Pictorial essay

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Ultrasonography as a diagnostic tool for posteromedial corner pathologies: a pictorial essay

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Abstract

The posteromedial corner (PMC) is a common location for knee joint pain, and accurate diagnosis is essential for appropriate treatment. The frequent causes of pain in the PMC include pathologies of the posterior part of the medial meniscus, damage to articular cartilage, popliteal cysts and the semimembranosus tendinopathy.

Currently, magnetic resonance imaging is the gold standard for assessing knee joint disorders, but its availability and cost can limit its use in some cases. In this pictorial essay, we presented the use of ultrasonography as an alternative method for assessing PMC.

We present a series of images to demonstrate the value of ultrasonography and describe the methods used for assessing PMC with a particular focus on semimembranosus tendinopathy.

Keywords: posteromedial corner; ultrasound; knee

Introduction

Knee joint disorders can significantly impact an individual's quality of life. The posteromedial corner (PMC), located between the medial margin of the posterior cruciate ligament (PCL) and the posterior margin of the longitudinal fibers of the superficial medial collateral ligament (MCL) [1] can be sources for knee joint pain. PMC comprises five structures: the semimembranosus tendon and its expansions, the posterior oblique ligament, the oblique popliteal ligament, the posteromedial joint capsule, and the posterior horn of the medial meniscus [2]. Currently, the assessment of knee joint disorders typically relies on magnetic resonance imaging (MRI) as the standard diagnostic tool [3], but its availability and cost can limit its use in some cases.

In this pictorial essay we present our experience and expertise gained through many years of using ultrasound (US) in daily orthopedic practice. This work describes the methods used for assessing PMC with a particular focus on semimembranosus tendinopathy. To provide a clear representation of US, high-quality images acquired from our clinical practice were included.

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Ultrasound image of normal structures of the knee joint in the posteromedial corner

The structures of the PMC can be visualized under US, as illustrated in figures 1–4.

Figure 5 schematically illustrates the posterior oblique ligament anatomy and attachments of the semimembranosus tendon, which has five major arms. The US image of these structures is shown in figures 6 and 7.

Meniscus pathologies

The common meniscus pathologies include degenerative lesions, mechanical damage, and meniscal cysts [4-6].

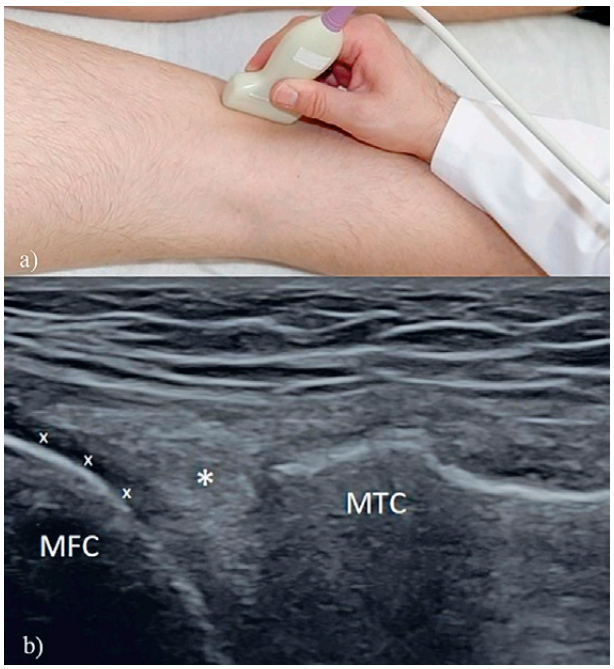

Fig 1. a) Correct positioning of the probe in the longitudinal plane over a posteromedial corner of the knee joint. b) Posteromedial structures in the longitudinal plane. MFC, medial femoral condyle; MTC medial tibial condyle; asterisk, posterior part of the medial meniscus; x, cartilage covering the posterior part of the medial femoral condyle.

