Adhesive Capsulitis

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Craig Silverberg and Habib Zahir

Introduction

Adhesive capsulitis, also known as arthrofibrosis or frozen shoulder, describes a condition where the shoulder is significantly limited in its range of motion leading to significant pain. This condition is a pathological process in which the connective tissue surrounding the shoulder joint capsule becomes thick, stiff, and inflamed. The shoulder joint capsule contains ligaments that attach the top of the humeral head to the glenoid (socket), also referred to as the "ball-and-socket" joint [1].

Adhesive capsulitis can be a primary or secondary finding. Primary, or idiopathic, adhesive capsulitis occurs without any inciting event or trauma. Females between the ages of 40 and 60 years old are most prone to this condition, which often involves the nondominant extremity. Secondary adhesive capsulitis is often observed after injury to the shoulder, such as a periarticular dislocation of the glenohumeral joint. It can also be a severe complica-

C. Silverberg
Department of Rehabilitation and Human Performance, Icahn School of Medicine, New York, NY, USA

H. Zahir (✉)
Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, Manhasset, NY, USA

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tion after open or arthroscopic shoulder surgery, including rotator cuff repair and shoulder arthroplasty [2]. The incidence of adhesive capsulitis in the general population is approximately 3–5%. The incidence is significantly higher, approximately 20–25%, when individuals have other comorbidities, such as diabetes, thyroid disease, stroke, and Parkinson disease, and when people are taking antiretroviral medications [3].

Pathology

The pathology of adhesive capsulitis is poorly understood, and it is often idiopathic. The leading hypothesis is based upon arthroscopic observations that suggest an initial stage of inflammation which then progresses to fibrotic contracture of the shoulder capsule. Neviaser and Neviaser classified adhesive capsulitis into four stages based on the arthroscopic appearance of the joint capsule: [4].

- Stage 1 is the "pre-adhesive stage." It entails proliferation of fibroblasts without adhesion formation. Patients typically have full range of motion (FROM) and report pain, often at night. Symptoms are nonspecific and misdiagnosis is common.
- Stage 2 is the "acute adhesive synovitis." It is characterized by hypertrophy of the synovium and early adhesion formation, often in the inferior capsular fold. Patients begin to experience mild loss of range of motion (ROM) with pain.
- Stage 3 is the "maturation stage." It involves the transition of synovitis to fibrosis, in which the axillary fold is obliterated and is often adhered to the capsule. Pain is less severe in this stage than in the earlier stages, but ROM is significantly restricted.
- Stage 4 is the "chronic stage." It is the last stage in which ROM is severely reduced and there is an increase in dense fibrotic adhesions. This makes it very difficult to identify intra-articular structures. Patients at this stage have minimal pain, unless their ROM is forcefully moved beyond the restraints of their scarred capsule.

The initial inflammatory reaction involves the recruitment of inflammatory cells and cytokines, such as macrophages, B and T lymphocytes, TGF-b, TNF-a, and interleukins [5]. The presence of cytokines is evidence of a possible autoimmune process, but the relationship is also not well established [6]. One study suggests inflammation is seen in the axillary fold, the anterosuperior joint capsule, the coracohumeral ligament, and the rotator cuff interval [7]. Another study indicates that there is a pathophysiological difference in protein expression between the upper (rotator interval and middle glenohumeral ligament) and lower (anterior-inferior glenohumeral ligament) parts of the shoulder in adhesive capsulitis [8]. These inflammatory changes eventually progress to reactive capsular fibrosis, which is also driven by increased levels of TGF-B and other profibrotic cytokines [3, 6]. This process overlaps and corresponds to the different arthroscopic and clinical phases (Fig. 5.1).

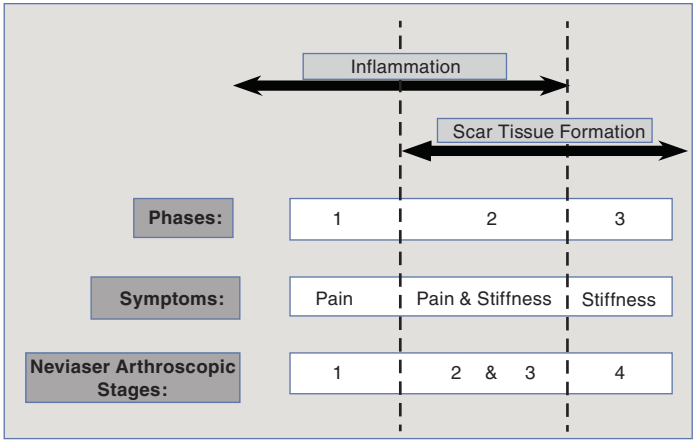

Fig. 5.1 Pathologic phases of adhesive capsulitis. Depiction of the overlapping nature of inflammation and scar tissue formation creating the breakdown of the three clinical phases of adhesive capsulitis. This is compared with four phases described by Neviaser AS, and Hannafin JA (2010)

In summary, inflammatory and fibrotic pathogenesis contributes to the thickening and contraction of the glenohumeral joint capsule and the tissue surrounding the joint, thereby diminishing the joint volume. The normal shoulder joint volumetric capacity is 28–35 mL of injected fluid, whereas in adhesive capsulitis, the joint is limited to only about 5–10 mL [4].

