(ii) Shoulder and elbow imaging

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Abstract

The shoulder is a ball and socket joint, the stability of which is predominantly conferred by surrounding soft tissue. The majority of clinical symptoms in the shoulder are either instability related or impingement syndrome in the subacromial area.

The elbow is a complex hinge joint with three individual articulations. It is surrounded by a number of tendons and, like the shoulder, joint stability is maintained by multiple ligaments. Trauma, tendinopathy and systemic diseases can affect the elbow joint.

Imaging plays an invaluable role in patient management. The plain radiograph, although being a very useful baseline investigation having reasonable clinical use, has its limitations. The mainstay of shoulder and elbow imaging is US and MRI.

The following article outlines common and slightly uncommon shoulder and elbow pathologies and their imaging appearances.

Keywords CT; MRI; plain radiographs; tear; tendinopathy; US

Introduction

The shoulder joint is a ball and socket joint with a large range of movement. The shallow glenoid is small compared with the large humeral head, comparable to a tee and golf ball: the area of glenohumeral contact is only about one-third of the total head surface.[1] The shallow nature of the joint limits mechanical stability; joint stability is therefore highly dependent on the joint musculature, tendons, ligaments, and cartilage including the labrum, which deepens the glenoid articulation.

Furthermore the acromion, coracoid, and coracoacromial ligament form a bony-ligamentous coracoacromial arch. Movement of the humerus may impinge the rotator cuff tendons against the coracoacromial arch.[1]

The vast majority of shoulder joint pain is therefore related to instability and impingement syndrome along with other causes.

Plain films remain an initial investigation and are readily available. They play a key role in identifying bone abnormalities and although there are limitations in identifying soft tissue abnormalities, can identify secondary signs of soft tissue pathology such as impingement syndrome, calcific tendinopathy and others.[2] CT, although sensitive in trauma scenarios, has limitations in studying soft tissue details, resulting in limited use for shoulder imaging. CT can also be useful in quantifying degenerative disease. Although MR arthrogram (MRA) is superior, CT arthrogram is performed where MR imaging is contraindicated.

Currently the mainstay of shoulder imaging is US and MR. US is good to assess soft tissue abnormalities such as tendinopathy, tendon tear and bursitis. The diagnostic accuracy for full thickness rotator cuff tears can reach 100% and 91% for partial thickness tears, and are comparable with MR.[3] However, accuracy can be variable, depending on the inter-observer variability between the individuals performing the US examination. Dynamic imaging is a further advantage of US.

MR imaging is widely used to assess shoulder pain. A large number of studies have described MR imaging in the assessment of rotator cuff, labrum, capsule, biceps tendon, articular cartilage, ligament and bone marrow abnormalities.[1,2,4] Unenhanced MR, indirect and direct MRA are different ways of assessing the shoulder joint. Additionally, there is no statistically significant difference between the sensitivities and specificities of MR versus US in diagnosing either full- or partial thickness tears. The jury is still out regarding the choice of either ultrasound or MR for studying the rotator cuff. Clinical examination and arthroscopy remain the gold standard for evaluation of shoulder instability and the glenoid labrum; however MR has 92% specificity in predicting labral abnormalities and is increasingly preferred preoperatively.[4] MR is contraindicated in patients who have a cardiac pacemaker, ferromagnetic foreign bodies (particularly in the orbit), and some cochlear implants.

The imaging of the elbow joint follows a similar pattern. Despite advances in elbow imaging with MR, US and CT, conventional radiography remains the most appropriate initial imaging technique for the elbow and its disorders. The ability to visualize the elbow in multiple planes has favoured MR and CT, which allows exquisite detailed imaging of the bone, cartilage, ligaments and tendons around the elbow. US is effective in the evaluation of soft tissue and also for performing US guided injections and interventions.

Impingement syndrome

To understand impingement syndrome, particular emphasis should be given to the subacromial space. The subacromial space contains the tendons of the supraspinatus, anterior fibres of infraspinatus, the long head of biceps, and the subacromial subdeltoid (SASD) bursa.

The common MR imaging finding is abnormal configuration of the acromion in impingement syndrome which includes an inferiorly projecting hook, anterior down sloping, low lying acromion, inferolateral tilt and Os-acromiale. Degenerative changes in the acromio clavicular joint and thickening of the coracoacromial ligament can also lead to subacromial impingement.[5,6]

The supraspinatus tendon is affected far more commonly than other tendons (Figure 1). Impingement can cause mucoid degeneration and partial or full thickness tears. Tendon abnormalities may exist without structural or mechanical causes of impingement. The long head of biceps tendon can also be

