Introduction

Promotion of a physically active lifestyle is encouraged worldwide, particularly with regard to the many health benefits. In children and adolescents, regular sports practice facilitates the development of fundamental movement skills, helps to prevent obesity and its long-term consequences and has long-lasting benefits on bone health ***(Frisch et al., 2009)***.

Unfortunately, increased intensity and volume of sport practice lead to a higher rate of acute and overuse injuries. For the young athlete, the consequences of sports injuries could be numerous, ranging from re-injury to career-ending. Long-term impacts of sports injuries are frequently found in adulthood, such as an accelerated development of osteoarthritis. In addition to the potentially long-term outcomes of sports injuries on later life, the related healthcare costs constitute a substantial economic burden. Reduction of only a moderate proportion of all sports injuries is of significance for the young athletes' health and could have a long-term economic impact regarding health-care costs ***(Caine et al., 2006)*****.**

The knee is the largest joint in the body and subjected to enormous loads during many sports activities. However, it is a relatively unstable and intricate joint with numerous tendinous, ligamentous, and meniscal attachments, which make it particularly vulnerable to complex injuries after trauma ***(Christopher et al., 2008)*****.**

The main acute injuries in youth sports are sprains, fractures, dislocations and contusions. Overall, sprains account for 27-48% of all injuries in the young athlete, with the knee being the most common anatomical location for sprains. The injury type that has received most attention is the knee sprain, resulting in ACL or meniscus tears. Typically, sports such as tennis, volleyball, handball, basketball and soccer are especially concerned here ***(Gall et al., 2008)*.**

Magnetic resonance (MR) imaging of the knee has seen significant advances since its initial application, in 1984, for evaluation of the meniscus. Magnetic Resonance Imaging (MRI) is performed more commonly on the knee than on any other joint, and it is an excellent diagnostic tool that can aid in the evaluation of a host of sports-related injuries involving the ligaments, tendons, menisci, osseous structures, and articular surfaces. It has currently become the most widely used non invasive imaging method for detecting meniscal injuries, with a reported diagnostic accuracy of as high as 98%, compared to arthroscopy, remaining the gold standard for confirming the diagnosis of meniscal tear ***(Karachalios et al., 2005).***

MR imaging provides high anatomic and pathologic definition of soft tissue, ligaments, fibrocartilage, and articular cartilage. Fast spin-echo (FSE) imaging, used in conjunction with fat-suppression (FS) MR techniques, has extended the sensitivity and specificity of MR in the detection of articular cartilage injuries and the evaluation of meniscal tears. Additional advantages of MR imaging are multiplanar and thin-section capabilities and the ability to evaluate subchondral bone and marrow ***(Stoller et al., 2007).***

Aim of the Work

The aim of the study is to emphasize the role of Magnetic resonance imaging in the assessment of sports related knee injuries.

Chapter (1): Anatomy of Knee Joint

The knee joint is the largest and most complicated joint in the body; it is a special type of hinge joint. While hinge joints normally allow one degree of movement, this joint allows flexion & extension produced by a combination of rolling and gliding, and, when in a flexed position, also allows a small degree of rotation ***(Platzer, 2004).***

Because it must perform its movement while also bearing most of the body's weight, it seems as though stability of this joint should be a primary feature when, in fact, the joint design itself engenders relative instability. The knee joint is composed from the bony surfaces, menisci, ligaments, articular cartilage, joint capsule and the muscular elements (Figure 1) ***(Levangie and Norkin, 2005).***

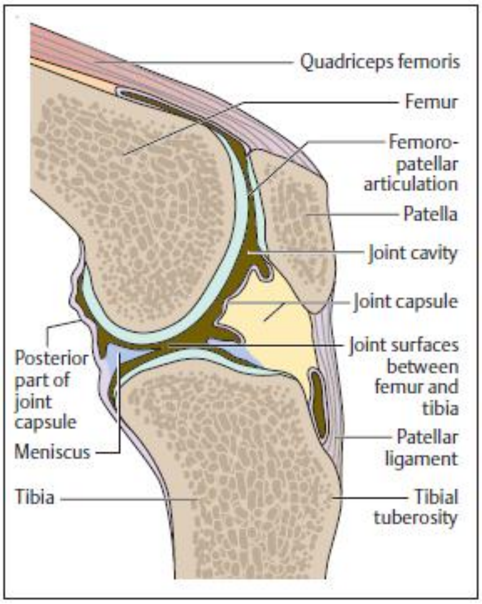

Figure (1): Sagittal section of knee joint ***(Quoted from Faller et al., 2004).***

