MR IMAGING
OF
SYNOVIAL LESIONS AROUND THE KNEE

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Abstract

In conclusion, MR imaging, owing to its superior soft-tissue
contrast, is the imaging modality of choice for demonstrating and quantifying pathologic changes of the synovium and provides invaluable information to the clinician regarding the need to either initiate or modify therapy in those patients suffering from diseases of, or affecting, the synovium.

key word:
SYNOVIAL LESIONS

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Omar Abu El-Qasem

Contents

List of Abbreviations

MRI → magnetic resonance imaging
ACL→ anterior cruciate ligament
PCL→ posterior cruciate ligament
SE→ spin echo
FSE→ fast spin echo
CT → computed tomography
STIR→ short tau inversion recovery
SNR→ signal to noise ratio
PD→ proton density
PVNS→ pigmented villonodular synovitis
TCL→ tibial collateral ligament
MCL→ medial collateral ligament
DESS→ double echo steady state
SMTCL→ semimembronasus tibial collateral ligament
FCL→ fibular collateral ligament
PTFJ→ proximal tibiofibular joint
RA→ rheumatoid arthritis

List of Figures

Introduction

Disorders of the knee are responsible for a major source of referrals to the musculoskeletal radiologists. Most cases have suspected abnormalities within the joint either following an acute injury or a more insidious development of symptoms. Other common causes of referral are anterior knee pain, focal and diffuse swellings. MRI is the technique of choice for assessing the internal structures ***(Ostlere, 2003).***

Synovial disorders often affect the knee joint and are a common cause of morbidity. Before MR imaging, radiologists were limited in their ability to provide information about the presence or absence of synovial disease. With the advent of MR imaging, useful information can now be provided to referring clinicians, often at a time when the initiation of therapy may mitigate significantly the long term sequelae of synovial disorders. MR imaging owing to its superior soft tissue contrast, is the imaging modality of choice for demonstrating and quantifying pathologic changes of the synovium. MR imaging provides invaluable information to the clinician regarding the need to either initiate or modify therapy in those patients suffering from diseases of, or affecting, the synovium ***(Frick et al, 2007).***

Many synovial-lined cavities occur around the knee, and MR imaging is capable of demonstrating the precise anatomic relationships of these spaces. Knowledge of normal anatomy,

however, is necessary to accurately assess abnormal, fluid-filled structures. ***(Morrison & Kaplan, 2000)***

Cystic lesions in and around the knee are commonly encountered by primary care physicians during routine examinations or diagnostic workups for knee problems. The vast majority of masses are benign, but a mass or lesion can indicate an underlying condition or injury or, rarely, be malignant. A mass about the knee has a limited differential diagnosis: Popliteal (Baker's), ganglion, and meniscal cysts are the most common, but a few other conditions must be considered. Bursal swellings surrounding the knee, for example, may be confused with cysts. ***(Warren & Matthew, 1999)***

Although the presentation of cystic masses may be similar, their management may differ, thus highlighting the importance of appropriate categorization. MR aids in the characterization of lesions by first localizing them, and then defining their relationship with adjacent structures and identifying any additional abnormalities. ***(Beaman & Peterson, 2007)***

Knowledge of the location, characteristic appearance and distinguishing features of cystic masses around the knee as well as potential imaging pitfalls such as normal anatomical recesses and atypical cyst contents on MR imaging aids in allowing a specific diagnosis to be made. This will prevent unnecessary additional investigations and determine whether intra-articular surgery or conservative management is appropriate. ***(McCarthy & McNally, 2004)***

Aim of work

This work will review the MRI appearances of the various synovial disorders around the knee joint as well as the anatomy of synovial-lined structures around the knee joint including the joint capsule, plicae, bursae, and tendon sheaths.

1

Anatomical considerations

Knee joint anatomy

The knee, one of the largest and most complicated joints in the body, is a synovium-lined, diarthrodial 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)) (Rand and Berquist, 1992***).

