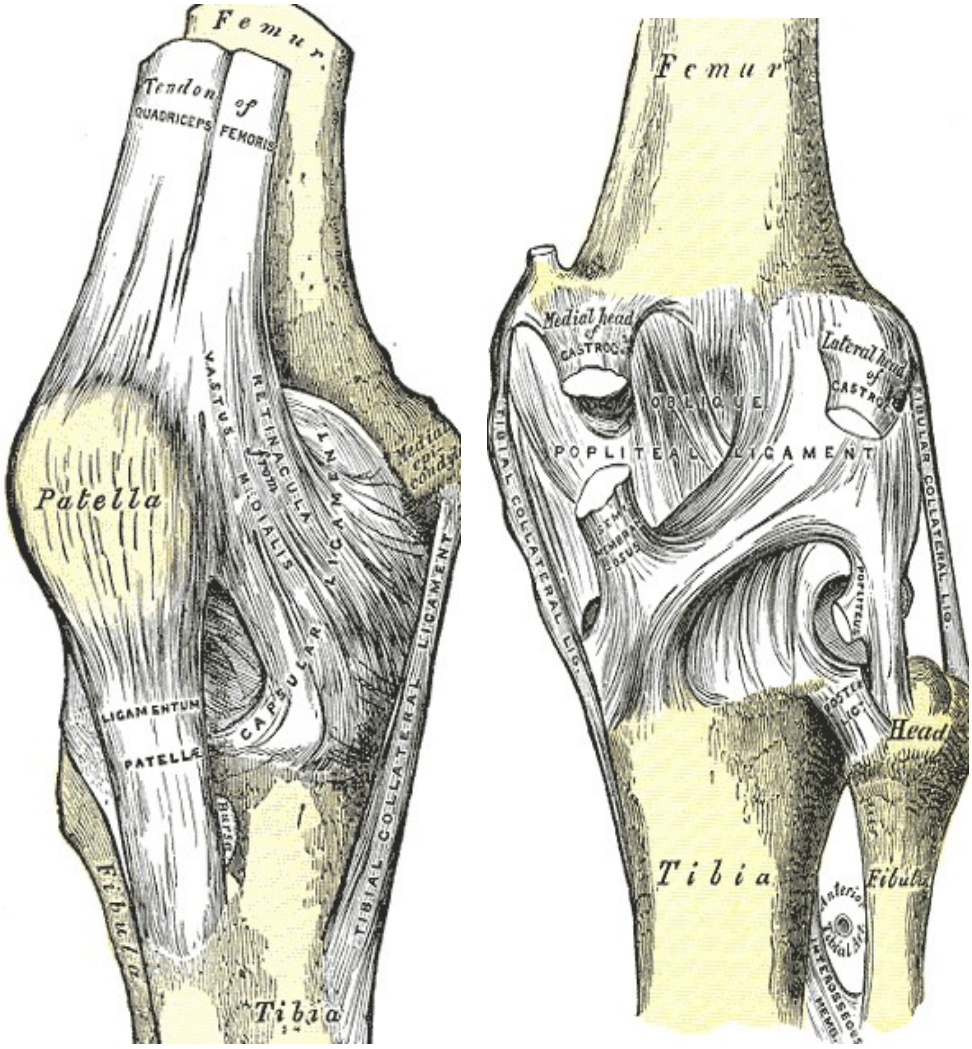


Fig. (2): Capsule of the right knee joint (distended) in lateral (up) and posterior (down) aspects. Quoted from ***(Stadring et al., 2005).***

2. The Ligamentum Patellae (Fig. 3):

The ligamentum patellae is the central portion of the common tendon of the Quadriceps femoris, which is continued from the patella to the tuberosity of the tibia. It is a strong, flat, ligamentous band, about 8 cm. in length, attached above to the apex and adjoining margins of the patella and the rough depression on its posterior surface; below, to the tuberosity of the tibia; its superficial fibers are continuous over the front of the patella with those of the tendon of the Quadriceps femoris. The medial and lateral portions of the tendon of the Quadriceps pass down on either side of the patella, to be inserted into the upper extremity of the tibia on either side of the tuberosity; these portions merge into the capsule, as stated above, forming the medial and lateral patellar retinacula. The posterior surface of the ligamentum patellae is separated from the synovial membrane of the joint by a large infra-patellar pad of fat, and from the tibia by a bursa ***(Stadring et al., 2005)***.