The degenerative lesions of the meniscus are characterized by heterogeneous echogenicity, without visible lesions or fissures (fig 8).

In meniscus various forms of mechanical damage can be found, such as free-margin delamination, intrameniscal, radial, vertical, horizontal, flap, parrot beak and bucket-handle-type tears [7]. The intrameniscal tear is visualized in figure 9a. The common presentation of meniscal damage in the posterior region is a horizontal or oblique tear, which may be limited to the meniscus body or present as more extensive delamination. In cases of larger horizontal or oblique tears, contact with the inner surface of the joint may occur (fig 9b). This type of damage usually occurs in individuals over 40 due to degenerative changes, and is often associated with other abnormalities, particularly meniscal cysts or osteoarthritis [7].

In the posterior part of the meniscus, flap (fig 9c) and complex (fig 9d) tears may be present, with the flap usually originating from the lower part of a delaminated meniscus. In cases where pain occurs during physical activity and prolonged isometric exertion of the limb, meniscal tests are usually positive, and local tenderness may indicate the presence of a meniscal injury with a meniscal cyst (fig 9e,f). Radial lesions and bucket handle tears are typically found along the middle third of the meniscus.

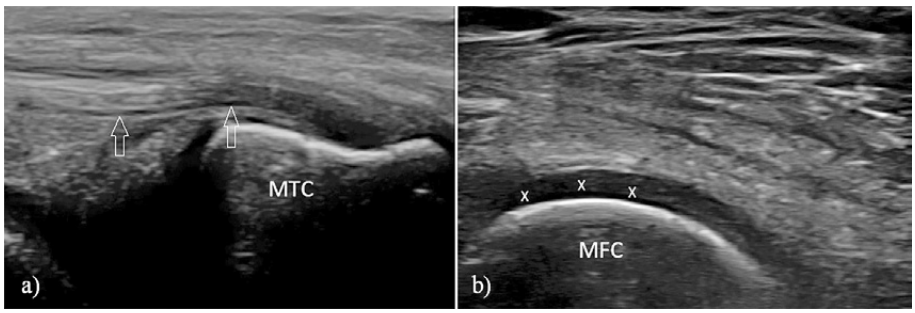

Fig 2. a) Distal semimembranosus attachment, direct part (empty arrows), and its attachment to the tubercle on the posterior surface of the medial tibial condyle (MTC) below the joint line; b) x, cartilage covering the posterior surface of the medial femoral condyle (MFC).

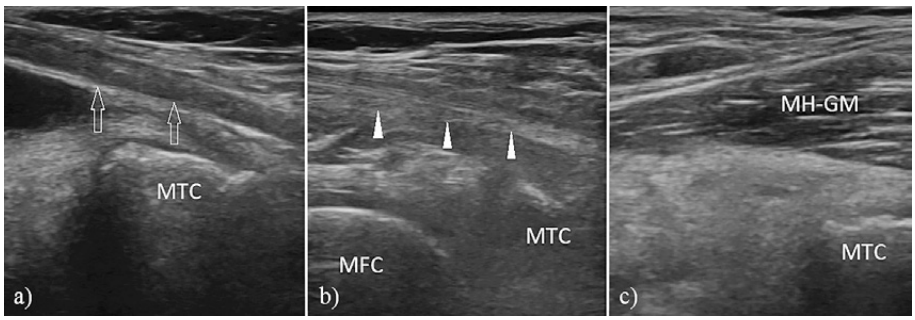

Fig 3. Longitudinal images of a) semitendinosus tendon (empty arrows); b) gracilis tendon (arrowheads); c) medial head of the gastrocnemius muscle (MH-GM). The gracilis tendon is thinner and located slightly more superficially than the semitendinosus tendon.

