The radiological assessment of shoulder pathology

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Abstract

Radiological imaging plays a central and invaluable role in the assessment and management of patients with suspected shoulder pathology. Whilst conventional plain film radiography remains the first-line investigation of choice, limitations with its ability to evaluate the soft tissue structures means that it is usually supplemented with ultrasound and/or MRI. The following article reviews common and uncommonly encountered shoulder pathologies and their respective imaging findings, with a specific focus on their ultrasound and MRI appearances.

Keywords CT; imaging; MRI; plain radiographs; rotator cuff; shoulder; ultrasound

Introduction

The shoulder complex comprises three bones forming four different joints: glenohumeral, acromioclavicular (AC), sternoclavicular and scapulothoracic, along with 30 muscles and six different ligaments. The 'shoulder joint' or glenohumeral joint is a very mobile and an inherently unstable joint formed by the articulation of the larger humeral head and a smaller shallow glenoid. With the analogy of a golf ball on a golf tee, only 30% of the humeral head is in contact with the glenoid, stability being inferred by both static and dynamic stabilizers including the capsule, labrum, ligaments and rotator cuff musculature.[1]

The most common presentation of suspected shoulder pathology is pain, with specific pain patterns for common shoulder pathologies having been described in the literature.[2] Other symptoms include those of instability, weakness and stiffness. Causes of shoulder pain can be broadly split into those that are intrinsic to the shoulder complex or extrinsic, the latter including those referred from cervical discogenic disease. As a result, radiological imaging plays a central and pivotal role in the assessment and management of such patients.

Four main imaging modalities are commonly used: conventional plain film radiography, ultrasound, CT and MRI. Being readily available and inexpensive, plain radiographs form the first line of investigation in patients presenting with shoulder pain, especially following trauma. Though good for assessing osseous trauma, degenerative change as well as other causes of pain such as calcific tendinitis, limited information concerning the soft tissue structures can be gleamed. Standard views include an asteroposterior (AP) view of the shoulder along with a scapular 'Y' or axillary view. CT is primarily used for the assessment of fracture configuration in the context of planned surgical fixation, assessing the degree of degenerative change as well as assessing glenoid bone stock and version when considering arthroplasty procedures.

Ultrasound is the first-line investigation in assessment of the rotator cuff, long head of biceps tendon, subacromial subdeltoid bursa, the presence of a glenohumeral joint effusion and any suspected mass lesion. The advantages of ultrasound over other imaging techniques are that it is a dynamic examination, suitable for 'one-stop' clinics and it allows therapeutic interventions to be performed, including both aspiration and injections. Limitations include the fact that it is operator dependent, it does not allow evaluation of the glenoid labrum or ligamentous structures and that underlying osseous structures are suboptimally assessed.

MRI imaging includes both non-arthrographic and arthrographic studies. Multi-planar non-arthrographic studies allow evaluation of the shoulder as a whole. MR arthrography has the added advantage over both ultrasound and non-arthrographic MR studies in that it allows assessment of the labrum and ligamentous structures and, as a result, it is the imaging modality of choice in patients with instability. In addition, partial thickness rotator cuff tears are more easily detected in arthrographic MR studies than by both ultrasound and non-arthrographic studies. Limitations with MR imaging include its availability, cost and certain contraindications. In cases where MRI is contraindicated (e.g. in the presence of a pacemaker), a CT arthrogram can be performed.

We will now review common and uncommonly encountered shoulder pathologies and their respective imaging findings.

Impingement

Impingement can broadly be classified into either extrinsic or intrinsic impingement, the former being secondary to structural changes outside the glenohumeral joint whilst the latter is caused by rotator cuff abnormalities. Both extrinsic and intrinsic impingement can be further subclassified.

Primary extrinsic impingement occurs where there is a rotator cuff impingement by the structures that form the coroacoacromial arch and encompasses both subacromial impingement and subcoracoid impingement.

Subacromial impingement occurs when anatomical structures, namely the supraspinatus tendon and subacromial subdeltoid bursa, become impinged and abrade between the humeral head and the undersurface of the acromion, AC joint and coro-acromial ligament during abduction of the arm. The long head of biceps tendon may also be affected. The affected tendon becomes tendinopathic, swollen and there is associated subacromial subdeltoid bursitis. This can progress to rotator cuff abrasion and the development of defects (tears). Causes include AC joint arthropathy, acromion configuration, os acromiale and thickening of the coraco-acromial ligament.

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Subcoracoid impingement is less common than subacromial impingement and occurs when the space between the coracoid process and the anterior humeral head becomes narrowed. Structures affected include the subscapularis tendon, the long head of biceps tendon and the middle glenohumeral ligament (MGHL). Secondary extrinsic impingement is associated with glenohumeral or scapulothoracic instability. Intrinsic impingement occurs when the rotator cuff becomes impinged against the glenoid or between the glenoid and humerus on abduction and external rotation of the shoulder.[3]

Plain radiographs

AP and outlet views are typically normal or show minimal changes. AP views allows assessment of the AC joint for hypertrophy and arthropathy, acromial spurs (Figure 1), detection of calcific deposits within the supraspinatus tendon along with radiographic signs suggestive of established impingement: greater tuberosity cysts and sclerosis. Outlet views allow assessment of the acromion morphology, with a Hooked Type III acromion being associated with rotator cuff disease.