Another important fat bas is Hoffa's Bad Of Fat its boundaries consist of the patellar ligament anteriorly, the inferior pole of the patella superiorly, and the femoral condyles and intercondylar notch posteriorly. Inferiorly, it extends to the level of the infrapatellar bursa anterior to the upper tibia. The ligamentum-mucosum is attached to the fat pad superiorly ***(Freeman, 2002).***



a **b**

Fig. (3): A knee joint in anterior view showing ligamentum patellae, articular capsule and tibial collateral ligament. **(b)** Knee joint in posterior view showing the oblique popliteal ligament, tibial and fibular collateral ligaments and articular capsule (right). Quoted from ***(Stadring et al., 2005).***

3. The Oblique Popliteal Ligament (Fig. 3,4):

This ligament is a broad, flat, fibrous band, formed of fasciculi separated from one another by apertures for the passage of vessels and nerves. It is attached above to the upper margin of the inter-condyloid fossa and posterior surface of the femur close to the articular margins of the condyles, and below to the posterior margin of the head of the tibia. Superficial to the main part of the ligament is a strong fasciculus, derived from the tendon of the Semimembranosus and passing from the back part of the medial condyle of the tibia obliquely upward and lateral ward to the back part of the lateral condyle of the femur. The oblique popliteal ligament forms part of the floor of the popliteal fossa, and the popliteal artery rests upon it ***(Stadring et al. 2005)***.

4. The Tibial Collateral Ligament (Fig. 3,4):

The tibial collateral is a broad, flat, membranous band, situated nearer to the back than to the front of the joint. It is attached, above, to the medial condyle of the femur immediately below the adductor tubercle; below, to the medial condyle and medial surface of the body of the tibia.

The fibers of the posterior part of the ligament are short and incline backward as they descend; they are inserted into the tibia above the groove for the semimembranosus. The anterior part of the ligament is a flattened band, about 10 cm. long, which inclines forward as it descends. It is inserted into the

medial surface of the body of the tibia about 2.5 cm. below the level of the condyle. It is crossed, at its lower part, by the tendons of the sartorius, gracilis, and semitendinosus -a bursa being interposed-. Its deep surface covers the inferior medial genicular vessels and nerve and the anterior portion of the tendon of the semimembranosus, with which it is connected by a few fibers; it is intimately adherent to the medial meniscus ***(Stadring et al., 2005).***

5. The Fibular Collateral Ligament (Fig. 3):

The fibular collateral is a strong, rounded, fibrous cord, attached, above, to the back part of the lateral condyle of the femur, immediately above the groove for the tendon of the popliteus; below, to the lateral side of the head of the fibula, in front of the styloid process. The greater part of its lateral surface is covered by the tendon of the biceps femoris; the tendon, however, divides at its insertion into two parts, which are separated by the ligament. Deep to the ligament are the tendon of the popliteus, and the inferior lateral genicular vessels and nerve. The ligament has no attachment to the lateral meniscus ***(Stadring et al., 2005).***

6. The Cruciate Ligaments (fig. 4,5)

The cruciate ligaments are of considerable strength, situated in the middle of the joint, nearer to its posterior than to its anterior surface. They are called cruciate because they cross each other somewhat like the lines of the letter X; and have

received the names anterior and posterior, from the position of their attachments to the tibia ***(Griffin et al., 2008).***