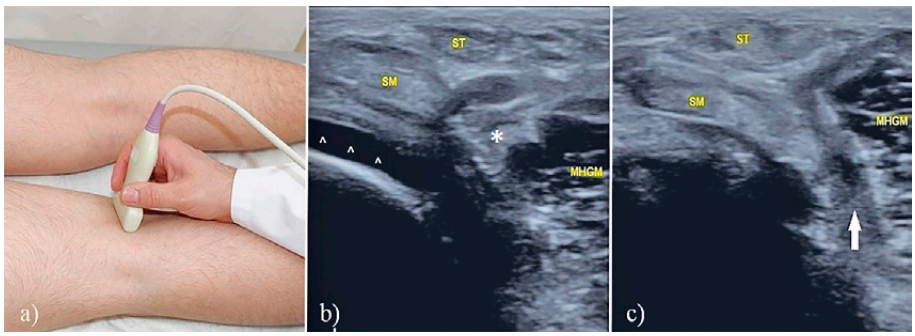

Fig 4. Cross-sections of posteromedial structures of the knee joint: a) positioning of the probe; b) the image at the level of the medial femoral condyle; c) the image at the level of the joint line. ST, semitendinosus tendon; SM, semimembranosus tendon; asterisk, tendinous part of the medial head of the gastrocnemius muscle; ^, cartilage of the medial femoral condyle; arrow, fluid-free gastrocnemius–semimembranosus bursa.

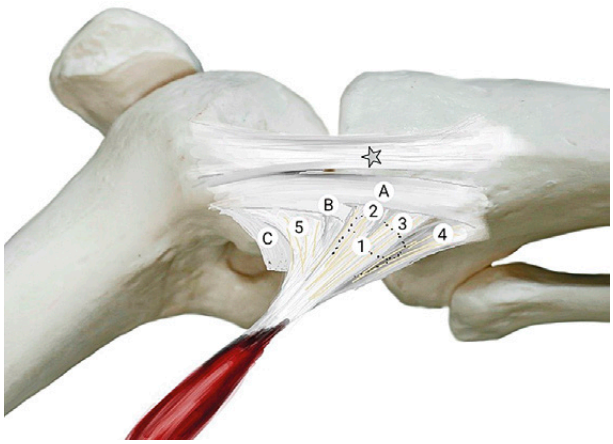

Fig 5. Schematic illustration of posteromedial corner structures. A–C - oblique ligament complex, A - distal (superficial) arm, B - central (tibial) arm, C- capsular (superior) arm; 1–5 attachments of semimembranosus: 1 (dotted) - direct (deep) arm, 2 - anterior (tibial) arm, 3 - inferior arm, 4 - distal attachment of inferior arm, 5 - capsular arm; star - medial collateral ligament.

Damage to the articular cartilage

Chondromalacia may be responsible for pain in the PMC. It is vital to assess the cartilage covering the surface of the medial femoral condyle in the supine position, including the front view of the femoral condyle, in maxi-

