



Definition

While many disease processes may cause a stiff and painful shoulder, falling under the frequently used vague umbrella term “frozen shoulder,” adhesive capsulitis (AC) is a distinct pathology with specific findings on exam and microscopy [2, 4, 5]. Prevalence of this disorder is 2–5% of the general population, affecting females about 70% of the time, with people between aged 40 and 60 years old most frequently affected [2, 4, 6]. Sedentary occupation appears to be a predisposing factor as compared to manual labor [5]. No racial predilection has been reported [2].

Adhesive capsulitis is characterized by insidious shoulder pain with gradual loss of both active and passive range of glenohumeral joint motion in multiple planes [2]. Patients will complain of severe, constant, dull pain that is located deep in the shoulder (sharp pain during movement of the joint) and referred to the deltoid insertion, often occurring at night [1, 2]. Restriction of motion tends to be most pronounced in external rotation, abduction, and flexion of the affected shoulder joint [2, 5]. Therefore, patients will have difficulty performing certain activities of daily living, such as combing their hair, dressing, reaching to a back pocket, or fastening a brassiere, and they are unable to sleep on the affected side [2]. The non-dominant shoulder is more commonly involved, but about 20–30% of patients will develop AC in the opposite shoulder as well, within 5 years [2, 4].

Although the pathophysiology is not fully clear, these symptoms are attributed to chronic inflammation and progressive fibrosis of the glenohumeral joint capsule subsyno-

vial layer, often without an identifiable instigator of an inflammatory and fibrotic cascade [1, 2, 7]. This causes the capsule to adhere to itself and to the anatomic neck of the humerus, which decreases joint volume and produces a mechanical restriction to motion [1, 2, 5]. The contracted adhered joint capsule causes pain, especially when suddenly stretched [1, 5].

Although the natural history of AC is widely debated, the disease process is often described in four clinical stages and may ultimately result in joint contracture [4]. These stages are the preadhesive phase, freezing, frozen, and thawing phase. Please refer to Table 12.1 for more detail regarding the symptoms, signs, physical therapy goals, and biopsy findings at each stage of AC [1, 2, 4, 5, 9]. It is important to note that each stage may take upward of 3–6 months. However, the time frame may be variable from each individual, and the patient may not progress to the subsequent stage [1]. Biopsy and arthroscopic findings are not necessary to determine the stage and discuss prognosis with the patient, as adhesive capsulitis is largely a clinical diagnosis based on history and exam findings [1, 2].

Primary AC is more common, characterized by idiopathic capsular inflammation and fibrosis, without any other lesions or underlying disease processes [1, 2, 7]. However, several systemic diseases are associated with development of primary AC. Type I and II *diabetes mellitus* in particular has a strong association with development of primary AC; in fact, up to 29% of patients with diabetes type II develop primary AC and 40% of those with diabetes type I [1, 2, 9]. Patients with insulin-dependent diabetes also reportedly have a higher rate of adhesive capsulitis that is resistant to non-operative management, possibly due to increased synovial neovascularization [8]. Other conditions that have been linked to the development of primary AC are thyroid disease, heart disease, prolonged immobilization, stroke, status post-breast cancer treatment, autoimmune disease, and rarely with Parkinson disease [2, 4]. Secondary adhesive capsulitis, on the other hand, encompasses a variety of conditions that result in a stiff shoulder, including

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Table 12.1 Natural history of adhesive capsulitis [2, 4, 5, 9]