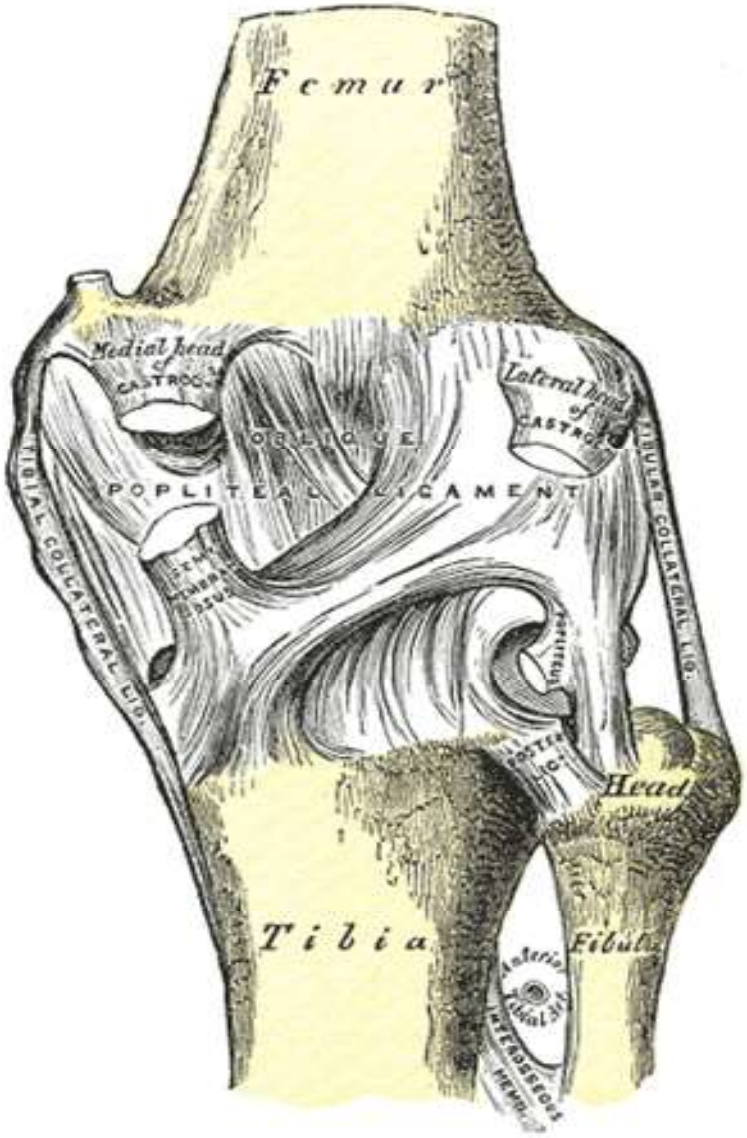


Fig. (4): Knee joint from behind, showing interior ligaments. Quoted from ***(Stadring et al., 2005).***

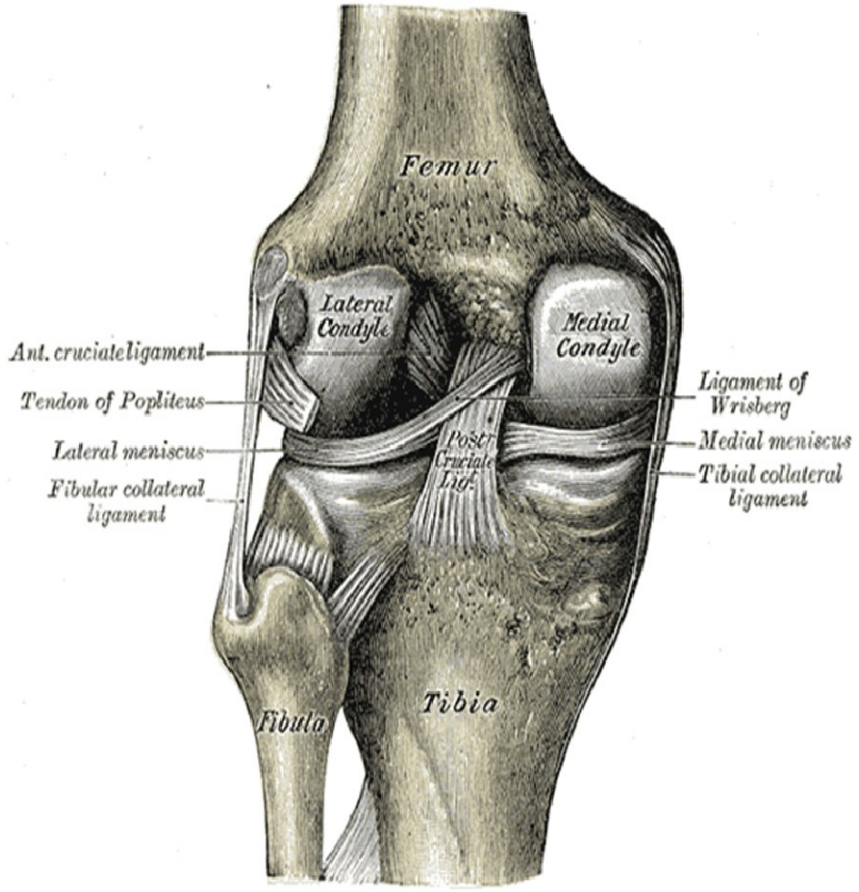


Fig. (5): Knee joint from the front, showing ACL, PCL, medial and lateral menisci. Quoted from ***(Stadring et al., 2005).***

7. The Anterior Cruciate Ligament

It is attached to the depression in front of the inter-condyloid eminence of the tibia, being blended with the anterior extremity of the lateral meniscus; it passes upward, backward, and lateral ward, and is fixed into the medial and back part of the lateral condyle of the femur ***(Griffin et al., 2008).***

8. The Posterior Cruciate Ligament

It is stronger, but shorter and less oblique in its direction, than the anterior. It is attached to the posterior inter-condyloid fossa of the tibia and to the posterior extremity of the lateral meniscus; and passes upward, forward, and medial ward, to be fixed into the lateral and front part of the medial condyle of the femur ***(Griffin et al., 2008).***

9. The Transverse Ligament

The transverse ligament connects the anterior convex margin of the lateral meniscus to the anterior end of the medial meniscus; its thickness varies considerably in different subjects, and it is sometimes absent.

10. Iliotibial band: fig (6)

The iliotibial band (ITB) is a thick band of fascia formed proximally at the hip by the fascia of the gluteus maximus, gluteus medius and tensor fasciae latae muscles.

The band consists of deep and superficial layers:

The superficial layer is the main tendinous component and inserts onto Gerdy's tubercle on the anterior lateral tibia.

The deep layer inserts on the intermuscular septum of the distal femur.

A small recess exists between the lateral femoral epicondyle and the ITB, which contains a synovial extension of the knee joint capsule (lateral synovial recess).