F u n c t i o n a l a n d

A combination of muscles, tendons, ligaments, and extensions of the joint capsule collectively help to offer multidirectional stability to the knee, while allowing for necessary mobility ***(Vohra et al., 2011).***

M o v e m e n t

The knee joint consists of the articulation between the condyles of the femur and the tibia and that between the femur and the patella. The two menisci adapt the joint surfaces of the femur and the tibia to each other and increase the surface for the transmission of force. When the knee joint is flexed, the femur executes a combined gliding and rolling motion over the tibial articular surface, during which the menisci are shifted more posteriorly the further the knee is flexed. The movements of the knee joint are guided by two sets of ligaments, the medial and lateral collateral ligaments and the anterior and posterior cruciate ligaments (Figure 2) ***(Abrahams et al., 2002).***

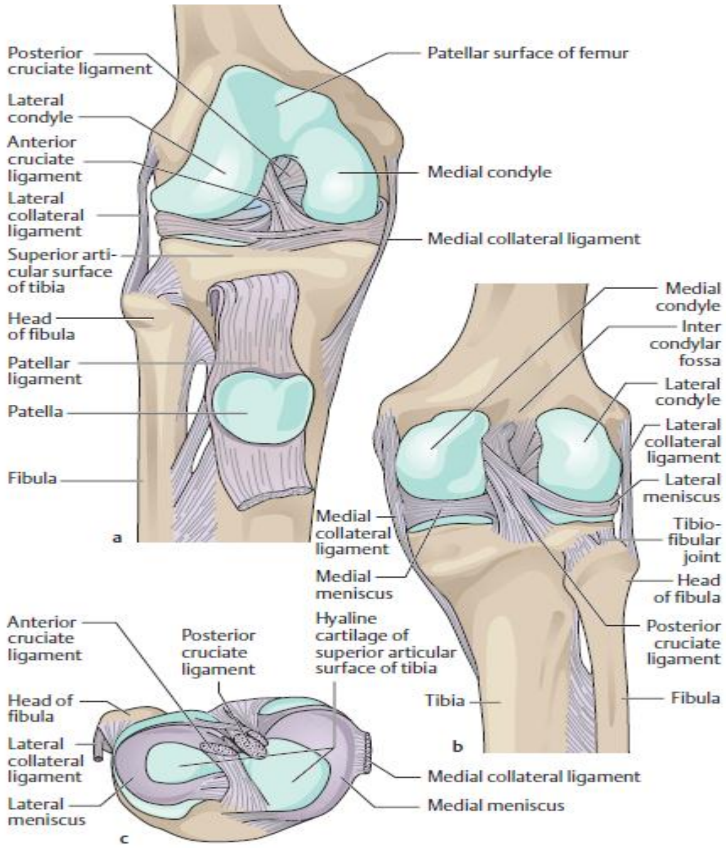

Figure (2): Anatomical structure of knee joint ***(Quoted from Abrahams et al., 2002).***

While the collateral ligaments primarily stabilize the extended leg, the cruciate ligaments take over that function in the flexed knee joint. Because of the uneven curvature of the femoral condyles, the collateral ligaments are fully tensed only during extension of the knee joint; they are relaxed during flexion. With the knee flexed, the cruciate ligaments limit internal and external rotation of the lower leg, internal rotation being more severely limited than external rotation by the coiling of the cruciate ligaments ***(Faller et al., 2004).***

Muscles inserted into the medial surface of the tibia (e. g., semitendinosus and semimembranosus) are internal rotators. The biceps femoris is inserted into the head of the fibula, and is the only external rotator of the lower leg. All three muscles are flexors of the knee joint, as is the sartorius. The most important extensor of the knee joint is the quadriceps femoris, inserted by the patellar ligament into the tibial tuberosity. The patella, the largest sesamoid bone in the human body, is embedded in the patellar ligament. It is triangular in shape and articulates with the anterior surface of the distal femur (patellar surface). As the knee flexes, the patella moves downward. Because there is considerable transfer of force in the joint between femur and patella, especially during flexion, this is the most highly stressed joint in the body, and is the earliest to show degenerative changes in its cartilage ***(Abrahams et al., 2002).***

