The Role of Ultrasonography in Diagnosis of Knee Diseases

Essay

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Abstract

Ultrasonography is the most rapidly developing technique in musculoskeletal imaging. It is a noninvasive imaging modality used for the assessment of the musculoskeletal system. It can provide clinically useful information on a wide range of pathologic conditions affecting components of the knee joint, including the tendons, ligaments, muscles, synovial space, articular cartilage, and surrounding soft tissues

Anterior knee pain is one of the most common complaints encountered by the orthopedist. Ultrasound provides an excellent non–invasive method in helping to differentiate patellofemoral problems including the common chondromalacia patella, from abnormalities involving the extensor mechanism

The ability to assess the tendons of the extensor mechanism of the knee is one of the particular strengths of ultrasound as it is able to accurately evaluate tendinosis, tendon tear and rupture

The collateral ligaments of the knee are easier to visualize with ultrasound than the cruciate ligaments due to their superficial location. Comparison with findings for the normal contralateral ligament is advisable to confirm the diagnosis

Ultrasound can be used in the setting of rheumatoid arthritis from early diagnosis, to assessment of severity, to evaluate response to therapy and can guide injections or aspirations. Color and power Doppler techniques can be used to measure neovascularization within the synovial lining of the joints, tendons, and soft-tissue masses

Ultrasound can differentiate cystic lesions from solid masses, Standard characteristics such as size, shape, location, and echogenicity can be determined with ultrasound.

Ultrasound can be used to assess the popliteal vessels; Power and Color Duplex ultrasound can differentiate between patent and thrombosed artery and for the detection of thrombosis within the popliteal vein

Key Words: Ultrasound- Power Doppler - Knee joint – extensor mechanism- patellar- collateral – cruiciate - Synovial – anserine - Bursae - arthritis - Popliteal Vessels.

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Introduction

Musculoskeletal ultrasound is a very useful tool in diagnosis of almost all disorders of musculoskeletal system and shall be a necessary tool of a physicians, specially a family physician, orthopedic surgeon, physiotherapist and rheumatologist **(Gilani S.A., 2012)**

With its outstanding diagnostic benefits notably high resolution and capability of real time assessment orthopedic ultrasound is often referred to as the "orthopedic Surgeon's stethoscope" **(Blankstein A., 2011).**

It is well established in Europe as a first line imaging modality in the investigation of musculoskeletal pathology **(Hilmir et al., 2010)**

Now routinely used by a growing number of rheumatology and sports medicine centers throughout UK and is rapidly gaining popularity in North America. **(El Mediany., 2012)**

There are several advantages of using ultrasound evaluation of the knee when compared to magnetic resonance imaging (MRI) is decreased cost when evaluating for a focal soft tissue abnormality**.** In addition, there is advantage gained by patient interaction, and the ability to perform a dynamic evaluation; Ultrasound can also directly guide a percutaneous aspiration or biopsy **(Jacobson JA., 2009).**

While, clinical examination of the knee joint is relatively easy, very small effusions and synovitic proliferations may be missed. Ultrasound can detect these as well as fluid in the knee **(Adhikari and Blaivas, 2010**).

Furthermore, ultrasound is useful for diagnosing pathologies relating to anterior knee pain, Synovial cysts, medial collateral ligaments, lateral collateral ligaments and in diagnosis of tears of patellar and quadriceps tears **(Blankstein A., 2011)**.

Ultrasound is valuable in the early detection of osteoarthritis and is helpful in defining the type and extent of bone and cartilage damage. Ultrasound is an excellent tool for the detection of effusion and synovitis, which correlate with joint pain, and is playing an important role in assessing the significance of the inflammatory component of osteoarthritis **(Bandinelli et al., 2012).**

Power and color Doppler add substantial advantages to standard musculoskeletal ultrasound because of its ability to visualize the movement of blood cells within a vessel with a particular application in detecting increased microvascular blood flow in synovial and entheseal inflammation **(Keen et al., 2009)**

Sensitivity of ultrasound can be improved by application of dynamic sonographic examination with stress tests to demonstrate instability and meniscal pathology and for the diagnosis of medial plica syndrome (**shetty et al., 2008**).

Functional ultrasonography is a rapid and inexpensive method of diagnosing anterior cruciate ligament (ACL) injuries with sensitivity: 97%, specificity: 87.5% **(Palm et al., 2009).**

Anatomy

Clinical Anatomy

1. **Osseous and articular Anatomy**
2. **Joints:**

Femorotibial Joint

Patellofemoral Joint

Superior Tibiofibular Joint

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Anterior tendons (Extensor Mechanism)

Posterior Tendons

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7. **Bursae**
8. **Popliteal Fossa:**

Popliteal Vessels

Tibial and Peroneal Nerves

Osseous and Articular Anatomy

The knee joint is the largest synovial joint in the body. It consists of three distinct and partially separated compartments that collectively form a complex ‘hinge' joint' articulation. Femorotibial joint, is formed by the articulation of the distal end of the femur to the proximal end of the tibia, The Patellofemoral joint, an articulation between the anterior aspect of the femur and the patella, and the Tibiofibular joint, an articulation between the lateral aspect of the tibia and the fibular head of the tibia (**Standring et al., 2008; McKinnis et al., 2010**).

Joint and Ligamentous Complexes

Femorotibial joint

Articular surfaces (figure 1):

- The two femoral condyles
- The adjacent surfaces of the superior aspect of the tibial condyles always referred as tibial plateau (**Standring et al., 2008**).

