Equipment and examination technique

1.1 Equipment

Ultrasound (US) is one of the best imaging techniques in musculoskeletal radiology because it is low in cost, has high spatial resolution, wide availability in hospitals, is well-tolerated by patients and is not biologically invasive, as it uses sound waves and non ionizing radiation, as in conventional radiology or computed tomography (CT). These features make ultrasound the ideal technique for the diagnosis and follow up of many pathologies and rheumatic syndromes and for the evaluation of the effects of therapy.

The high diagnostic value of ultrasound is strictly related both to the operator's knowledge of normal anatomy and to the effectiveness of ultrasound equipment to depict anatomical details (Fig. 1.1 a-c).

For this reason, the equipment and transducers' characteristics become very important when studying small and superficial structures, such as flexor and extensor tendons in fingers, which are very difficult to assess with other imaging techniques because of their superficial location.

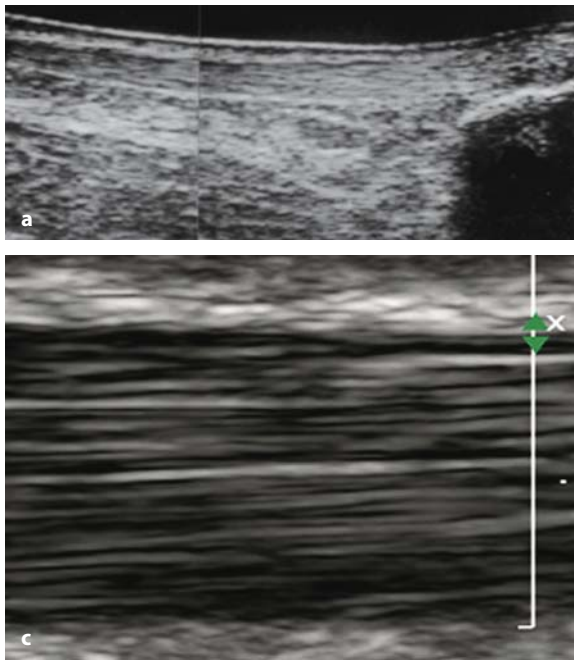
The most recent generation of ultrasound equipment allows highly detailed depiction of structures located just a few millimeters from the transducer.

New generation transducers may reach very high frequencies (up to 20 MHz), that allow the evaluation of submillimetric structures, such as tendon pulleys (Fig. 1.2).

The availability of new multifrequency probes allows the simultaneous study of both superficial and deep structures, granting a good penetration of ultrasound waves through the tissues.

Assistance can be given by a silicone spacer or by a thick layer of gel when using old equipment (e.g. transducers under 10 MHz frequency).

Musculoskeletal sonography should be per-



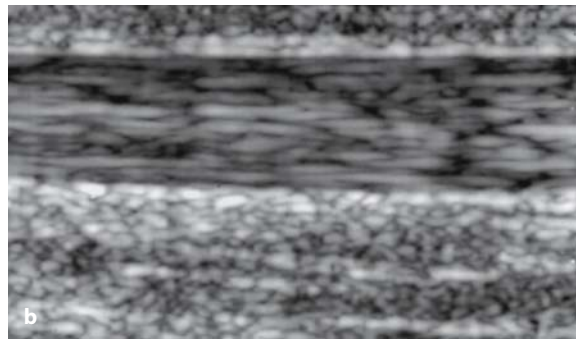


Fig. 1.1 a-c

Evolution in the resolution capability of tendon fibrillar echotexture. **a** Image obtained with ultrasound equipment from the early 90s: it is panoramic but has low spatial resolution. **b** Image obtained using ultrasound equipment from the late 90s with a good demonstration of the fibrillar echotexture. **c** Image obtained using the most recent generation of ultrasound equipment, showing great anatomical detail