Clinical Presentation

Symptoms of adhesive capsulitis are divided into three stages:

- In the initial "freezing" stage, the shoulder becomes stiff and painful to move. Pain is usually worse at night, and the inability to move the shoulder steadily increases. This stage lasts 6 weeks to 9 months [4, 9].
- The "frozen" stage is the period in which the pain starts to decline, but the shoulder remains just as stiff. This makes it difficult to complete daily tasks and lasts about 2–6 months [4, 9].
- The "thawing" or recovery stage entails a further decrease in pain and slow improvement in shoulder mobility. This stage usually lasts 6 months to 2 years, with an eventual return to full motion and strength [4, 9].

Physical Exam/Diagnostic Imaging

This condition is usually diagnosed clinically, based on a thorough history and physical exam. Adhesive capsulitis causes significant decrease in both active and passive shoulder range of motion [10]. Subtle clues in the history and physical exam can help differentiate adhesive capsulitis from a variety of other conditions that cause a painful, stiff shoulder [11]. The physical exam findings are tenderness to touch at the deltoid insertion and over the anterior and posterior capsule [10]. There can be pain around the medial scapula due to scapulothoracic motion.

The normal shoulder range of motion in degrees best measured by a goniometer includes abduction 180, adduction 45,

extension 45, forward flexion 90, internal rotation 55, and external rotation 40–45. In individuals with adhesive capsulitis, typically, the range of motion is lost in the following order: external rotation, abduction, internal rotation, and then forward flexion [10]. When evaluating patients using special tests of the shoulder, the Neer and Hawkins tests for impingement and Speed's test for biceps tendinopathy are typically positive in patients with frozen shoulder. There is no laboratory testing indicated for diagnosis.

Additionally, X-rays are routinely obtained to make sure the symptoms are not due to another cause such as arthritis. Further imaging such as MRI and ultrasound are usually not needed to make the diagnosis; however, features of the shoulder to look out for using these modalities are described below, per Radiopaedia [12].

Ultrasound

- Limitation of movement of the supraspinatus is considered a sensitive feature.
- Limited external rotation, identified when positioning for subscapularis tendon assessment.
- Thickened coracohumeral ligament (CHL) can be suggestive.
- Thickened inferior glenohumeral capsule echogenic material around the long head of biceps at rotator interval.
- Increased vascularity of long head of biceps at rotator interval.

MRI/MR Arthrography

The signs of adhesive capsulitis are variable with some but rarely all of the following expected to be present:

- T2 hyperintensity of the inferior glenohumeral ligament on T2 fat-saturated sequences.
- Coracohumeral ligament thickening >4–7 mm.
- Subcoracoid triangle sign

- Joint capsule thickening:
  - Anterior capsule thickness > 3.5 mm and abnormal hyperintensity.
  - Axillary pouch thickening >3–4 mm.
- Abnormal soft tissue thickening within the rotator interval with signal alteration.
- Abnormal soft tissue encasing the biceps anchor.
- Variable capsular and synovial enhancement within the axillary recess and rotator interval

Management/Return to Activities

Management of adhesive capsulitis is based on the etiology and severity of the fibrosis. For a majority of patients, the symptoms are self-limiting and will resolve over a 1–3-year period with conservative management. Physical therapy combined with a home exercise program is the initial mainstay of treatment. It is recommended to initially start with a gentle range of motion of the joint combined with progressive stretching exercises. Strengthening is not the focus in therapy for this condition [4].

Pharmacological treatment is often used as an adjunct with physical therapy. Nonsteroidal anti-inflammatory drugs are first-line adjuncts to help patients with their pain to make therapy more tolerable; however, Neviaser AS et al. showed that these medications don't influence overall recovery [4]. Oral and intra-articular steroid injections also have transient effects on pain, but studies show no significant change in motion of the joint or overall recovery. Other agents such as collagenase injections and anti-TNF agents are being studied to target the physiologic markers thought to play a role in the development of the pathological process.