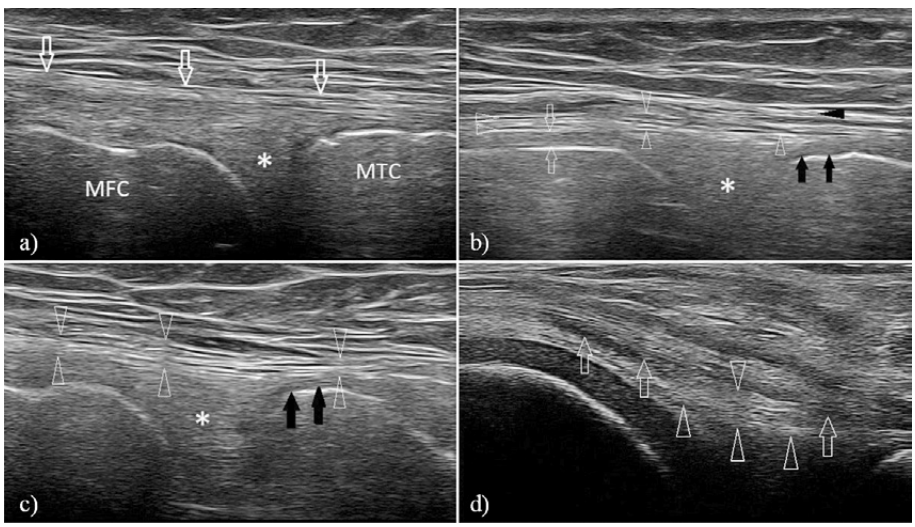

Fig 6. Ligaments of medial and posteromedial part of the knee: a) arrows, medial collateral ligament; asterisk, medial meniscus; MFC, medial femoral condyle; MTC, medial tibial condyle; b) unfilled arrowheads, distal (superficial) arm of posterior oblique ligament; unfilled arrows, joint capsule; black arrowhead, fascia; asterisk, medial meniscus; black arrows, meniscotibial ligaments; c) unfilled arrowheads, central (tibial) arm of posterior oblique ligament; asterisk, medial meniscus; black arrows, meniscotibial ligaments; d) relations between the capsular part of the posterior oblique ligament (arrowheads) and the capsular arm of the tendon of the semimembranosus muscle (arrows).

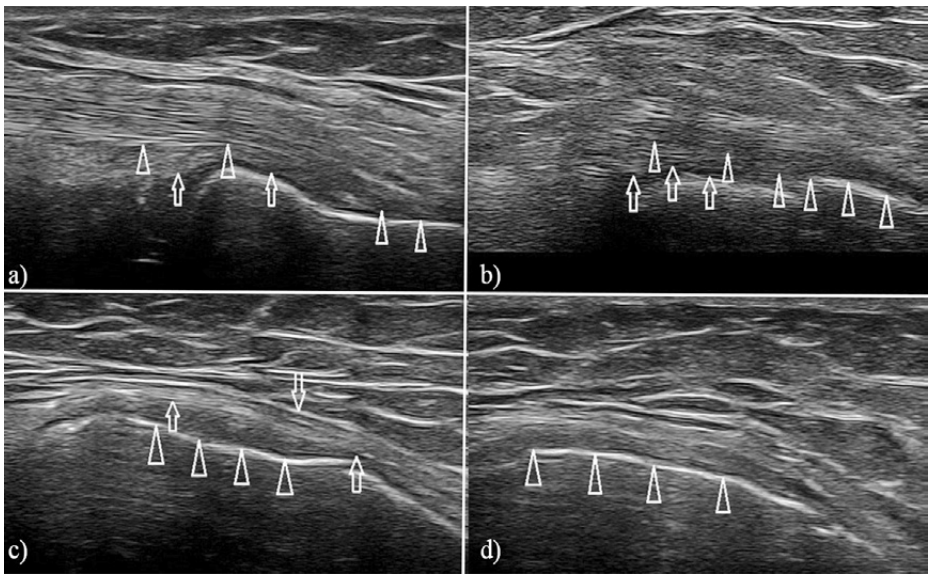

Fig 7. The posteromedial ligament and tendon structures: a) arrowheads, distal part and attachments of the direct arm of the semimembranosus tendon; arrows, central (tibial) arm of the posterior oblique ligament; b) arrowheads, distal part and attachment of the anterior arm of the semimembranosus tendon; arrows, central (tibial) arm of the posterior oblique ligament; c) arrowheads, inferior arm of the distal attachment of the semimembranosus tendon; arrows, distal (superficial) arm of the posterior oblique ligament; d) arrowheads, distal part and attachment of the inferior arm of the semimembranosus.