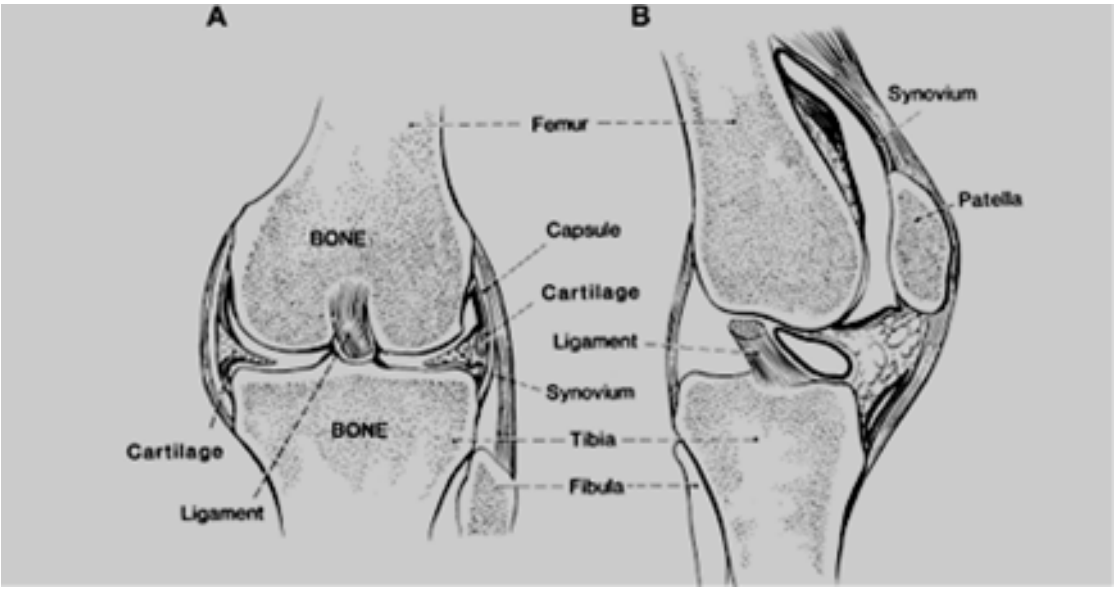

Fig.1. The knee capsule and synovium. Coronal and sagittal illustrations demonstrate the relationship between the knee capsule, the synovium and the supporting structures of the knee ***(Frick et al., 2007).***

Synovial anatomy and physiology:

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

The synovium is a smooth, pink, glistening membrane that contains minute folds, or microvilli, 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 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. The synovium also plays a critical role in the maintenance of joint integrity by assisting with the removal of debris (ie, cell fragments, particles, and so forth) that may accumulate within the joint during normal wear ***(Frick et al., 2007).***

Synovial attachments and extensions

Anteriorly the synovial membrane is attached to the articular margins of the patella (Fig. 4 A). Then the synovium extends circumferentially (Fig. 3 C) in contact with the retinacula (Fig. 9).

From the inferior aspect of the patella, the synovial membrane extends downward separated from the patellar ligament by the infrapatellar fat pad (Fig. 4 A and B).

At the lower margin of the patella there is the infrapatellar synovial fold (the ligamentum mucosum) (Fig. 4 B) which attaches to the femur and the tibia dividing the knee into medial and lateral synovial cavities separated by the extrasynovial space which houses the cruciate ligaments. Therefore, the cruciate ligaments are covered superiorly, medially, laterally and anteriorly, but not posteriorly, by the synovial membrane (Fig.4 A, B and E) ***(Rand and Berquist, 1992) (Shellock et al., 1991).***

Superiorly, the synovial membrane extends from the upper margin of the patella for a variable distance closely applied to the quadriceps muscle, then reflects on to the anterior aspect of the femur forming the suprapatel lar bursa (Fig. 4 A ,B).

Along the medial, lateral and posterior aspects of the capsule, the synovial membrane attaches to the femur at the edges of the articular surfaces.

Posterolaterally, the synovial membrane is separated from the fibrous capsule by the popliteus tendon. It is unusual to identify a bursa along the popliteus tendon, which communicates with the joint space posterolaterally.

Common bursa about the knee: (Figs. 2 & 3)

Bursae are typically interposed between bony surfaces and ligaments or tendons to reduce friction between these moving structures. Of the multiple bursae around the knee, only two, the suprapatellar and gastrocnemius–semimembranosus bursae, consistently communicate with the knee joint. Bursae around the