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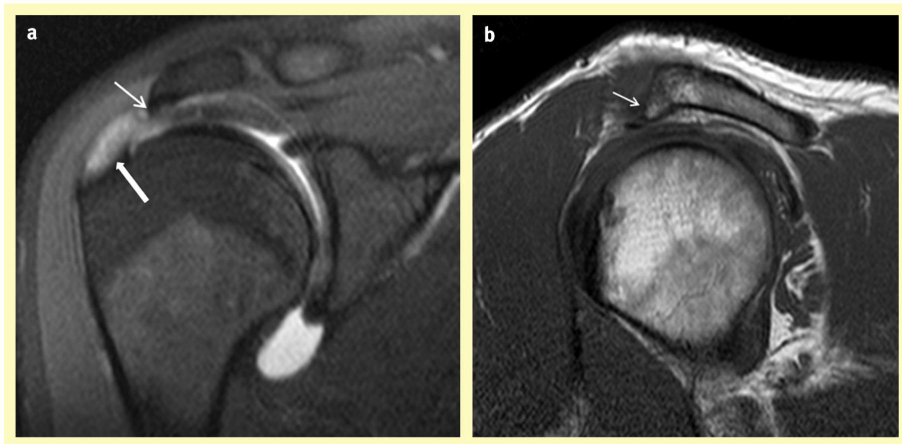

Figure 1 (**a**). MR arthrogram coronal oblique T2 fat suppressed image showing downward sloping of the acromion (arrow) with impingement and supraspinatus tendinopathy (thick arrow). (**b**). Sagittal oblique T1 image (different patient) shows type III acromion with anteroinferior hook formation (small arrow).

affected because of its location and course just beneath the supraspinatus tendon. Tendon tears are discussed in detail in the rotator cuff tear section.

The SASD bursa is the largest bursa in the body, located between the acromion, deltoid muscle and rotator cuff. Intra-bursal synovial fluid dissipates friction between the rotator cuff and the acromion and between the rotator cuff and the deltoid muscle. Distension of the SASD bursa can be seen on the fluid sensitive (T2) coronal oblique and sagittal oblique sequences of the MR and is best seen on longitudinal sections of US distal to the lateral edge of the greater tuberosity.[6]

Long standing impingement can lead to reactive bone changes such as cortical hypertrophy, sclerosis and small degenerative cysts in the greater tuberosity. These findings may precede tendon abnormalities.

MR is good at identifying the causes and effects of impingement but US is superior at identifying bursitis, tendinopathy and tears as a consequence of impingement. On dynamic US, there is usually buckling of the SASD under the subacromial arch.

Posterosuperior impingement is most commonly seen in athletes and limits overhead movements during abduction and external rotation. The infraspinatus tendon is seen to impinge between the humeral head and the posterosuperior glenoid with partial or full thickness tears. There can be an associated posterosuperior labral tear and degenerative osseous cysts on the humeral head.

Rotator cuff tear

Rotator cuff tears can be partial thickness or full thickness. The supraspinatus is the most commonly torn cuff tendon. Tears can extend posteriorly to involve infraspinatus or anteriorly to involve the bicipital pulley and subscapularis tendon. Isolated tears can exist in the tendons, with subscapularis tears slightly more common than infraspinatus tears, however they are rare. Tears can be caused by subacromial impingement, trauma (acute or chronic) or tendon degeneration. The anterior aspect of the distal supraspinatus close to the rotator interval is a common site for tears, but degenerative tears are also relatively common more posteriorly, at the supraspinatus–infraspinatus junction[7]

MR and US imaging can provide information about rotator cuff tears, such as tear dimensions, tear depth or thickness, tendon retraction and tear shape that can influence treatment selection and help determine the prognosis (Figures 2 and 3). In addition, tear extension to adjacent structures, muscle atrophy, size of muscle cross-sectional area and fatty infiltration has implications for the physiological and mechanical status of the rotator cuff.[8]

Partial thickness tears and degenerative changes of the tendons are often difficult to distinguish and are both included under the term tendinopathy. They are indistinguishable on T1 weighted MR images but on T2 weighted images the tendon

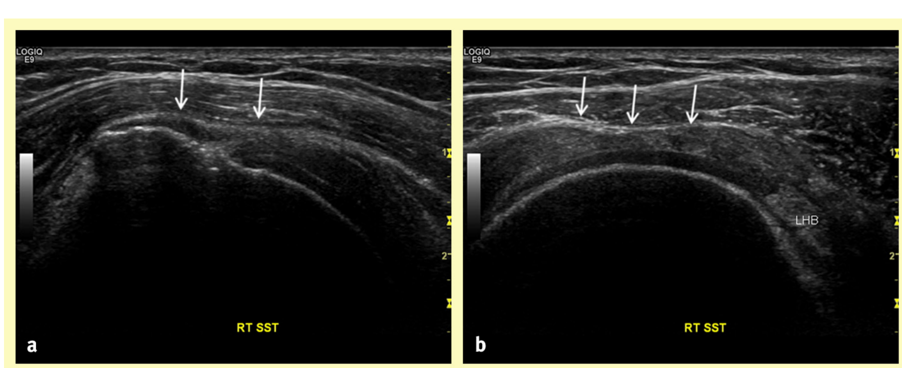

Figure 2 Longitudinal (**a**) and transverse (**b**) US image show loss of supraspinatus mid fibres in keeping with full thickness tear (arrows). LHB — Long head of biceps.