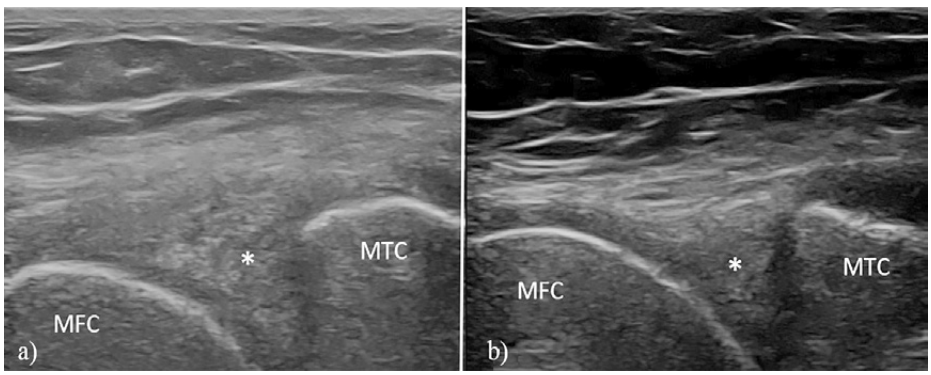

Fig 8. Examples of meniscus degeneration (a and b). Asterisk, heterogeneous echogenicity in the posterior part of the medial meniscus corresponding to degenerative changes; MFC, medial femoral condyle; MTC, medial tibial condyle.

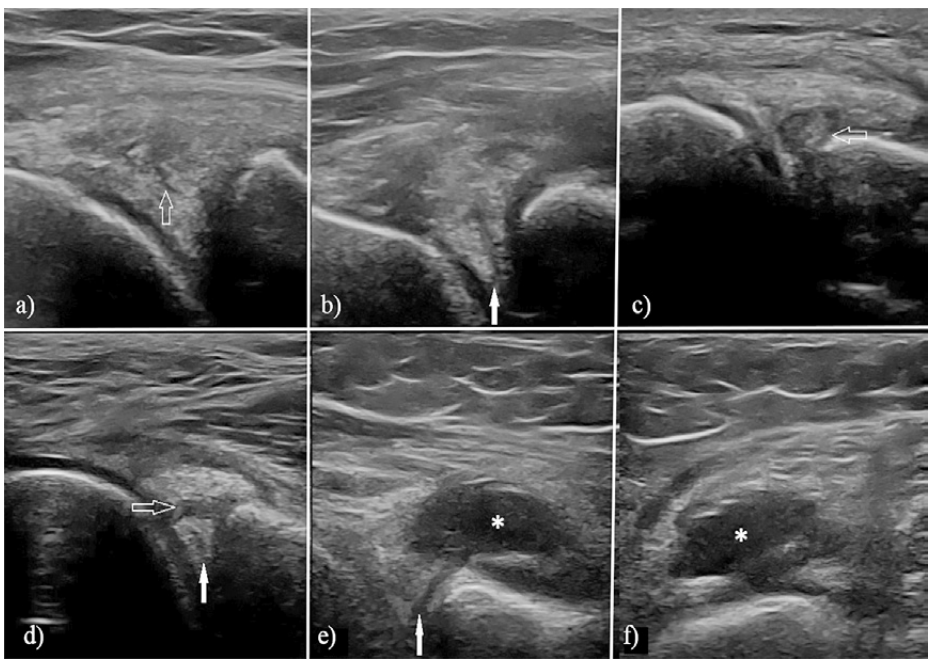

Fig 9. a) Unfilled arrow—intrameniscal tear (corresponding to type I lesion on magnetic resonance image—MRI); b) Horizontal tear with contact of the fissure (arrow) with the inside of the joint; c) "Flap" tear—unfilled arrow indicates a flap displaced under the meniscus, between its undamaged part, the joint capsule, the external surface and an articular margin of the medial condyle of the tibia; d) Complex tear—unfilled arrow indicates vertical and white arrow horizontal fissure of the tear; e) Longitudinal and f) transverse image of a meniscal lesion with cyst formation; white arrow—fissure of the tear; asterisk—the cyst filled with an anechoic fluid.

mum flexion over the entire width of the condyle, and both longitudinal and transverse sections. US presentations of successive grades of chondromalacia are shown in figure 10.

The US characteristics of healthy cartilage include: consistent thickness throughout the joint, anechoic or relatively hypoechoic structure, and a clearly visible outer layer.

