Imaging the shoulder - Adhesive capsulitis

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Learning objectives

- To review general issues about adhesive capsulitis (frozen shoulder).

- To describe the imaging findings of adhesive capsulitis emphasizing magnetic resonance imaging (MRI) and ultrasound (US).

- To review treatment options, with special emphasis on image guided treatment.
Background

Adhesive capsulitis is a common, painful condition of the shoulder. Its incidence is about 2-3%, and is more common between 40 and 70 years of age, with a female predilection.

Adhesive capsulitis results from an inflammatory contracture of the glenohumeral joint capsule and adherence to the humeral head, but the precise pathogenesis is unknown.

This entity may be characterized as primary (idiopathic), or secondary to an underlying condition, such as diabetes mellitus, rotator cuff tendinopathy or tear, subacromial bursitis, biceps tendinopathy, recent shoulder surgery or trauma, and inflammatory diseases.

Adhesive capsulitis may be classified into three sequential phases: a **painful phase**, a **freezing / adhesive phase**, and a **resolution phase**. All phases are characterized by decreased range of motion and pain.

# The painful phase lasts about 10-36 months

# The adhesive phase occurs at 4-12 months, and this time the pain gradually subsides but stiffness persists

# The resolution phase takes 12-42 months, and there is spontaneous improvement in the range of motion. These symptoms persist for about 30 months, and in some cases may never completely resolve.

The pain is often described as poorly localized, deep and has an insidious onset. Patients may have progressive pain and stiffness, with global loss of range of motion in all planes. Pain may impair sleep, as happens with other shoulder conditions.

The diagnosis of adhesive capsulitis is usually clinical. Differential diagnosis of a stiff, painful shoulder include acromioclavicular arthropathy, biceps tendinopathy, glenohumeral osteoarthritis, rotator cuff tendinopathy or tear, cervical disk degeneration, subacromial / subdeltoid bursitis, autoimmune disease and neoplasm.
Findings and procedure details

Adhesive capsulitis is clinically diagnosed, but there are important imaging findings radiologists should recognize.

Plain radiographs may be reported as normal, or may show periarticular osteopenia as a result of disuse.

MRI

MRI reveals some findings, the most characteristic including **thickening of the coracohumeral ligament** and **joint capsule** at the rotator cuff interval and complete **obliteration of the subcoracoid fat** (subcoracoid triangle sign).

- Measurement should be made at the thickest portion of the coracohumeral ligament on sagittal oblique images (Fig. 1).

- **Thickening of the joint capsule in the axillary recess** has also been described as a characteristic sign of frozen shoulder (Fig. 2). The thickest portion of the capsule may be determined in the rotator cuff interval and in the axillary recess. In the axillary recess, measurements may be obtained on coronal oblique images, on both the humeral and the glenoidal sides. Capsular thickening is present when measurements of more than 4 mm in the axillary recess are found (Fig. 3).

MRI after intravenous contrast administration may show **enhancement of the joint capsule** and synovial membrane in the rotator cuff interval and in the axillary recess.

- Obliteration of the subcoracoid fat triangle may be partial or complete (Fig. 4). Complete obliteration of the subcoracoid fat triangle is specific for the diagnosis of frozen shoulder, but the sensitivity is low. The subcoracoid fat triangle may be analyzed in the sagittal oblique plane. The borders of the triangle are defined by the coracoid process anterosuperiorly, the coracohumeral ligament superiorly, and the joint capsule posteroinferiorly (Fig. 5).

- Other MRI findings that may be found include **signal intensity changes and/or contour irregularity of the coracohumeral ligament** and **superior glenohumeral ligament**. Many patients with frozen shoulder also had **synovitis-like abnormalities** at the superior border or articular surface of the
subscapularis tendon, in the subscapularis recess, and specially around the long biceps tendon.

- MR arthrography may show decreased joint capacity and obliteration of the axillary recess in patients with frozen shoulder.

Ultrasound

- The diagnosis may be suggested at dynamic ultrasound scanning by noting restriction of sliding movements of the supraspinatus tendon underneath the acromion during arm abduction, or persistent visualization of the supraspinatus tendon during lateral elevation of the arm.
- Synovial inflammation documented with color Doppler imaging may also be present (Fig. 6).

Treatment

- Adhesive capsulitis is often a self-limited condition, so observation alone can be considered. Immobilization should be avoided.
- Most patients will recover with conservative treatment. Acetaminophen and nonsteroidal anti-inflammatory drugs are the first options for pain relief. For more severe cases, oral corticosteroids may be prescribed, providing short-term benefit in pain relief and improved range of motion (up to six weeks).
- Physical therapy has traditionally been a very important part of the treatment, and in conjunction with corticosteroid injections may be more effective.
- Radiographically or ultrasound-guided capsular distension with saline (hydrodilatation), with or without corticosteroid provide better short-term pain relief (up to six weeks) and improved range of motion, when compared to oral corticosteroids. In some studies a better outcome was achieved in the group treated with hydrodistension plus corticosteroids compared with the group treated with corticosteroids only. These techniques were developed in order to loosen capsule contraction which improves glenohumeral mobility.