Patients who do not improve with physical therapy are referred to an orthopedic surgeon for surgical options. Manipulation under anesthesia used to be the mainstay surgical approach prior to the advancement of arthroscopic procedures. Arthroscopic capsular release is the most frequently used approach by many institutions

today. Arthroscopic interventions allow the entire joint to be visualized by the surgeon, which allows the surgeon to confirm the diagnosis and to perform a more precise capsulotomy. Studies have shown that the arthroscopic approach have better outcomes for patients in alleviating pain and restoring the function of the shoulder within a 2–5-year period postsurgery [4]. Le HV et al. showed that patients who tend to have the worst outcomes with the arthroscopic capsular approach are females over the age of 50 years old with type 2 diabetes [2].

Proper postoperative management is very important to prevent postoperative inflammation which can lead to recurrence of adhesive capsulitis. In order to prevent this common and dreaded complication following surgery, it is important that the shoulder is kept immobilized in 90 degrees abduction and external rotation, with the head of the bed elevated to 30 degrees. Regardless of the surgical approach performed, directed physical therapy should be started as early as postoperative day 1. Patients are encouraged to maintain the arm in 90 degrees abduction and to reach the arm across the top of the head to touch the opposite ear with emphasis on internally and externally rotating the arm. It is recommended for patients to sleep with their arm abducted for at least 2 weeks after surgery. Therapy should be continued outpatient in a supervised setting with the same emphasis on the initial preoperative therapy of stretching and ranging the joint, with minimal emphasis on strengthening or vigorous movement [4].

It is best for patient's to slowly and progressively ease back into vigorous activities. The length of time to return back to normal activities greatly varies based on the individual, but at the minimum, a few weeks of continuous physical therapy is essential to return back to normal activities.

Conclusion

Adhesive capsulitis is a very common shoulder condition, typically found in middle-aged females with comorbid conditions. It shares many clinical signs as other shoulder pathologies, so a

thorough history and clinical examination is key to the diagnosis. If managed efficiently and in a timely manner with a combination of pharmacological, rehabilitative, and/or surgical treatment, patients can return back to their baseline functioning and quality of life.

References

1. DeLee J, Drez D, Miller MD, Thompson SR. DeLee, Drez, & Miller's orthopaedic sports medicine: principles and practice (fifth edition.). Chapter: shoulder anatomy and biomechanics. Philadelphia, PA: Elsevier; 2020.
2. Le HV, Lee SJ, Nazarian A, Rodriguez EK. Adhesive capsulitis of the shoulder: review of pathophysiology and current clinical treatments. Shoulder Elbow. 2017;9(2):75–84. https://doi.org/10.1177/1758573216676786.
3. Favejee MM, Huisstede BM, Koes BW. Frozen shoulder: the effectiveness of conservative and surgical interventions—systematic review. Br J Sports Med. 2011;45(1):49–56. https://doi.org/10.1136/bjsm.2010.071431.
4. Neviaser AS, Neviaser RJ. Adhesive capsulitis of the shoulder. J Am Acad Orthop Surg. 2011;19(9):536–42. https://doi.org/10.5435/00124635-201109000-00004.
5. Georgiannos D, Markopoulos G, Devetzi E, Bisbinas I. Adhesive capsulitis of the shoulder. Is there consensus regarding the treatment? A comprehensive review. Open Orthop J. 2017;11:65–76.
6. Rodeo SA, Hannafin JA, Tom J, Warren RF, Wickiewicz TL. Immunolocalization of cytokines and their receptors in adhesive capsulitis of the shoulder. J Orthop Res. 1997;15:427–36.
7. Ozaki J, Nakagawa Y, Sakurai G, Tamai S. Recalcitrant chronic adhesive capsulitis of the shoulder. Role of contracture of the coracohumeral ligament and rotator interval in pathogenesis and treatment. J Bone Joint Surg Am. 1989;71(10):1511–5.
8. Hagiwara Y, Mori M, Kanazawa K, et al. Comparative proteome analysis of the capsule from patients with frozen shoulder. J Shoulder Elb Surg. 2018;27(10):1770–8. https://doi.org/10.1016/j.jse.2018.03.010.
9. Redler LH, Dennis ER. Treatment of adhesive capsulitis of the shoulder. J Am Acad Orthop Surg. 2019;27(12):e544–54. https://doi.org/10.5435/JAAOS-D-17-00606.

10. DeLee J, Drez D, Miller MD, Thompson SR. DeLee, Drez, & Miller's orthopaedic sports medicine: principles and practice (fifth edition.). Chapter: shoulder diagnosis and decision making. Philadelphia, PA: Elsevier; 2020.
11. DeLee J, Drez D, Miller MD, Thompson SR. DeLee, Drez, & Miller's orthopaedic sports medicine: principles and practice (fifth edition.). Chapter: stiff shoulder. Philadelphia, PA: Elsevier; 2020.
12. Knipe H. Adhesive capsulitis of the shoulder: radiology reference article. *Radiopaedia Blog RSS*, https://Radiopaedia.org, 27 Nov. 2021., https://radiopaedia.org/articles/adhesive-capsulitis-of-the-shoulder.