Popliteal cysts

Popliteal cysts arising from the gastrocnemius-semimembranosus bursa can develop due to various pathological conditions, such as joint degeneration including chondromalacia, meniscal injury with exudation, rheumatoid arthritis, gout, or pigmented villonodular synovitis [8], as depicted in figure 11.

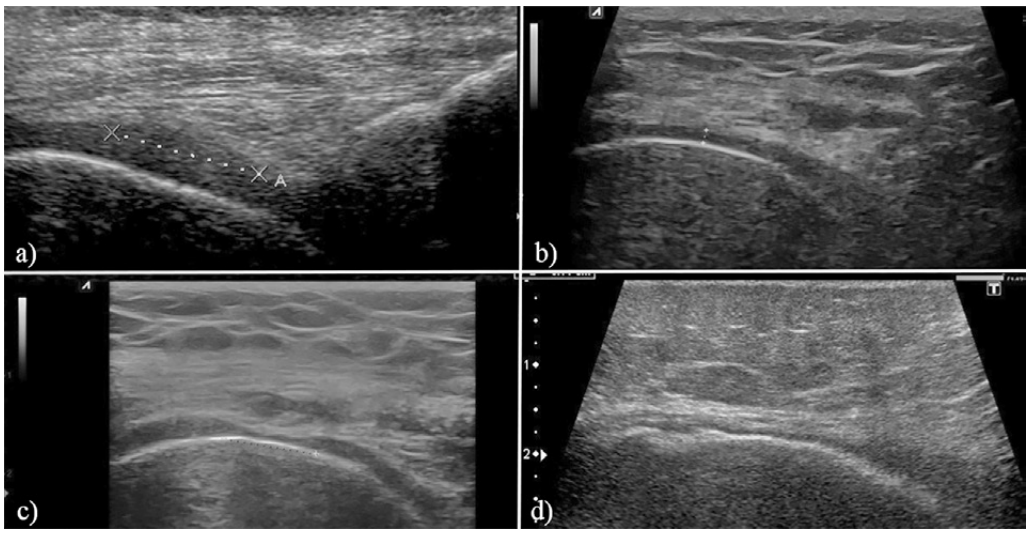

Fig 10. Chondromalacia: a) focal grade I - thickening and increased echogenicity of the cartilage; (b) grade II - reduced thickness and increased echogenicity of the cartilage; c) focal grade III - cartilage thickness reduction, a defect exceeding half of the thickness and increased echogenicity of the cartilage; d) grade IV - cartilage defects of full-thickness and irregularities in the surface of the bone.