Stability

The knee joint is primarily composed of 3 articulating compartments: patella-femoral, medial femoro-tibial, and lateral femoro-tibial formed by the combined action of the femur, tibia, patella and two fibrocartilaginous disks (menisci) ***(Faller et al., 2004).***

Major medial stabilizers include the deep coronary ligaments and superficial portions of the medial collateral ligament (MCL), medial tendons (sartorius, gracilis, semitendinosus, and semimembranosus), and deep crural fascia of vastus medialis, which helps to form the medial patellar retinaculum anteriorly. Posteriorly, the deep portion of the MCL, with contributing fibers from the semimembranosus tendon and synovial sheath, form the posterior oblique ligament, a major stabilizer of the posteromedial knee. The MCL bursa is located along the middle third of the medial knee joint between the superficial and deep components of the MCL ***(De Maeseneer et al., 2000).***

The lateral femorotibial compartment is formed by the lateral femoral condyle and lateral tibial plateau articulation, and houses the lateral meniscus and articular cartilage. It can communicate with the proximal tibiofibular joint in a minority of individuals. Lateral joint stabilizers are composed of muscles, tendons, and ligaments. The anterolateral joint is stabilized by the joint capsule and the iliotibial tract, which inserts on Gerdy’s tubercle along the anterolateral tibia, and is a fascial extension of the tensor fascia lata (Figure 3) ***(Vohra et al., 2011).***

The posterolateral corner is a complex anatomic area providing stabilization, achieved by several structures including the fibular (lateral) collateral ligament (FCL), biceps femoris tendon, popliteus muscle and tendon, popliteal fibular and popliteal meniscal ligaments, oblique popliteal, arcuate, and fabellofibular ligaments, and lateral gastrocnemius muscle. These structures are collectively referred to as the arcuate ligament complex. The major stabilizers of the posterolateral corner are adequately visualized on routine knee MR imaging examinations. The FCL has an oblique course from the lateral femoral condyle, immediately anterior to the origin of the lateral head of the gastrocnemius muscle, to the fibular head ***(Klecker et al., 2008).***

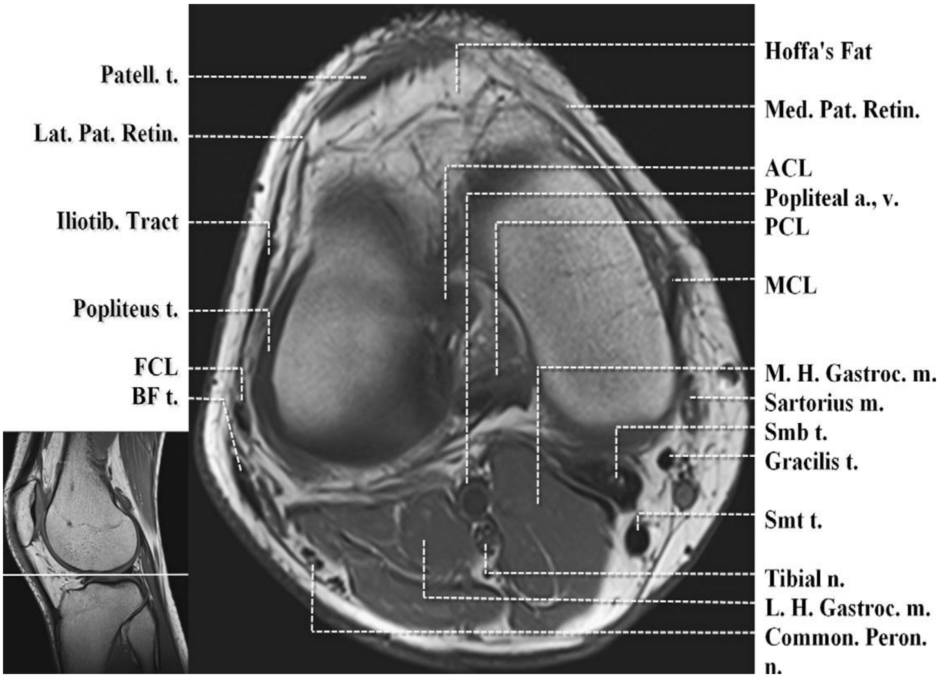

Figure (3): Axial T1-weighted image. Femorotibial joint space. a., artery; ACL, anterior cruciate ligament; BF LH. t., SH m., biceps femoris short head muscle, long head tendon; Comm. Peron. n., common peroneal nerve; FCL, fibular collateral ligament; Iliotib., iliotibial; m., muscle; MCL, medial collateral ligament; M.H./L.H. Gastroc., medial and lateral heads of gastrocnemius; Med./Lat. Pat. Retin., medial and lateral patellar retinacula; n., nerve; Patell. tend., patellar tendon; Smb, semimembranosus; Smt, semitendinosus; t., tendon; v., vein ***(Quoted from Vohra et al., 2011)***.