	Symptoms	Physical exam findings	Biopsy results	Physical therapy goals
Stage 1 “Preadhesive stage” ~3 months	Gradual onset of shoulder pain, especially at night; often referred to the deltoid insertion Mild stiffness	Pain on palpation around joint capsule or capsular stretch Under anesthesia: full motion is possible	Few inflammatory cells Hypervascular, hypertrophic synovitis Capsular tissue is normal (no adhesions or contractures)	Interfere with the inflammation with gentle ROM Pain control Education Activity modification Specific therapies may include scapulohumeral stabilization, pendulum exercises, hydrotherapy
Stage 2 “Freezing stage” ~6 months	Pain at night Severe stiffness	Restricted motion especially in forward flexion, abduction, internal and external rotation Under anesthesia: some motion loss	Hypertrophic, hypervascular synovitis Early formation of adhesions, most notably in the dependent inferior capsular fold Perivascular and subsynovial capsular scar	Minimize adhesions Pain control Specific therapies may include passive joint glide, cane exercises, active exercises in scapular plane
Stage 3 “Frozen or Maturation Stage” ~4–20 months	Pain improves, present only at end range of motion and occasionally at night Very severe stiffness	Significant loss of motion (a mechanical block) Under anesthesia: significant restrictions persist	Hypercellular, collagenous tissue with a thin synovial layer	Decrease restriction of motion Scapulohumeral stabilization Specific therapies may include active warm-up followed by aggressive prolonged low-load stretching, scapular and rotator cuff muscle strengthening, heat
Stage 4 “Thawing or chronic stage” ~5–26 months	Minimal pain except when the arm is suddenly moved beyond the limits of the scarred capsule Very severe stiffness which gradually improves	Significant motion loss However, gradually improving range of motion	Not reported	Same as stage 3 above

injury to the structures surrounding the shoulder joint [2, 4]. Examples of such conditions are calcific tendinitis, rotator cuff injury, glenohumeral arthritis, acromioclavicular arthritis, and biceps tendinitis, where a stiff shoulder ensues without a capsular source of limitation of motion [2]. Frequent overlap can make it difficult to determine whether the patient is afflicted with primary or secondary AC; however, since this distinction has important implications for treatment and prognosis, familiarity with these terms is important.

Although adhesive capsulitis is largely considered a self-limited disease, its course is very protracted, and without treatment patients with adhesive capsulitis may face months to years of pain and debility [2]. Younger age, male gender, diabetes, greater severity of symptoms at the onset of disease, and loss of range of motion despite conservative treatment for 4 months or more portend a poorer prognosis, longer recovery, and a higher likelihood that the patient will require surgery [4, 5]. Patients should be counseled that they

face a prolonged recovery, regardless of which treatment regimen is selected [1].

Diagnosis

Differentiating AC from other potential causes of shoulder pain and stiffness predominantly rests on the history and clinical exam [1, 2]. Pain due to AC is less likely to be related to a specific activity or repetitive use (i.e., athletic or occupational injury) [1]. Additionally, age should be taken into consideration since patients younger than 40 or older than 70 years of age are more likely to have a condition other than adhesive capsulitis causing shoulder dysfunction.

Diagnostic injection of an anesthetic may be useful to differentiate between AC and conditions such as subacromial bursitis and rotator cuff injury, since restriction in passive range of motion would not significantly improve postinjection in patients with adhesive capsulitis [2].

Differential Diagnosis

The differential diagnosis for a patient with unilateral shoulder pain and stiffness, whether of spontaneous onset or post-injury or surgical intervention, should also include the following [1, 2]:

- Adhesive capsulitis
- Full- or partial-thickness rotator cuff injury
- Calcific tendinitis
- Subacromial/subdeltoid bursitis
- Biceps lesion or bicipital tenosynovitis
- Glenohumeral or acromioclavicular osteoarthritis
- Cervical radiculopathy
- Brachial plexopathy
- Malignancy
- Infection
- Fracture/dislocation
- Tendinopathy
- Peripheral neuropathy
- Autoimmune disease (e.g., SLE, RA)
- Avascular necrosis
- Referred pain

Physical Exam Findings

- On physical exam, a patient with AC will have restricted glenohumeral range of motion in both active and passive testing, due to a mechanical limitation. The most important physical exam finding is *restricted passive range of motion* [2].
 - Passive range of motion is usually preserved in most other conditions causing shoulder pain where the restriction is not mechanical (i.e., tendinopathy), with the exception of several conditions such as osteoarthritis and shoulder dislocation, which can result in decreased passive range of motion similar to AC [2].
 - Shoulder flexion, abduction, external rotation, and internal rotation should be examined while stabilizing the scapula [2]. When testing range of motion in AC, the examiner can feel a sense of tethering caused by the contracted capsule, a mechanical restriction that is different from motion limitation due to pain [5]. Comparison to the unaffected side is important [1].
 - Pain is often present on premature end range, most pronounced in external rotation and abduction of the affected shoulder joint (Fig. 12.1), although also often limited in forward flexion and internal rotation [9].
- Atrophy of the muscles surrounding the shoulder girdle may be appreciated [1].