Some authors postulate that distension would be more effective in the intermediate phase (patients with symptoms for at least 3 months).
• In cases where there is little or no improvement after 6-12 weeks of conservative treatment and who cannot tolerate their symptoms should be referred to an orthopedic surgeon. **Surgical options** include joint manipulation under anesthesia and capsular release.

**Hydrodilatation with or without corticosteroid**

Traditionally, the glenohumeral joint is injected with fluoroscopy guidance from an anterior approach, with a small test injection of radiopaque contrast material to confirm intraarticular position. This technique may be used to inject corticosteroids or contrast agents for CT or MR shoulder arthrography.

Sonography is an accurate alternative to fluoroscopy for injection of the shoulder joint which may be used for corticosteroid injection and/or capsule hydrodistension, and also contrast agents for CT or MR arthrography. Sonographic guidance avoids the use of ionizing radiation and iodinated contrast material, and is generally faster. Both anterior and posterior sonographic approaches to glenohumeral joint injection were reported.

A posterior approach to glenohumeral joint avoids intralabral or extraarticular contrast material injection.

- **Technique**

  • For the posterior approach the patient stays in a semiprone position with the affected shoulder uppermost and the ipsilateral arm placed over a pillow (Fig. 7).
  
  • A high frequency linear transducer is positioned inferior to the scapular spine and aligned in the long axis of the myotendinous junction of the infraspinatus, with the posterior glenoid rim and humeral head in the field of view (Fig. 8).
  
  • A 20- to 22-gauge needle is introduced and a slow injection is performed.
  
  • Distension of the joint may be performed with various substances, including combinations of saline, local anaesthetic, corticosteroids, contrast, and air (we use a combination of ropivacaine, methylprednisolone, lidocaine and 20 cc saline).
• When a sufficiently large volume of fluid has been injected, the posterior recess of the glenohumeral joint begins to distend, and the posterior capsule displaces away from the humeral head.

• After the procedure, it is important to mobilize the shoulder and avoid immobilization.
Fig. 1: Sagittal oblique T1 MRI. Thickened coracohumeral ligament (arrows) in a patient with frozen shoulder.

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Fig. 2: Coronal T1 (left) and PD-fatsat (right) MRI. Thickening (left) and intermediate signal (right) of the joint capsule in the axillary recess in a patient with adhesive capsulitis.

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Fig. 3: T2-fatsat MRI: Thickening of the capsule in the axillary recess, and intermediate signal in adjacent soft tissues.

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**Fig. 4:** T1 sagittal oblique MRI (left): Almost complete obliteration of subcoracoid fat (arrow); T2 fat-sat sagittal oblique MRI (right): intermediate signal scar in the rotator interval.

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Fig. 5: T1 sagittal oblique MRI: Normal subcoracoid triangle bordered by the coracoid process (Cor), the coracohumeral ligament (CHL), and the joint capsule.

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**Fig. 6:** Ultrasound (with color Doppler imaging): Hypoechogenicity and hyperemia in the rotator interval.

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**Fig. 7:** Injection technique. A high frequency linear transducer is aligned with the long axis of the myotendinous junction of the infraspinatus.

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**Fig. 8:** Ultrasound guided glenohumeral joint hydrodistension. The posterior recess of the glenohumeral joint begins to distend, and the posterior capsule displaces away from the humeral head (from left to right).

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Conclusion

• Adhesive capsulitis is a painful condition of the shoulder, with an incidence of 2-3%, and more common between 40-70 years of age.

• Adhesive capsulitis results from an inflammatory contracture of the glenohumeral joint capsule and adherence to the humeral head, and may be classified into three phases: a painful phase, a freezing / adhesive phase, and a resolution phase.

• Progressive pain and stiffness may persist for 30 months, and in some cases may never completely resolve.

• The most characteristic MRI findings include thickening of the coracohumeral ligament and joint capsule at the rotator cuff interval and complete obliteration of the subcoracoid fat (subcoracoid triangle sign).

• On ultrasound, the diagnosis may be suggested at dynamic scanning by noting restriction of sliding movements of the supraspinatus tendon, and synovial inflammation on color Doppler imaging.

• Adhesive capsulitis is often a self-limited condition and most patients will recover with conservative treatment.

• Radiographically or ultrasound-guided capsular distension with saline (hydrodilatation), with or without corticosteroid permits to loosen capsule contraction and improves glenohumeral mobility.
References