Ultrasound

The affected tendon initially shows tendinopathic change, being thickened, heterogenous and irregular in appearance. With prolonged impingement, rotator cuff tears may be seen. Thickening of the subacromial subdeltoid bursa in keeping with bursitis is also seen (Figure 2). In subacromial impingement, abduction of the arm leads to bunching of subacromial subdeltoid fluid beneath the coracoclavicular ligament (Figure 3). Ultrasound also allows therapeutic steroid and local anaesthetic injection into the subacromial space.

MRI

Sagittal T1 sequences are useful for assessing the morphology of the acromion. A downward sloping acromion is best seen on coronal T1 sequences. Other findings include the presence of an os acromiale, rotator cuff tendinopathic change, rotator cuff tears, subacromial subdeltoid bursitis and a thickened coracohumeral ligament.

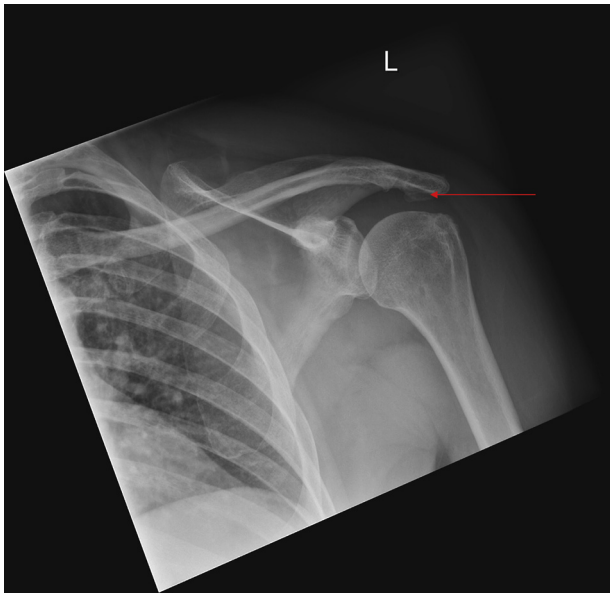

Figure 1 Anteroposterior radiograph of the shoulder demonstrating subacromial spur (arrow).

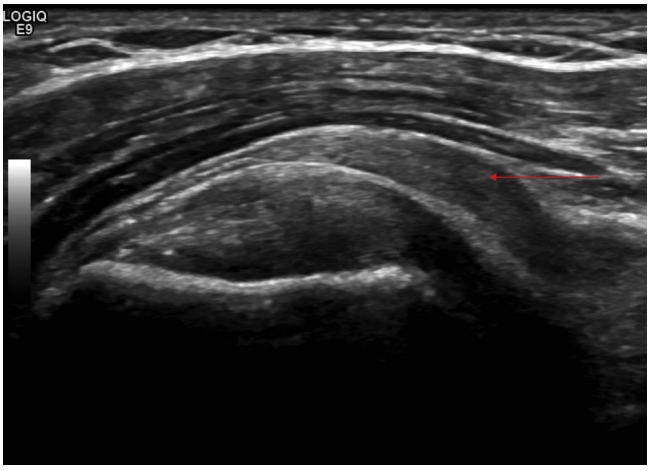

Figure 2 Ultrasound demonstrating marked thickening of the subacromial subdeltoid bursa (arrow) in keeping with bursitis.

Rotator cuff tears

Rotator cuff tears can be categorized as either partial or full thickness, with the supraspinatus tendon being the most commonly affected. The subscapularis and infraspinatus tendons are less frequently involved. Causes include tendinosis, subacromial impingement and trauma.

Partial thickness tears can be located on either the bursal or articular surface, the latter being more commonly encountered. Special types of partial thickness tears include interstitial tears, which are not seen on arthroscopy, and the rim rent tear, which is a partial thickness articular surface tear occurring at the footprint at the greater tuberosity. Partial thickness tears can be graded by their extent: Grade 1 – less than 3 mm deep, Grade II – 3–6 mm deep (<50% of cuff thickness involved) and Grade III – more than 6 mm deep (>50% of cuff thickness involved).[4]

Complete full thickness tears extend from the bursal to articular surface and allow free communication of fluid between the subacromial bursa and the glenohumeral joint. In the older patient, these are usually midsubstance tears, whereas in the younger patient, tears usually affect the anterior free edge and involve the rotator cuff cable.

When radiologically evaluating tears, the following information should be gained: which tendon is involved and where in the tendon is the tear located, whether the tear is partial or complete thickness, size and possible tendon retraction, whether there is any anterior or posterior extension and the presence of any fatty atrophy involving the affected muscle belly.

Plain radiographs

These may show radiographic changes associated with subacromial impingement and degenerative change. If there is a complete rotator cuff tear, superior migration of the humeral head relative to the glenoid may be seen (Figure 4).

Ultrasound

Partial thickness tears are more difficult to diagnose than full thickness tears.[5] Typical signs of a partial thickness tear include

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