



Shoulder stiffness: diagnosis



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BACKGROUND

Pain and stiffness of the shoulder is a common complaint, particularly in the 40–80 years age group. There are several causes of painful, stiff shoulders, but the most common cause in the fifth decade of life is idiopathic capsulitis ('frozen shoulder').

OBJECTIVE

This article summarises the functional anatomy of the shoulder joint, the pathology of the conditions that lead to shoulder stiffness, and methods to differentiate them.

DISCUSSION

Clinical history and examination is effective in differentiating rotator cuff tears, impingement and frozen shoulder. Restriction of glenohumeral joint motion, particularly in external rotation, with no abnormality on X-ray is strongly suggestive of the diagnosis of frozen shoulder. Plain true anteroposterior X-rays are important to identify glenohumeral joint arthritis. Ultrasound is often helpful for confirming or denying rotator cuff tears when there is doubt on the clinical examination.

The shoulder is the third most commonly injured joint, after the spine and the knee. While instability is the major disorder in young athletic individuals,¹ pain and stiffness are the most common presenting features in those aged 40 years and over. These symptoms can arise from:

- the rotator cuff and subacromial space
- the capsule, or
- the cartilage (*Table 1*).

The most common cause for pain in the shoulder is a disorder of the rotator cuff complex. Stiffness is often secondary to pain, but can also be caused directly by capsular tightness and loss of glenohumeral joint capsular volume. Shoulder pain and stiffness may also be caused by glenohumeral arthritis. It is important to determine the cause of shoulder dysfunction as the management of each is different.

Anatomy and pathology

The joint capsule

The normal shoulder joint permits a wide range of motion. Usually the shoulder capsule is less than 3 mm thick, large and lax, especially in the axillary fold. The synovium lining the shoulder capsule is pale. When the arm is abducted the axillary fold obliterates. The glenohumeral joint capsule

has discrete thickenings or capsular ligaments – the superior glenohumeral ligament, the middle glenohumeral ligament, the inferior glenohumeral ligament complex and the coracohumeral ligament. The coracohumeral ligament originates from the lateral base of the coracoid process, passes through the rotator interval and inserts in the tuberosities of the humerus. All four ligaments become taut in external rotation.

In adhesive capsulitis, the lining synovium becomes very vascular (*Figure 1*) and the capsule becomes thickened (>5 mm) and taut. An arthrogram of a normal shoulder shows a well formed axillary fold and the shoulder readily accepts 15–18 mL of fluid.² In adhesive capsulitis, the joint accepts less than 10 mL of fluid and often as low as 5 mL of fluid. Lundberg² has shown a direct correlation between loss in intra-articular glenohumeral volume and restriction in elevation.

Rotator cuff

The rotator cuff consists of four tendons – supraspinatus, infraspinatus, subscapularis and teres minor – that surround the humeral head (*Figure 2*). The major function of these tendons is to hold – centre – the humeral head in the glenoid when performing overhead activities.

Table 1. Causes of shoulder pain and stiffness			
Structure	Diagnosis	Age group	Key features
Rotator cuff and subacromial space	Impingement/ Subacromial bursitis	35–70 years	Precipitated by episode of overhead activity Pain with overhead activities and at night
	Supraspinatus tendinosis		Positive impingement signs
	Rotator cuff tears	40 years +	Positive impingement signs Often restricted internal rotation +/- weakness of supraspinatus +/- weakness external rotation
	Calcific tendonitis	30–40 years	Acute extreme pain in shoulder and arm X-ray: calcification at insertion of supraspinatus
Capsule	• idiopathic adhesive capsulitis ('frozen shoulder')	40–60 years	Global restriction of passive movement Rubbery block to first 15° external rotation Normal X-ray
	• post-traumatic		
	• postsurgical		
Cartilage	Glenohumeral joint arthritis	60 years +	Restricted range motion, crepitus, X-ray changes

Rotator cuff dysfunction

Overuse of the rotator cuff can result in degenerative changes or tendonopathy of the supraspinatus tendon. With time, this tendonosis can extend and turn into a full thickness rotator cuff tear, often in association with a traumatic episode. Fatigue or injury to the rotator cuff complex results in an impairment of its ability to hold the humeral head against the glenoid. When the rotator cuff is malfunctioning, the deltoid forces the humeral head upward and causes secondary 'impingement' of the rotator cuff tendons underneath the acromion and the coracoacromial arch. The bursa that lies between these two structures often becomes irritated and thickened causing pain, particularly with over-

head activities and at night. Chronic large tears of the rotator cuff lead to proximal humeral head migration, malalignment of the glenohumeral articulation and secondary arthropathy – 'cuff tear arthropathy' (Figure 3).

