Ultrasound imaging for the rheumatologist
XI. Ultrasound imaging in regional pain syndromes

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ABSTRACT
Regional pain syndromes (RPS) are common complaints in clinical rheumatological practice. Ultrasound (US) allows a detailed assessment of soft tissue involvement and its use may have considerable impact on the management of RPS. The present review provides an update of the available data about US imaging in RPS together with research issues relating to periarticular soft tissue pathology. The research agenda covers: definition of standard scanning protocols for US examination of the most common RPS assessed by the rheumatologist and the clinical impact of US findings in the management of patients with RPS.

Clinical applications
A list of the most common RPS together with the corresponding pathological conditions that may be revealed by US is presented in Table I. Different pathological conditions may manifest with similar clinical features and US assessment may be critical for the identification of the involved tissue and its pathology (9). In cases with tendon pathology, for example, US can demonstrate tenosynovitis, calcific tendinopathy, partial or complete tears and tendon dislocation. Moreover, in the clinical setting of a suspected tendon rupture, US can provide quantitative findings which may direct the rheumatologist in the management approach. Furthermore, power Doppler permits the detection of active inflammation with the demonstration of local increased perfusion. US is also useful for needle guidance during fluid aspirations, biopsies and intra or periarticular injections. Finally, US can be used for monitoring the effects of specific local therapeutic approaches including intra and periarticular injections or ‘eccentric loading’ training programmes for treating Achilles tendinopathy (10-13).

There are some limitations to the use of US in RPS that must be borne in mind. US findings are strongly dependent on both the operator experience and the quality of the equipment. Furthermore, some pathological lesions, especially those related to trauma, may not be detectable by US due to an inadequate acoustic window (i.e. cruciate ligaments and, anterior part of the glenoid labrum).

Competing interests: none declared.
Calcific tendinopathy
Oedema of the subcutaneous soft tissues
Proximal interphalangeal joint inflammation
Pes anserine tendinopathy
Pes anserine bursitis
Infrapatellar bursitis
Prepatellar bursitis
Calcification of the triangular fibrocartilage complex
Tenosynovitis of the flexor carpi radialis tendon
Synovitis, arthrogenic cyst
Plantar fasciitis
Retrocalcaneal bursitis
Calcaneal enthesopathy
nous xanthomas or tophi
Subdeltoid bursitis
Tophaceous deposits
Synovitis of the wrist
Tenosynovitis of the finger extensor tendons, including De Quervain’s tenosynovitis
Carpo-metacarpal joint pathology
Radio-ulnar, radio-carpal and intercarpal joint pathology (i.e. joint effusion, synovitis, arthrogenic cyst)
Carpometacarpal joint pathology (i.e. joint effusion, synovitis, osteophytes)
Tenosynovitis of the finger extensor tendons, including De Quervain’s tenosynovitis
Tenosynovitis of the flexor carpi radialis tendon
Calcification of the triangular fibrocartilage complex
Patellar tendon pathology (i.e. calcification, partial tear, tophaceous deposits)
Prepatellar bursitis
Infra-patellar bursitis
Enthesopathy of both the upper and lower poles of the patella
Pes anserine bursitis
Pes anserine tendinopathy
Finger flexor tendons (i.e. tenosynovitis, tendon tear)
Proximal interphalangeal joint inflammation
Oedema of the subcutaneous soft tissues
Humeral enthesopathy
Humeral head fractures
Acromio-clavicular joint pathology
Gleno-humeral joint pathology
Rotator cuff pathology
Long head of the biceps tendon pathology
Median nerve pathology
Tenosynovitis of the finger flexor tendons
Synovitis of the wrist
Tophaceous deposits
Aberrent muscle
Long head of the biceps tendon pathology (i.e. complete or partial tear, tenosynovitis, tendon dislocation)
Rotator cuff pathology (i.e. complete or partial tear, calcification)
Subdeltoid bursitis
Gleno-humeral joint pathology (i.e. joint effusion, synovitis, osteophytes)
Acromio-clavicular joint pathology (i.e. joint effusion, synovitis, osteophytes)
Humeral head fractures (i.e. greater tuberosity fracture, Hill-Sachs impact fracture)
Achilles tendinopathy (i.e. complete or partial tear, calcification, intratendinous xanthomas or tophi)
Calcaneal enthesopathy
Retrocalcaneal bursitis
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Oedema of the subcutaneous soft tissues
Humeral enthessopathy
Calcific tendinopathy
Table I.
Regional pain syndromes and pathological conditions detectable by ultrasonography.