- Tenderness may be elicited to palpation of the deltoid insertion and anterior/posterior capsule [2]. However occasionally, patients may present with tenderness at the long head of biceps tendon as well, because its synovium is confluent with that of the glenohumeral joint [5].
- Isometric muscle testing within available range usually does not cause significant pain, and rotator cuff strength is usually intact unless a significant amount of atrophy has occurred [1, 5]. Therefore, limitation of *external rotation* with intact strength of the rotator cuff muscles should raise concern for AC [4].
- Gait might display decreased arm swing on the affected side [1].

Imaging

- Imaging such as MRI, ultrasound, and X-rays is not required to make the diagnosis of AC, but is often used to evaluate patients with shoulder pain and stiffness [2].
- Evidence of pathology such as rotator cuff injury or tendinopathy on MRI, subacromial bursitis on ultrasound, and fractures, dislocations, glenohumeral osteoarthritis, or calcific tendinitis on X-ray would *not* be consistent with primary AC [5].
- The ultrasound and MRI findings in a patient with adhesive capsulitis would show a thickened joint capsule, especially specific when in the axillary recess, hypervascularity of the joint capsule, and less consistently coracohumeral ligament thickening and obliteration of the space under the coracoid process [2, 5, 8].
- Shoulder arthrography may show decreased joint volume in patients with AC, which is postulated to correlate with degree of joint range of motion restriction [2].
- X-ray in adhesive capsulitis may demonstrate proximal humerus osteopenia of disuse [2, 4].
- Arthroscopy prior to any surgical or closed intervention is gaining popularity as it allows for complete inspection of the joint and therefore aids in confirmation of the diagnosis and staging, may help to visualize any secondary causes of shoulder pain, and allows for the possibility of therapeutic synovectomy [4, 5].
- As mentioned earlier, secondary adhesive capsulitis may have other findings on imaging, while primary disease would be limited to the joint itself with findings depending on the stage of disease.

Treatment

- Management of secondary AC should focus on the underlying condition producing shoulder immobility, while primary adhesive capsulitis treatment is usually more



Fig. 12.1 Limitations of glenohumeral range of motion in adhesive capsulitis. Patient with adhesive capsulitis of the right shoulder. Above figure demonstrates the most common limitations in *passive* range of motion due to adhesive capsulitis. (a) Limited passive external shoulder

rotation on the affected side. (b) Full passive range of motion in unaffected shoulder (external rotation). (c) Limited passive shoulder abduction on affected side. (d) Full passive abduction range of motion in unaffected shoulder

focused at the joint capsule itself [4]. It is very important to identify the inciting pathology in secondary AC so as to direct therapy appropriately [5].

- Initial management varies based on practitioner and patient preference and has even been as basic as “benign neglect,” with a minimal home exercise program (pendulum exercises and active range of motion within the patient’s pain threshold), heat, and NSAIDs as needed. Several studies have reported successful resolution of symptoms with this management [4, 5].
 - Initial management commonly includes a structured exercise program with gentle range of motion and physical therapy (PT) to reduce pain, prevent capsular contracture, and educate the patient about activity modification to interrupt the inflammatory cascade [2, 4].
- Strengthening the scapular muscles stabilizes glenohumeral mechanics, which may be negatively altered by pain [4].
 - Cone exercises have been useful to address limitations in external and internal rotation range of motion [4].
 - Modalities such as iontophoresis, cryotherapy, thermotherapy, low-power laser therapy, and transcutaneous electrical nerve stimulation (TENS) are sometimes employed to reduce pain as well [4, 6].
 - Of all the modalities, TENS and deep heating through diathermy have been shown to be the most useful additions to stretching and exercises in patients with AC [6].
 - In the later stages, aggressive low-load prolonged stretching is especially useful [4].