Calcific tendonitis

A variant of rotator cuff dysfunction is the condition of calcific tendonitis. This condition is relatively rare and occurs in younger individuals, ie. 30–40 years of age. They present with acute, extreme pain in the shoulder and arm. X-rays show calcification in the insertion of supraspinatus (Figure 4). The cause of this condition is undetermined. The material that deposits within supraspinatus is initially of the consistency of toothpaste and with time



Figure 1. Arthroscopic pictures highlight the pale normal synovium in contrast to the red frozen shoulder synovium

hardens and turns into bone. With further time (2–3 years) it usually disappears altogether.

Cartilage

Arthritis of the shoulder (Figure 5) is much less common than in the knee and hip. Like other joints, there may be an underlying cause; for instance an autoimmune inflammatory arthropathy or a specific injury which has disrupted the normal kinematics of the joint. Examples of injuries disrupting kinematics of the glenohumeral joint include recurrent dislocations and a large rotator cuff tear. Like other joints the major presenting features of glenohumeral arthritis are pain and, with time, stiffness.

History

The patient commonly presents to the general practitioner complaining of pain particularly with overhead activities and at night. Features in the history can give important clues to diagnosis.

Age of patient

Age is helpful when considering the causes for shoulder stiffness since idiopathic adhesive capsulitis primarily affects

