Musculoskeletal ultrasound

Used to best advantage

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BACKGROUND
Effective management of both acute and chronic musculoskeletal pain revolves around a good history and physical examination, as well as a more detailed knowledge of anatomy than is required in other related medical disciplines. Imaging – if indicated – should not be looked upon as the panacea for problem solving but needs to be considered in the light of what a particular modality is best designed to do.

OBJECTIVE
In the practice of cost effective medicine, a specific imaging modality must be chosen on the basis that it is the best economically to provide the information sought which in turn allows the formulation of an appropriate management plan.

DISCUSSION
Ultrasound imaging has many advantages over other modalities for assessing musculoskeletal dysfunction. The major advantages are no radiation, 'real time' allows visualisation of functioning tissue, and it is the gold standard for assessing tendons. The most expensive or latest imaging modality is not always the most appropriate.

A patient presenting with musculoskeletal pain or dysfunction often requires a decision to be made as to whether or not to image, and which imaging would most assist the management of the presenting problem. General practitioners are often pressured by patients to 'do something', especially when the pain adversely affects daily function.

There is an unfortunate impression that magnetic resonance imaging (MRI) reveals all and patients may need to be informed that a 'horses for courses' approach applies. Resorting to imaging in the hope of discovering the pathology underlying pain and dysfunction when the presentation is difficult to resolve is not good medical practice. On rare occasions there may be some justification in using a particular modality mainly to reassure an anxious patient that the tissues concerned appear normal.

Ultrasound imaging is one of many modalities which – when used wisely – can benefit both patient and practitioner.

Ultrasound images result from a hand transducer sending out sound waves and recording their 'echo', which varies due to pitch and direction of the sound secondary to the tissue type. Reflection from bone is white, while fluid collections are black with varying degrees of grey relating to other tissue types.

The first clinical application of ultrasound was to differentiate a Baker cyst from a deep vein thrombosis. Since then, its major use is in assessing fluid collections, hernias, torn ligaments, partial and full tendon ruptures, cysts, cartilage tears, presence of foreign bodies, dislocated tendons, swellings within muscle, and clinical inflammation versus noninflammatory joint disease. It has no place in assessing bony pathology.

When considering ultrasound for musculoskeletal dysfunction, the practitioner's decision should be based on a knowledge of the advantages and limitations of this imaging modality.

Advantages and limitations

The advantages of ultrasound include:

- low cost compared with computerised tomography (CT) and MRI

- no radiation
- readily available
- no contraindications
- physical contact with the patient at all times
- real time allows visualisation of tissue function
- use as a guide for biopsy, aspiration and injecting
- ability to perform provocative manoeuvres to reproduce the patient's pain
- more sensitive than X-ray in detecting rheumatoid erosion, and
- good for assessing soft tissues in the presence of hardware such as plates, screws, prostheses.

Limitations include:

- the inability to define pathology in bone, and
- the high degree of operator dependence.

Assessing the expertise of the radiology service may not be easy but some clues can be found in reports, which should reflect:

- a knowledge of the anatomy relating to the presentation
- an awareness of normal variants and scan artefacts
- equipment with a transducer frequency of at least 7 MHz, lateral resolution and noise suppression
- a comparison with the other side using identical landmarks
- an awareness that many of the changes seen may have no clinical relevance
- pathology on the hard image if possible.

Ultrasound appearance of soft tissue structures

Skeletal muscle

On ultrasound the muscle fibres – fasciculi – appear hyperechoic (black) with the surrounding tissue layers hypoechoic (white) which produces the striped appearances when the muscle is examined along its length showing alternating bands of dark fasciculi and white perimysium.

Ultrasound readily defines muscle fibres and can better localise and assess partial versus complete muscle rupture. It is also useful in detecting scars, calcifications, myositis ossificans, serous cysts and hernias.

Tendon

Ultrasound has become the gold standard for assessing tendons and has the advantage of allowing dynamic assessment (*Figure 1, 2*). Tears, tenosynovitis and paratenonitis are the routine domain of ultrasound, as is the follow up of tendon repair. The use of colour Doppler ultrasound can detect very small neovessels in patellar and Achilles tendinoses. Neovessels have been associated with pain, and their disappearance with improvement.