<table>
<thead>
<tr>
<th>Regional pain syndrome</th>
<th>Pathological conditions detectable by ultrasonography</th>
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<tbody>
<tr>
<td>Carpal tunnel syndrome (9, 22-26)</td>
<td>Median nerve pathology, Tenosynovitis of the finger flexor tendons, Synovitis of the wrist, Tophaceous deposits, Aberrent muscle</td>
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<tr>
<td>Painful shoulder (2, 9, 15-21)</td>
<td>Long head of the biceps tendon pathology (i.e. complete or partial tear, tenosynovitis, tendon dislocation), Rotator cuff pathology (i.e. complete or partial tear, calcification), Subdeltoid bursitis, Gleno-humeral joint pathology (i.e. joint effusion, synovitis, osteophytes), Acromio-clavicular joint pathology (i.e. joint effusion, synovitis, osteophytes), Humeral head fractures (i.e. greater tuberosity fracture, Hill-Sachs impact fracture)</td>
</tr>
<tr>
<td>Heel pain (3, 30-33)</td>
<td>Achilles tendinopathy (i.e. complete or partial tear, calcification, intratendinous xanthomas or tophi), Calcaneal enthesopathy, Retrocalcaneal bursitis, Plantar fasciitis</td>
</tr>
<tr>
<td>Wrist pain (9, 22, 34-36)</td>
<td>Radio-ulnar, radio-carpal and intercarpal joint pathology (i.e. joint effusion, synovitis, arthrogenic cyst), Carpo-metacarpal joint pathology (i.e. joint effusion, synovitis, osteophytes), Tenosynovitis of the finger extensor tendons, including De Quervain’s tenosynovitis, Tenosynovitis of the flexor carpi radialis tendon, Calcification of the triangular fibrocartilage complex</td>
</tr>
<tr>
<td>Anterior knee pain (9, 37-39)</td>
<td>Patellar tendon pathology (i.e. calcification, partial tear, tophaceous deposits), Prepatellar bursitis, Infra-patellar bursitis, Enthesopathy of both the upper and lower poles of the patella, Pes anserine bursitis, Pes anserine tendinopathy</td>
</tr>
<tr>
<td>Sausage finger (9, 22, 40)</td>
<td>Finger flexor tendons (i.e. tenosynovitis, tendon tear), Proximal interphalangeal joint inflammation, Oedema of the subcutaneous soft tissues</td>
</tr>
<tr>
<td>Lateral and medial epicondylitis (41)</td>
<td>Humeral enthessopathy, Calcific tendinopathy</td>
</tr>
</tbody>
</table>

**Fig. 1.** A. Dactylitis due to tenosynovitis of the finger flexor tendons (FT) involving the 3rd finger of the hand. MC: metacarpal bone; PP: proximal phalanx; MP: middle phalanx; DP: distal phalanx. B. Painful shoulder with partial thickness tear (arrow) of the subscapularis tendon (ST). H: humerus. C. Lateral epicondylitis: enthesopathy of the common extensor tendon (ET) with tendon thickening and hypoechogenicity, presence of calcifications and enthesophyte (arrow). H: humerus.

For further ultrasound images, please go to www.clinexprheumatol.org

**Literature review**

Since the earliest US investigations of popliteal cysts, the indications for US have steadily increased. Currently the literature to date would strongly support the use of US in the assessment of several types of RPS, including painful shoulder, carpal tunnel syndrome, heel pain, wrist pain, sausage finger, anterior knee pain and lateral and medial epicondylitis (Table I) (14-41). US can sensitively identify the anatomical structure involved and assess the extent of the lesion.

The shoulder has been the subject of multiple US investigations to date. In experienced hands US is a reliable imaging modality for assessing shoulder abnormalities such as bicipital tendon involvement, rotator cuff tears, bursitis, gleno-humeral joint inflammation and humeral head fractures (15-21). When compared to physical examination, US demonstrates higher accuracy in the diagnosis of peri-articular shoulder lesions (15). Using US as the gold standard, sensitivity of physical examination was low (less than 20%) for the detection of supraspinatus tendon tears and other studies show that it can vary between 33% to 100% (16). Physical examination does, however, have a specificity of 100% for the recognition of supraspinatus tendon tears but is unable to differentiate partial from full thickness tears. This can be explained by the specific experience of the operator, the variable quality of the equipment and the gold standard (i.e. arthrography, surgical intervention, MRI) used to confirm the US findings.

In patients with carpal tunnel syndrome, US has been proposed as first step in the diagnostic work-up after clinical examination. US provides information on both median nerve and carpal tunnel pathology. Cross-sectional studies using electromyography as the gold standard, demonstrated the efficacy of US in detecting median nerve neuropathy (22-25). US measurement of median nerve cross-sectional area correlates well with EMG findings.

Normal value has been determined as less than 10 mm² while an area higher than 15 mm² is an indicator for surgical intervention in some centres (22-26).
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References
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