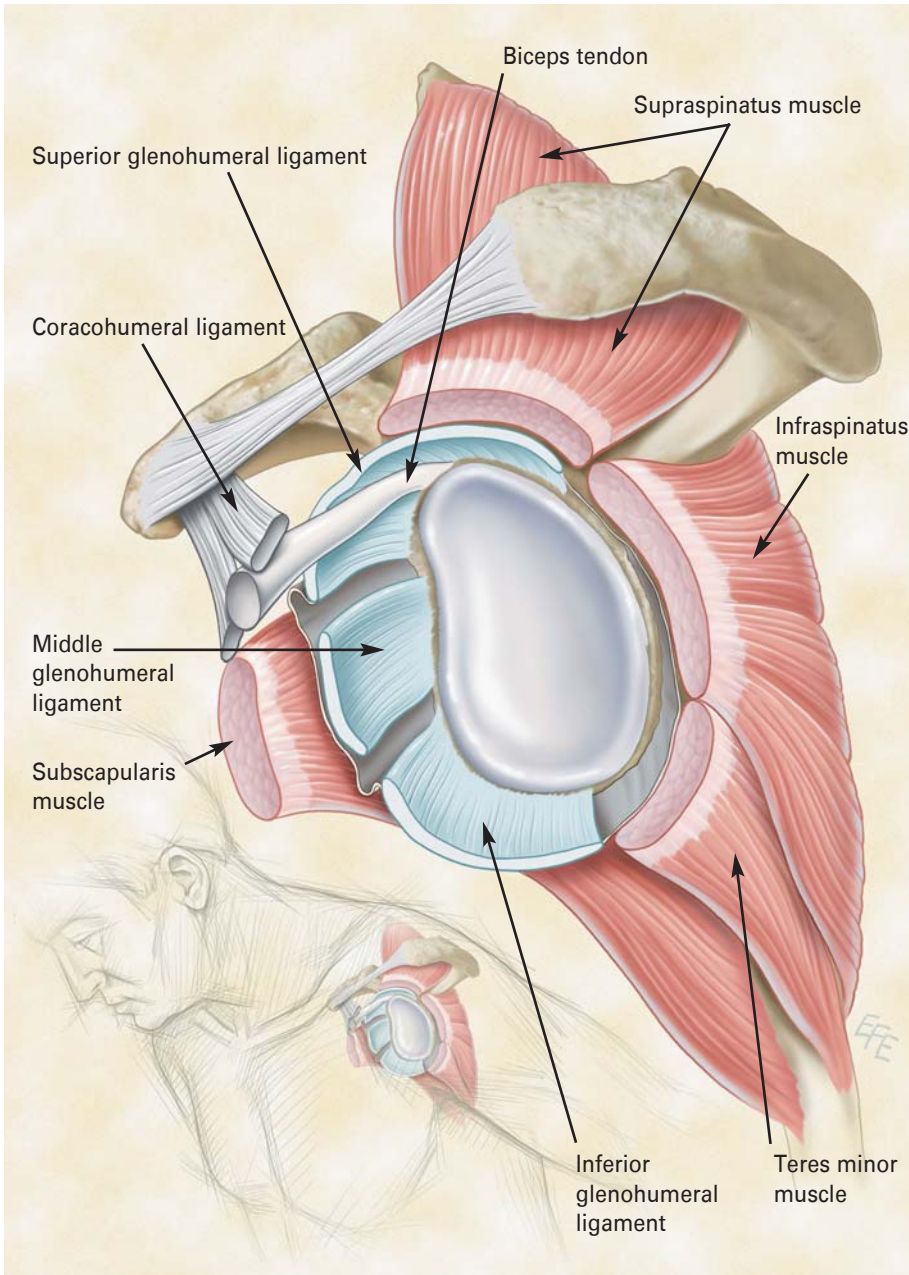


Figure 2. Rotator cuff

the 40–60 years age group. It is unlikely to present in younger or older patients. Osteoarthritis is more common with advancing age, ie. 60 years and over. Rotator cuff dysfunction increases in a linear fashion with age and is rarely present before 30 years of age.³

Sex of patient

Gender is relevant to idiopathic adhesive capsulitis, with women being more commonly affected than men. The female to male ratio is 1.3:1.^{4,5}

Shoulder affected

The left shoulder is consistently more affected by adhesive capsulitis than the right shoulder, with a mean left to right ratio of 1.5:1.^{2,6}

Mechanism of injury

It is important to determine if there was a specific initiating event. An acute or traumatic episode such as lifting a heavy object or falling onto an outstretched arm, alerts the GP to injury to the rotator cuff tendons or a fracture. An episode of overhead activity

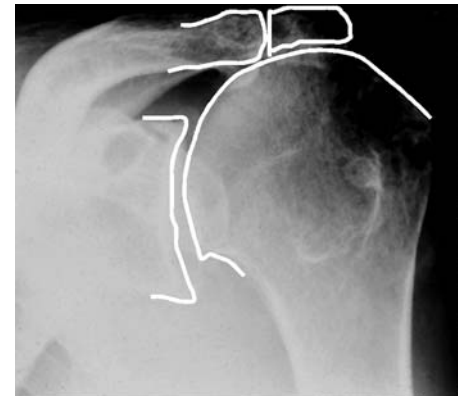


Figure 3. An X-ray illustrating the upward migration of the humeral head due to cuff tear arthropathy

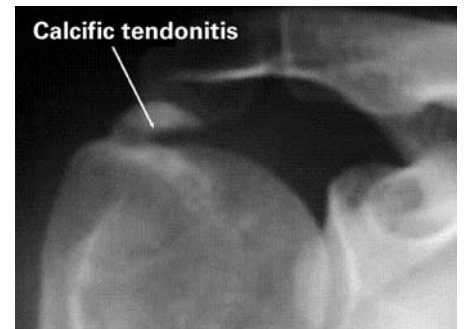


Figure 4. AP X-ray of the right shoulder showing calcium deposits in the supraspinatus as it inserts into the greater tuberosity



Figure 5. True AP X-ray left shoulder illustrating changes in osteoarthritis: loss of joint space, subchondral sclerosis and osteophyte formation

fatigue such as painting the house can initiate impingement. A gradual onset of symptoms is more consistent with impingement syn-



Figure 6. Physical examination demonstrating the technique of assessing the range of external rotation at the shoulder



Figure 7. Testing the strength of supraspinatus power. The patient is asked to resist downward

drome, frozen shoulder and arthritis.

Occupation and sporting injuries

Other aspects of the history to consider include the patient's occupation, particularly when heavy lifting or repetitive overhead work is involved, and the type of sports played.

Previous surgery

A history of previous surgery is important, as any stiffness may be postsurgical.

Diabetes

There is a significant correlation between adhesive capsulitis and diabetes.⁷

Examination

Examination of the patient with a painful, stiff shoulder consists of assessing:

- the range of movements
- power of the muscle groups, and

- presence of crepitus.

Interpretation of findings in a painful shoulder may not always be easy. However, our aim here is to simplify interpretation to determine the cause of stiffness.