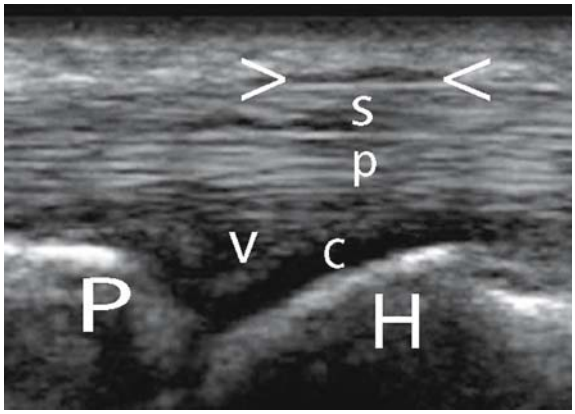


Fig. 1.2

High resolution longitudinal US scan of flexor digitorum communis: the *arrowheads* indicate the 1st reflection pulley. *H* = metacarpal head; *P* = proximal phalanx; *v* = volar plate; *c* = cartilage; *s* = flexor digitorum superficialis; *p* = flexor digitorum profundus

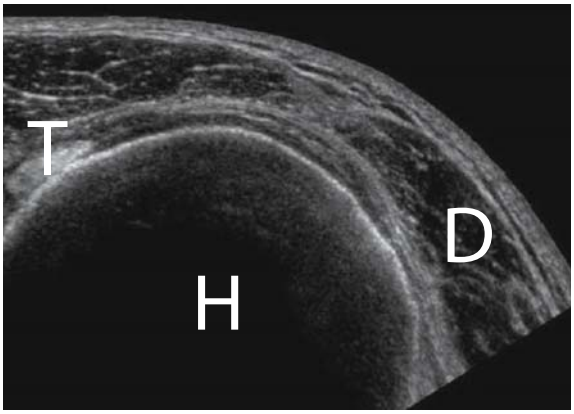


Fig. 1.3

EFV US scan of a shoulder that shows most of the humeral head (*H*), and the superficial tissues in a massive rotator cuff rupture. *T* = long head of biceps tendon; *D* = deltoid

formed with an excellent superficial definition (5 millimeters at least), because incorrect depiction of skin and subcutaneous tissue may cause artifacts and compromise the evaluation of clinical findings.

We suggest the use of ultrasound equipment with a very high-frequency transducer to assess the most superficial structures and a multifrequency transducer (about 7.5-12.5 MHz) to obtain a general evaluation of those deep musculoskeletal structures that cannot be easily studied with a very high frequency transducer.

When studying rheumatic diseases, it is mandatory to use ultrasound machines provided with a color and power Doppler module (low speed flows) to assess the synovial, tendinous or muscular inflammatory hyperemia [1-3]. Equally important is the set up for the use of contrast agents, which is particularly useful in the follow-up of the therapy [4, 5].

The visualization of images can be improved with different softwares, such as extended field of view (EFV), multi-planar bidimensional (MPR) and three-dimensional reconstruction (3D). These reconstruc-

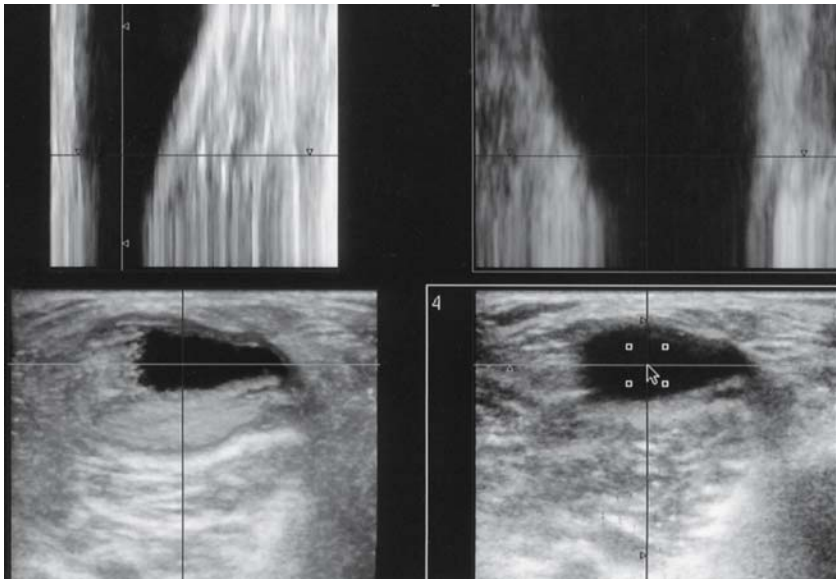


Fig. 1.4

Bidimensional MPR on three different spatial planes of a subfascial fluid collection following a muscular tear