- With traditional exercise programs and PT, care must be taken to avoid an overly aggressive exercise regimen so as not to exacerbate the pain and inflammation [1]. Staying within the “tolerable discomfort” range is generally considered preferable [4]. Strengthening is rarely necessary [5]. Pendulum exercise, gentle stretching, and active range of motion within the pain-free range have been shown to be sufficient [4].
- Physical therapists are also trained in dynamic splinting, which has been helpful in avoiding maladaptive shoulder mechanics due to capsular contractures [6].
- Anti-inflammatory medications (e.g., acetaminophen and NSAIDs) are often used to address shoulder pain at all stages of AC, therefore facilitating physical therapy and helping with sleep. However they do not substantially affect recovery [2, 4, 5].
- A short course of oral steroids (3 weeks) has been shown to reduce pain and improve range of motion in adhesive capsulitis in the short term, a few weeks, but due to their side effect, profile steroids are not considered standard treatment [1, 2, 4]. Moreover, treatment with oral steroids has raised concerns about rebound pain and restriction in range of motion limiting progress later in the course of disease as compared to placebo [4].
- Steroid injections either to the subacromial-subdeltoid bursa or to the glenohumeral joint, especially earlier in the course of disease progression when the inflammatory response is increasing, also result in transient improvement of pain (lasting on average 1–6 weeks). They are generally considered preferable over oral steroids due to a lower side effect profile and have been reported to confer similar outcomes as physical therapy [1, 2, 4, 5, 9].
 - Although the improved accuracy when using image-guided (ultrasound or fluoroscopic guidance) injection technique as opposed to palpation guided has been shown, the correlation to additional clinical benefit is currently debated [9].
 - Injection with triamcinolone 40 mg appears to have the highest reduction of pain and improvement in range of motion in this patient population [3]. A healthy shoulder joint can accommodate 28–35 ml of injected fluid; however, due to the contracted nature of shoulders affected by AC, the joint volumetric capacity in AC is limited to only 5–10 ml of injected fluid [5].
 - Local side effects may include injection flare, periarticular calcification, cutaneous atrophy or depigmentation, higher risk of tendon fragility, avascular necrosis, and joint infection [3]. Systemic complications may include blood glucose elevation in diabetics and a drop in serum cortisol level after 1–4 weeks of treatment [3].
- Although non-operative management should be attempted first, up to 10% of cases are refractory to non-surgical management after about 4–6 months of noninvasive treatment [4, 5]. These patients should be referred for a pain management or surgical evaluation based on the patient’s prognosis, disability, and desired activity level [4].
 - Interventional techniques may include hydrodilatation, which involves expansion of capsular volume to increase pressure and cause capsular rupture by injecting fluid under local anesthesia; suprascapular nerve block, which attempts to temporarily block afferent and efferent pain signaling; synovectomy; manipulation under anesthesia (MUA); and either open or arthroscopic capsular release [4].
 - Due to higher rate of morbidity, open surgery is reserved for cases refractory to arthroscopic and closed manipulation [4]. Recovery post open capsular release is understandably longer, postoperative therapy is more limited, and the procedure has been shown to carry more risk for insulin-dependent diabetics [4].
 - After most interventions above, patient should be enrolled in a postoperative therapy program the day after surgery. Starting postoperative day 1, the focus is to maintain motion and prevent recurrence of adhesive capsulitis. Mild to moderate intensity stretches, and ROM exercises are continued in outpatient physical therapy two to three times a week, along with three times daily home stretching program, until full motion is restored and maintained [5].
- In conclusion, the stage of disease and severity of symptoms should be considered in tailoring proper management. Physical therapy and anti-inflammatory agents remain the mainstay treatment especially in the initial stages of adhesive capsulitis, and those patients who are refractory to noninvasive treatment may benefit from interventions such as arthroscopic capsular release or MUA. More research is necessary to investigate these interventions.

When to Refer

- Nonresponsive to physical therapy or conservative management
- Worsening of pain or contracture despite treatment

Referral

- Prompt physical therapy referral may be helpful if home exercise program does not produce relief or if patient is not able to do the exercises independently.
- Glenohumeral steroid injections are often performed by primary care physicians, orthopedics, sports medicine, physiatrists, anesthesiologists, or rheumatologists.
- For more invasive procedures, interventionist referral to pain management, interventional radiology, or orthopedic surgery may be appropriate.

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