The biceps femoris common tendon, directly posterior to the iliotibial tract at the level of the femoral condyles, joins the FCL to form the conjoint tendon before inserting upon the fibular head. The intra-articular segment of the popliteus tendon originates just below and passes beneath the FCL (through the popliteus hiatus), and then the arcuate ligament. The extra-articular segment of the tendon quickly joins its muscle belly, which in turn attaches to the posteromedial proximal tibial surface ***(Vohra et al., 2011).***

Plica:

Early in the development of the knee joint, it is divided into three compartments by synovial tissue which breaks down to create the single compartment knee joint most usually seen. Remnants of the synovial folds known as plica may be found in the normal adult knee and typically lie in one of three positions. The medial patellar plica arises from the medial wall of the knee joint and extends a variable distance into the knee joint. The supra-patellar plica embryologically divides the supra-patellar pouch from the remainder of the knee joint. The infra-patellar plica extends from the infra-patellar fat pad to the apex of the intercondylar notch. While a complete intact plica may persist completely dividing the knee joint into two or more cavities, more commonly a remnant of the plica persists as a synovial fold ***(Hopper and Grainger, 2010).***

Patellofemoral joint:

The bony morphology of both the femoral trochlea and the articular surface of the patella are vital in maintaining the knee joint stability. Nevertheless, the quadriceps muscle/tendon complex and patellar tendon do not act in a straight line through the patella, the angle created by the two structures is referred to as the Q angle (Figure 4) ***(Vohra et al., 2011)***.

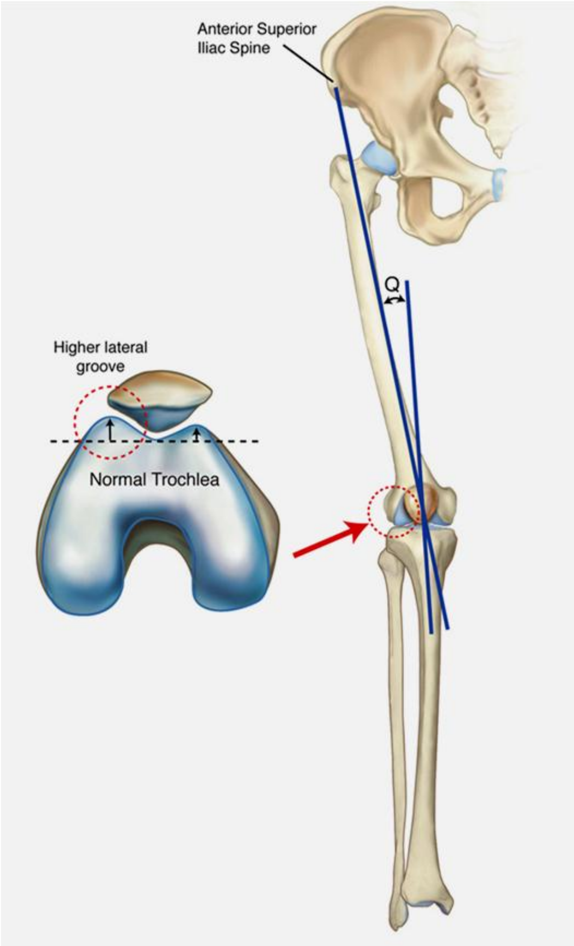

Figure (4): The Q angle is defined as the angle between the quadriceps mechanism and the patellar tendon and is a helpful measure of patella tracking. The greater the anatomic valgus, or the greater external rotation present in the tibia, the larger the Q angle will be, resulting in laterally directed force vector. Normal Q angle is typically considered to be <15 degrees. Increased femoral ante version will also result in a high Q angle by causing internal rotation of the femur relative to the tibia ***(Quoted from Panagiotopoulos et al., 2006).***