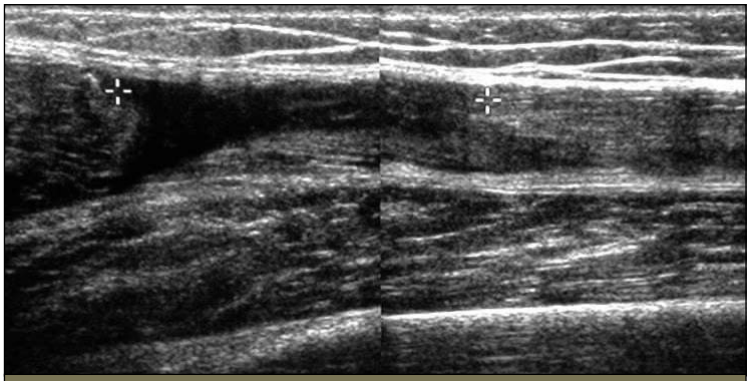

Figure 1. Longitudinal view of Achilles tendon showing full thickness tear at the musculotendinous junction. The gap is between the two crosses. Tendon is on the right, muscle on left. Flexor hallucis longus muscle lies deep to Achilles

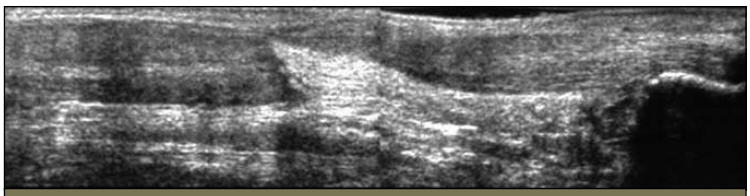

Figure 2. Longitudinal view of Achilles showing mid tendon rupture. The two ends of the torn tendon just touch. Distal tendon to the right, inserting onto calcaneum

An important and valuable property of a tendon is anisotropy, whereby the reflection of sound waves at different angles produces variable response. In inexperienced hands, this may lead to false diagnosis, such as the erroneous report of a rupture.

Peripheral nerve

Nerves and tendons have a similar appearance on ultrasound but can be differentiated by tendon movement induced by active contraction of muscle as well as by anisotropy; the nerve is visualised while the tendon may black out.

The diagnostic utility of ultrasound is the painless assessment of nerve entrapments. Structures frequently assessed include the:

- median nerve in the carpal tunnel
- ulnar nerve in Guyon's canal
- common peroneal nerve at the fibular head, and
- posterior tibial nerve in the tarsal tunnel, as well as the possible presence of a neuroma.

Soft tissue masses

Ultrasound cannot readily differentiate the tissue type but has a valuable role in:

- confirming the presence and size of a mass
- differentiating diffuse oedema from a localised mass
- differentiating a solid from a cystic mass
- guiding needle biopsy or aspiration
- monitoring response to therapy
- determining the presence of muscle tears or ruptures.

Blood flow within a mass can be determined using colour Doppler ultrasound that identifies the origin and pattern of the vascular supply.

Joints and surrounding structures

Disruption of intra-articular cartilage can be detected earlier than by any other modality. Dynamic ultrasound shows the movements within the joint as well as the integrity of the related tendons and ligaments. Plain ultrasound is very reliable in revealing intra-articular swelling as well as in the surrounding bursae and can evaluate tears in ligaments and tendons.

Summary of important points

- Effective management of musculoskeletal pain revolves around a thorough history and an appropriate physical examination.
- A reliable physical examination necessitates a detailed knowledge of anatomy and biomechanics.
- An imaging modality is chosen because it is the best suited for the specific investigation.
- Ultrasound is the only imaging modality that allows assessment of surrounding tissues on movement of a joint.
- Free from ionising radiation, ultrasound is a safe guide for joint injections and aspirations as well as soft tissue biopsies.

Further reading

This article was based on van Holsbeek MT. Musculoskeletal ultrasound. 2 edn. St Louis Mosby, 2001.

Conflict of interest: none declared.

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