Pathological findings in rheumatic diseases

The ability of US to make an accurate evaluation of soft tissue involvement in a wide range of diseases of the locomotor system has led to its increasing widespread use in the field of rheumatology [1-10]. Significant technological progress has been made over the last few years, generating ever more sophisticated and reliable ultrasound machinery. The high resolution is now such that real *in vivo* histological examination is now possible. The main reason for the relative lack of wide diffusion of its use amongst rheumatologists is that a long training period is necessary in order to acquire full operator independence.

Initially, the use of US in rheumatology was limited to the identification of large collections of synovial fluid (popliteal cysts, bursitis) [11]. These collections can be easily identified even with 'first generation' US equipment that uses probes with frequencies between 3.5 and 5 MHz. These are, however, inappropriate for the study of superficial soft tissues. With the advent of the 'second generation' US machines, with 7.5 MHz linear probes, US can now explore larger joints. Clinical practice now includes the study of the shoulder, hip and knee has proven useful in the examination of large tendons (Achilles, long head of biceps and patellar tendon).

The potential applications of US in rheumatology have been further increased with the dawn of the 'third generation' US machines, equipped with very high-frequency probes (> 10 MHz). These can reach a spatial resolution of less than a tenth of a millimeter and make it possible to study the finest details of the smaller joints and hand tendons which are involved early on in chronic arthritis.

5.1 Osteoarthritis

Several sonographic abnormalities may be observed in patients with osteoarthritis. These include changes within cartilage, joint cavity widening resulting from fluid collection with or without synovial proliferation, and osteophytes [12-14].

Changes within cartilage

Loss of the thin, sharp contour of the superficial margin of the cartilaginous layer is one of the early features of osteoarthritis. US is exquisitely sensitive in detecting structural changes within different tissues and can reveal fibrillation and cleft formation in osteoarthritis (Fig. 5.1) [15].

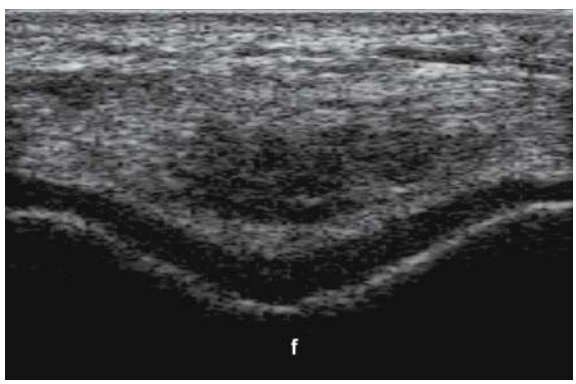

Fig. 5.1

Osteoarthritis. Supra-patellar transverse scan with knee in maximal flexion shows loss of the normal clarity of cartilage layer together with blurring of the superficial margin of the femoral condylar cartilage. *f* = femur

Increased echogenicity with patchy or diffuse loss of clarity may be seen even in patients without any other findings to indicate damage to the cartilage structure. These changes would seem to reflect structural alterations such as fibrillation of cartilage and cleft formation [13]. Particular attention should be paid to distinguish these early findings in osteoarthritis from artifacts caused by inaccurate setting (gain level) or probe position [16].

A slight increase in cartilage thickness caused by inflammatory edema in the early phases of osteoarthritis has been noted [13]. Variable narrowing of the cartilaginous layer is detectable in patients at a more advanced stage of the disease. Cartilage thinning may be focal, or extend along the entire cartilaginous layer (Fig. 5.2).

US measurement of femoral condyle articular cartilage thickness could be of practical benefit for an early diagnosis of osteoarthritis. Accurate quantification of cartilage thickness cannot always be obtained in patients with advanced osteoarthritis because of poor visualization of the cartilage-synovial space interface. Complete cartilage loss can be observed in advanced disease (Fig. 5.3) [12, 13, 17].

Supra-patellar scanning of weight-bearing areas can be difficult in patients with advanced osteoarthritis and/or painful knee, resulting in limited maximal active flexion [15-18]. Diagnostic accuracy in the detection and grading of cartilage abnormalities should be the subject of further research. The knee and the metacarpophalangeal joints are the locations in which US can best demonstrate the various evolutionary phases of cartilage involvement in osteoarthritis.

The articular cartilage of the metacarpal head can be evaluated by longitudinal and transverse dorsal scans, with the metacarpophalangeal joint held in maximal active flexion. Standard longitudinal dorsal and volar scans may also be useful.

Proximal and distal interphalangeal joints are generally evaluated by means of longitudinal and transverse dorsal scans with the finger in a neutral position. US with high frequency probes allows for an in-depth study of these joints, even if only a limited portion of the cartilage can be explored, due to the acoustic barriers (Fig. 5.4 a, b, c)

Joint effusion

Small to moderate joint effusions are commonly found in patients with osteoarthritis (Figs. 5.5, 5.6, 5.7). Minimal fluid collections that may be missed on clinical examination are easily detected by US. Synovial fluid is usually anechoic. Non-homogeneous echogenicity of synovial fluid and/or echogenic spots with or without acoustic shadowing can be generated by proteinaceous material, cartilage fragments, crystal aggregates and calcified loose bodies.

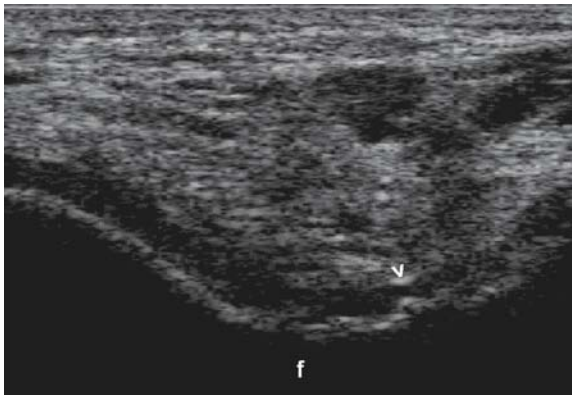

Fig. 5.2

Osteoarthritis. Supra-patellar transverse scan with knee in maximal flexion demonstrates focal cartilage thinning (*arrowhead*) and marked irregularity of the subchondral bone. *f* = femur

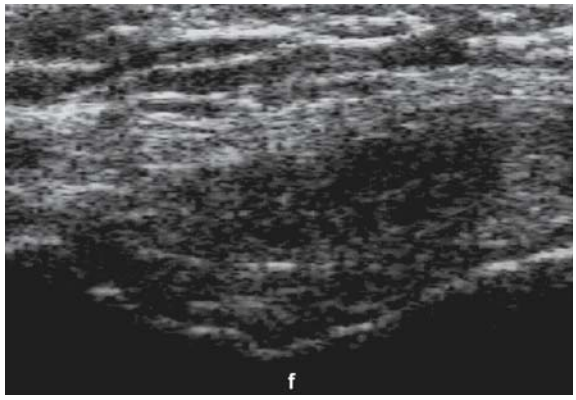

Fig. 5.3

Osteoarthritis. Supra-patellar transverse scan with knee in maximal flexion shows complete loss of cartilage. *f* = femur