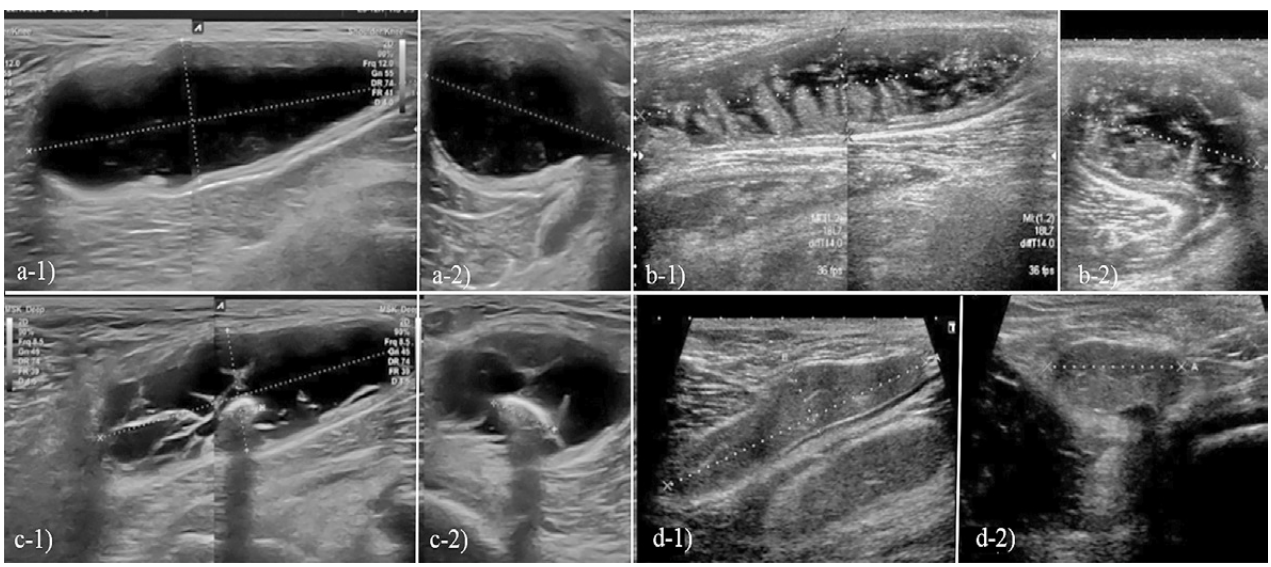

Fig 11. Different presentations of popliteal cysts. On each image, the left side (a-1, b-1, c-1, d-1) shows the longitudinal view and the right side (a-2, b-2, c-2, d-2) shows the corresponding transverse views. a) a simple cyst filled with anechoic fluid; b) a cyst in a rheumatoid arthritis patient, with a significant synovial proliferation; c) a cyst containing a loose body; d) a cyst filled with echogenic fluid (postoperative hematoma; the same contents were found in the joint cavity of the patient, a joint puncture confirmed that the contents inside were blood).

Clinical signs of a cyst include pain on the PMC with concomitant swelling in this area. However, swelling of the entire lower leg may occur after cyst rupturing (fig 12) [8].

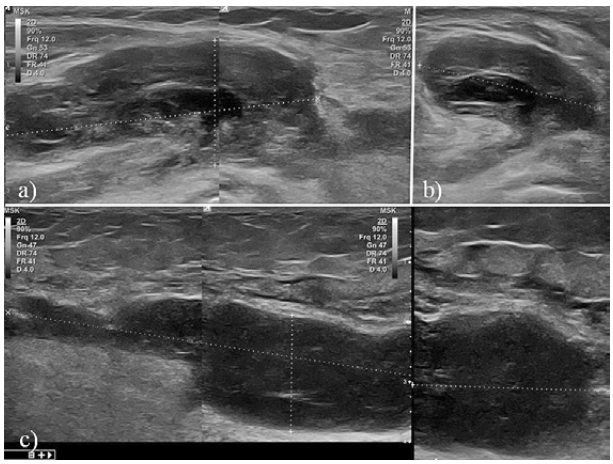

Fig 12. Ruptured popliteal cyst: a) longitudinal and b) transverse images of the main part of the cyst; c) Longitudinal scans showing fluid spreading distally in the soft tissues of the calf.

Semimembranosus tendinopathy

Overuse is the common cause of semimembranosus tendonopathy, which usually affects the distal portion of the tendon's straight part [5].

US examination typically reveals segmental thickening, decreased echogenicity, and the disappearance of fibrilar echostructure, (fig 13 and 14). Clinically, the disease presents as the tenderness and the pain on the posteromedial side of the joint, which usually worsens with flexion against resistance. The pain experienced during US examination triggered