Range of motion

Visual estimation is as reliable as more complex methods for estimating shoulder range of motion.⁸ In brief, the subject is seated upright on the edge of an examination couch with feet supported on a footstool. The examiner then moves the affected extremity to the end of the passive range of shoulder movement. The first and easiest motion to evaluate is external rotation (*Figure 6*). Hold the patient's elbow by their side – arm positioned by the side of the trunk in 0° glenohumeral abduction with elbow flexed to 90° – and gently externally rotate the forearm. If there is a rubbery block to external rotation within the first 15° the condition is likely to be secondary to capsular tightness, ie. adhesive capsulitis.

Maximum passive internal rotation is estimated by positioning the hand behind the back while the examiner moves the extremity upward along the midline to the highest vertebral level that can be reached by the patient's thumb.

Forward flexion and abduction at the shoulder should also be checked. Pay particu-

lar attention to the scapula, as it will often move on the rib cage with the arm to make up for the glenohumeral loss of movement. If this movement of the scapula on the rib cage is not restricted with downward pressure with one hand, then a loss of range of motion of the glenohumeral joint may be missed. This is also a good time to palpate for glenohumeral joint crepitus (indicating arthritis).

Tests for shoulder strength

Test for external rotation and supraspinatus power

A hand held dynamometer is the most reliable means for measuring shoulder strength,⁹ however, as a screening tool manual muscle tests are quicker and easier.³ External rotation power is best tested in the same manner as external rotation range of motion with the examiner resisting the patient's external rotation movement. Supraspinatus power is best tested with the patient sitting on the examining couch and holding their arm at 90° of forward flexion, with the arm held in line with the supraspinatus fossa. The patient is asked to resist downward pressure by the examiner (*Figure 7*). Decreases in supraspinatus and external rotation power are an indication of rotator cuff tear.³ Power on internal rotation is a good control.³

Special tests

The impingement signs - the arm is abducted to 90° then rotated in internal and external rotation – will most likely be positive in all of the conditions and is not particularly helpful at discriminating impingement versus rotator cuff tear versus frozen shoulder.

Investigations

A plain true anteroposterior (AP) and lateral X-ray is important, especially to rule out glenohumeral joint arthritis and calcific tendinitis of the supraspinatus tendon. A true AP X-ray is made parallel to the glenoid joint surface. Since the scapula is 30° internally rotated, the X-ray beam and plate also need to be internally rotated. Calcific tendinitis is characterised by the calcification of the supraspinatus as it inserts into the greater tuberosity (*Figure 4*).

Sclerosis of the greater tuberosity and of the under surface of the acromion are often signs of rotator cuff dysfunction, ie. impingement and/or rotator cuff tear. Proximal humeral head migration, when the humeral head is no longer centred on the glenoid and especially if it is articulating underneath the acromion, is a sign of chronic rotator cuff tear (Figure 3). Osteopenia of the humeral head is often a helpful sign for idiopathic adhesive capsulitis.¹⁰

If a rotator cuff tear is suspected,³ ultrasound can confirm the diagnosis. In our experience ultrasound has as high a probability of detecting a rotator cuff tear as magnetic resonance imaging (MRI), and is quicker, cheaper and less distressing for the patient.¹¹ If the ultrasound is indeterminate, an arthrogram should be performed. This is an investigation where radio-opaque dye is injected into the glenohumeral joint. Leakage into the subacromial space is an indication for a full thickness rotator cuff tear.

SPOT CHECK

- Rotator cuff tears often cause restricted internal rotation. Weakness of external rotation and supraspinatus are useful tests for identifying a rotator cuff tear. Ultrasound is useful for confirming the diagnosis. If it is indeterminate, consider arthrogram or MRI
- Grinding or crepitus should alert the GP to glenohumeral joint arthritis. A true AP X-ray should confirm this diagnosis
- Pain in the impingement position is common for a number of conditions and only diagnostic for impingement syndrome when range of motion and power are normal
- Frozen shoulder: global restriction of passive movement – normal X-ray

Conclusion

Dysfunction of the rotator cuff muscles leads to shoulder and peri-scapular arm pain and often stiffness secondary to pain. Tightness of the shoulder capsule occurs in idiopathic adhesive capsulitis and is common in the 40–60 years age group. Disruption of the

articular cartilage – arthritis – may also cause stiffness, but is less common than in the hip and knee. Several of these conditions may coexist. It is important to differentiate the cause of shoulder stiffness, as the treatment discussed in the accompanying article is specific for each disorder (see the article 'Shoulder stiffness: management' page 149 this issue).

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