The patella is stabilized by medial and lateral retinacular structures (Figure 5). It is the medial retinacular structures which are responsible for resisting the tendency for the patella to move laterally which results from the Q angle geometry. These comprise the medial patella-femoral ligament (MPFL), the MCL, the patella-tibial ligament and the patella-meniscal ligament. Of these structures studies have shown it is the MPFL that provides the greatest restraint to lateral displacement of the patella. The MPFL meshes with the fibers of vastus medius obliqus close to its patellar insertion suggesting that the MPFL acts as both a static and a dynamic restraint ***(Panagiotopoulos et al., 2006).***

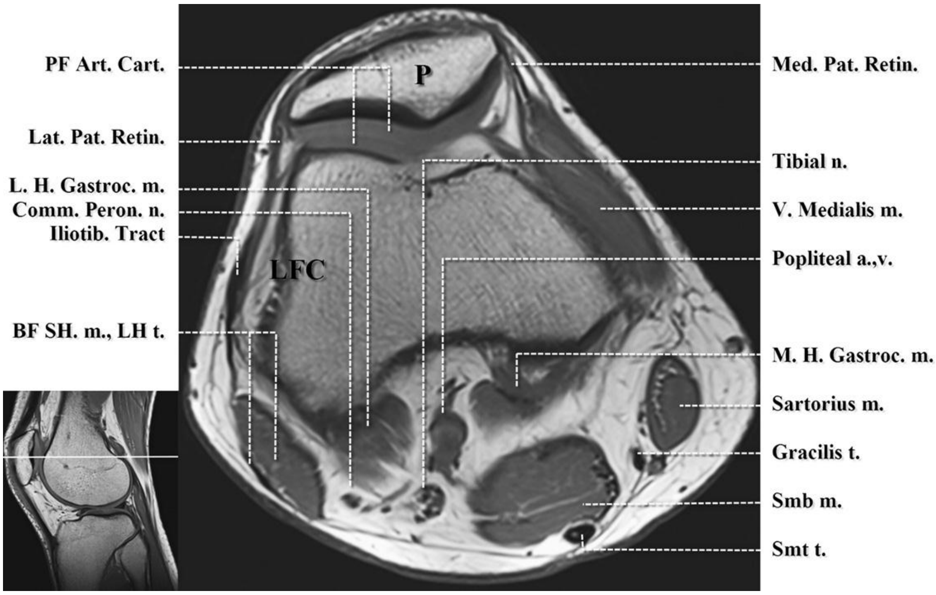

Figure (5): Axial T1-weighted image. Mid patellofemoral compartment. a., artery; BF SH. m., LH t., biceps femoris short head muscle, long head tendon; Comm. Peron. n., common peroneal nerve; m, muscle; n, nerve; M.H./ L.H. Gastroc., medial and lateral heads of gastrocnemius; Iliotib., iliotibial; Med./Lat. Pat. Retin., medial and lateral patellar retinacula; PF Art. Cart., patellofemoral articular cartilage; Smb, semimembranosus; Smt, semitendinosus; t., tendon; v., vein; V., vastus ***(Quoted from Vohra et al., 2011)***.

The extensor mechanism of the knee is composed of the quadriceps tendon, prepatellar quadriceps continuation, and patellar tendon ***(Wangwinyuvirat et al., 2009).***

The quadriceps tendon is striated in appearance, due to interspersed fat between 4 contributing muscles: vastus lateralis, vastus intermedius (deep), rectus femoris (superficial), and vastus medialis. The patellar tendon is a hypointense band arising from the inferior pole of the patella and attaching to the tibial tuberosity ***(Vohra et al., 2011).***

The prepatellar quadriceps continuation is a thin sliver of hypointense signal comprising superficial fibers from the rectus femoris tendon.

Numerous bursae are present around the knee joint, and allow for smooth motion of various stabilizing structures in relation to one another. Visualization of these potential spaces is commonly due to pathologic fluid accumulation (bursitis). The semimembranosus-gastrocnemius bursa, located within the posteromedial aspect of the knee, communicates with the knee joint in a majority of individuals, and is referred to as a popliteal (Baker’s) cyst ***(Beaman et al., 2007).***

The neck of the cyst is formed by the tendon of the medial head of the gastrocnemius muscle laterally and