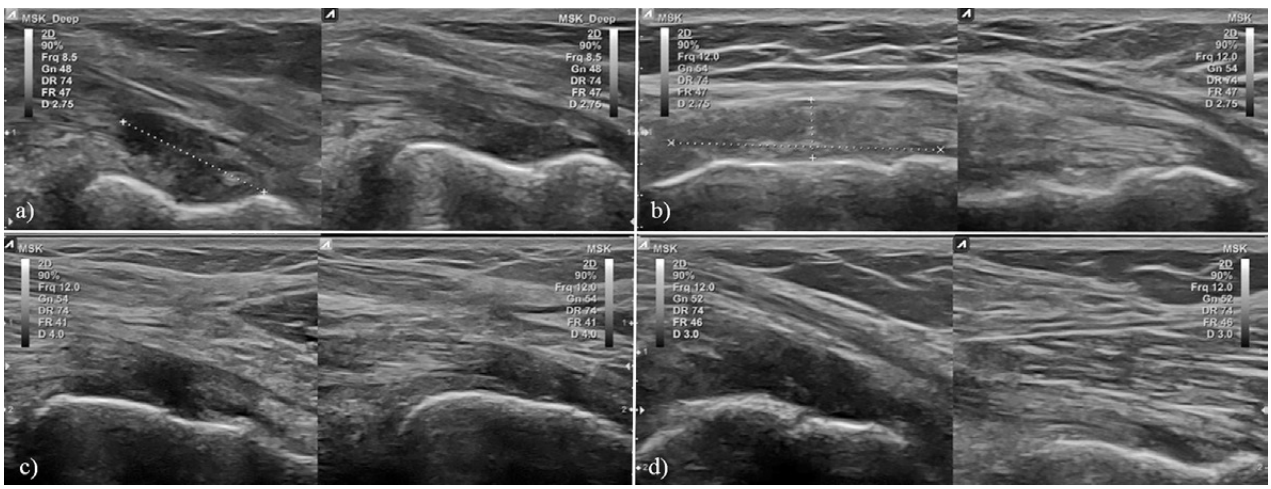

Fig 13. a–d) Comparative US examination showing affected (left) and healthy (right) tendons of the semimembranosus muscle. On the affected side, segmental thickening decreased echogenicity, and the disappearance of the typical filamentous echostructure is visible on each image.

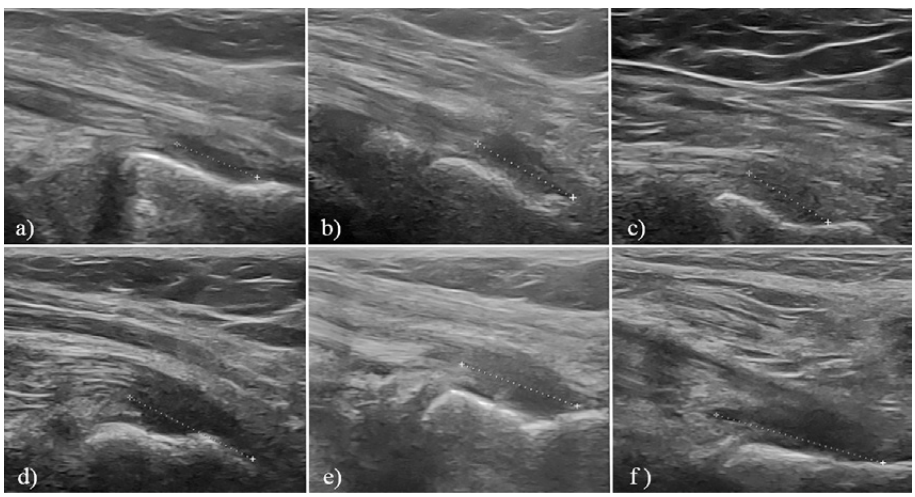

Fig 14. a–f) Six different studies of semimembranosus tendinopathy. The first image shows that only the deep half of the distal part of the tendon is affected with the disease; in the other cases, the entire thickness of the tendon is affected.

by relatively low pressure from the probe, can help differentiate semimembranosus tendinopathy from the meniscus damage , which usually causes pain during physical activity.

In **conclusion**, the PMC is a common location for knee joint pain, and accurate diagnosis is essential for appropriate treatment. . Our experience suggests that US can be a useful diagnostic tool for characterizing PMC. A multidisciplinary approach to diagnosis and treatment, involving clinicians, radiologists, and other healthcare professionals, is crucial for achieving optimal patient outcomes.

Conflicts of interest: none.

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