Patellofemoral Joint:

The articular surface of the patella is adapted to that of the femur **(figure 1 & 2)**. The latter extends onto the anterior surfaces of both femoral condyles like an inverted U. Since the whole area is concave transversely and convex in the sagittal plane, it is an asymmetrical sellar surface. (**Standring et al., 2008**).

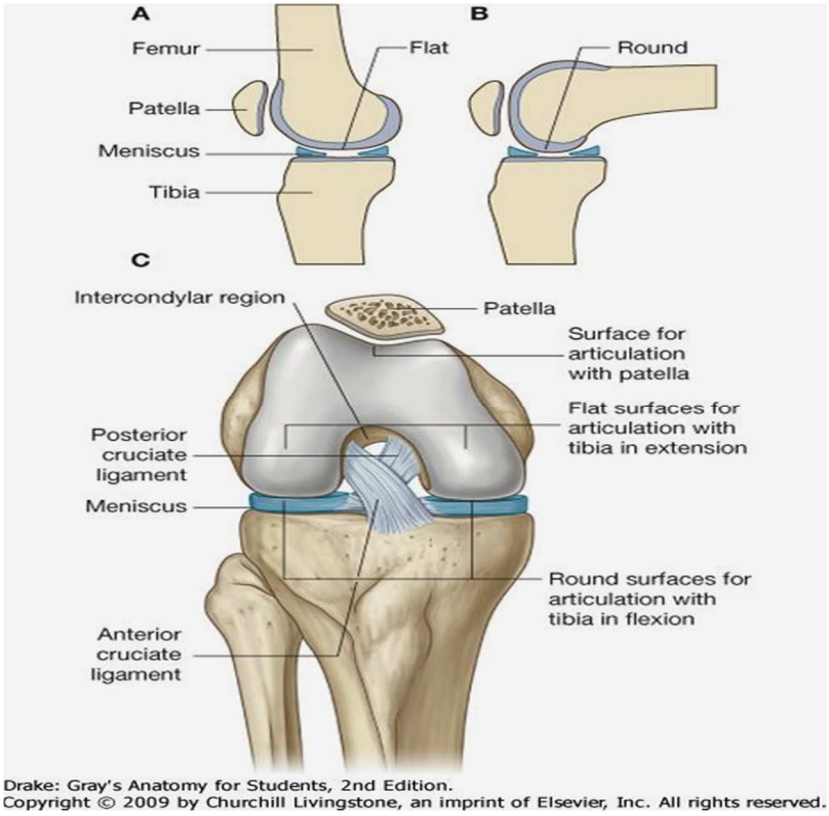

Figure (1): knee joint. Articular surfaces of the knee joint. A. Extended. B. Flexed. C. Anterior view (flexed) **(Drake et al., 2009)**

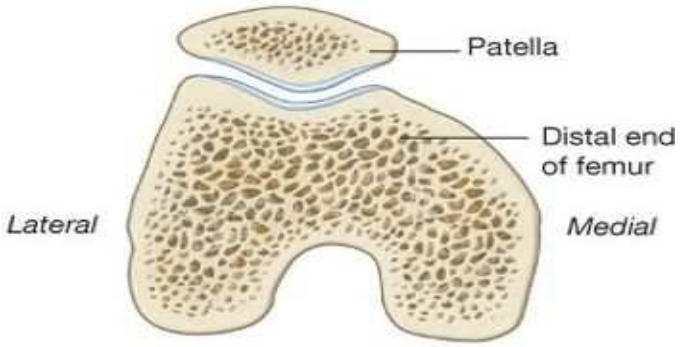

Figure (2): Patellofemoral joint Superior view **(Drake et al., 2009)**

Superior Tibiofibular Joint

The small proximal tibiofibular joint is synovial in type and allows very little movement. Articulation is between the lateral condyle of the tibia and the head of the fibula **(figure 3)**. The articular surfaces are flattened and covered by hyaline cartilage. In most cases, the superior tibiofibular joint is completely separated from the larger Femorotibial joint (**Standring et al., 2008**).

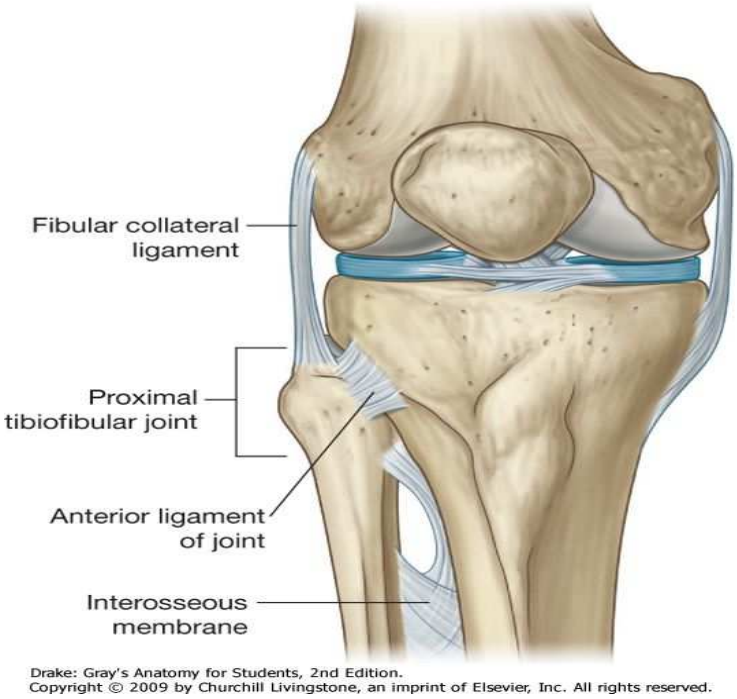

Figure (3): proximal Tibiofibular joint **(Drake et al., 2009)**