

ARTHROSCOPIC CAPSULAR RELEASE

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Introduction

The diagnosis of frozen shoulder, or adhesive capsulitis, is one of exclusion. It is characterized by a limitation of both active and passive range of motion of the glenohumeral joint, which is not primarily due to some underlying condition such as arthritis, rotator cuff tear, cervical radiculopathy, or peripheral neuropathy. The etiology, diagnostic criteria, treatment methods and natural history of this condition are today still under debate and investigation. It is felt that the pathology is a process that first involves inflammation of the synovium, resulting in subsynovial fibrosis. This leads to capsular fibrosis, thickening, and ultimately contracture of the glenohumeral capsule. Contracture of the glenohumeral capsule can be posttraumatic and postsurgical in origin. In particular, this can result from surgical procedures designed to correct glenohumeral instability. Whereas adhesive capsulitis is usually more global, affecting the entire glenohumeral capsule, capsulorrhaphy that is overly tightened may result in primarily anterior or posterior capsular contracture. Isolated posterior capsular contracture can also result from a traumatic traction injury.

Even as our knowledge of the potential pathologic components of adhesive capsulitis has increased, it seems that there is no clear understanding of its natural history. The treatment methods have encompassed a wide variety of techniques. This demonstrates that no truly effective option has been established. Patient-performed home therapy has shown resolution of symptoms, but at a time interval of sometimes two or more years. Physiotherapy, when performed in a more aggressive setting, has been shown to be detrimental to progress and pain relief in some reports. Intra-articular steroid injections and hydraulic distention, have also had variable results. Operative intervention by manipulation under anesthesia has resulted in restored motion and decreased pain, but it has been associated with complications such as fracture, tendon rupture, and neurologic injury. There are reports that manipulation has not been effective and patients remained symptomatic. In a few reports, some patients could not be effectively manipulated under anesthesia and required a conversion to either arthroscopic or open release. A more invasive option, the open release through a deltopectoral approach, has been utilized to restore glenohumeral motion. This is usually reserved for treatment after previous open surgical procedures that have resulted in limitation of glenohumeral motion. In the setting of isolated posterior capsular contracture following posterior capsulorrhaphy, open posterior releases have been proposed to address the pattern of stiffness.

The arthroscope has been utilized in a variety of ways in the assessment and treatment of adhesive capsulitis. It has been used to confirm the diagnosis and to provide a hydraulic distention of the capsule. The arthroscopic approach allows for documentation of the pathology, both grossly and histologically. It has been used after manipulation to investigate the post-manipulation pathology and to address associated factors such as prominent acromion with impingement pathology, and acromioclavicular joint arthralgia. Pollock et al used arthroscopy after manipulation to address these associated factors and showed satisfactory results in 83% of patients.

More recent reports have utilized the arthroscope to perform the capsular release to restore motion, instead of manipulation of the shoulder for releasing or lysing the capsule. The capsular release techniques have been performed in a variety of ways. Initially manipulation would be attempted and, if not successful, then an arthroscopic capsular release would be performed with restoration of motion. Other authors avoided initial manipulation and utilized an arthroscopic technique to perform an inferior capsulotomy and debridement of the synovitis. No manipulation was performed, and this technique revealed 87% good or excellent results. In contrast, other authors have released only the anterior capsule and rotator cuff interval and, then, performed a gentle post-release manipulation avoiding any instrumentation to the inferior capsule. Warner et al used this technique in 23 patients with idiopathic adhesive capsulitis. They reported complete pain relief and restoration of motion within 7 degrees of the unaffected side. Most reports describe the use of an arthroscopic electrocautery device to release the capsule, though some authors have used basket forceps. A study that utilized only a motorized shaver to release the rotator cuff interval and anterior capsule was reported by Ogilvie-Harris and Myerthall in 17 diabetics. The capsular release was carried down to the inferior 6 o'clock position and the intra-articular subscapularis tendon was also debrided with the motorized shaver. Thirteen of these 17 diabetics has no pain and restoration of motion. Pearsall et al utilized a similar release technique dividing the capsule 1 cm lateral to the glenoid rim and releasing the same intra-articular portion of the subscapularis tendon along with the interval and anterior capsule. This was performed with an electrocautery device. Eighty-three percent of their patients felt that their shoulders were pain free and had been restored to near normal motion.

Other authors have performed a more circumferential or balanced release involving the rotator cuff interval, anterior, posterior, and inferior capsular structures. Harryman et al reported excellent restoration of motion and elimination of pain utilizing arthroscopic capsular release forceps (Smith & Nephew Endoscopy, Andover, MA, USA) to resect the capsule both anteriorly, inferiorly and posteriorly. Nicholson et al reported dramatic pain relief and restoration of motion in 36 patients at an average of 3 months after release. They utilized the Arthro wand bipolar electrocautery (ArthroCare, Sunnyvale, CA, USA) and circumferentially released the capsule and rotator cuff interval off the glenoid rim preserving the labrum. The capsular release technique has

shown efficacy not only in idiopathic adhesive capsulitis, but also in postoperative and post injury stiff shoulders. A subset of patients with isolated, refractory posterior capsular contracture have similarly benefited from an arthroscopic capsular release technique addressing the involved posterior capsular structures.

Indications for an arthroscopic capsular release are still evolving. The etiologic process, inciting factors, the pathophysiology, or the natural history of this condition are not fully understood. Therefore, it is difficult to classify the stage of the disease or the severity of the disease, which makes a treatment approach more difficult to define. It is important to urge the patient to be 'patient'. Conservative treatment with gentle stretching and active-assisted range of motion exercises is instituted initially. Non-steroidal anti-inflammatory medication is utilized. The synovial inflammation that is felt to be an initiator of the disease process has motivated us to use glenohumeral intra-articular steroid injections to decrease pain and, hopefully, facilitate restoration of motion. However, there are those patients who do not respond to physician-directed non-operative treatment methods. An arthroscopic capsular release is indicated if patients have had symptoms for over 3 months and have shown no progress or worsening symptoms with a least 6 weeks of home stretching and physician-directed physical therapy. With pain and shoulder dysfunction that is affecting their occupation, recreation, and/or sleep, arthroscopic capsular release is discussed.

Surgical principles

The purpose of the arthroscopic capsular release is to safely and effectively restore motion and function, relieve pain, and shorten the natural history of a painful, stiff frozen shoulder. From clinical and arthroscopic surgical experience, frozen shoulder may represent a common pathway of expression to a variety of initiating causal factors. This process could be caused by, sustained by, or be involved with any or all of the components of the glenohumeral joint capsule (anterior, inferior, posterior), coracohumeral ligament (rotator interval) and/or the subacromial space. The arthroscope allows identification, documentation, and the ability to address all areas of pathologic involvement. It also allows the surgeon to address associated or concomitant conditions, such as a prominent acromion or acromioclavicular joint arthralgia. Arthroscopic capsular release allows for a controlled and less traumatic separation of the contracted tissue that is more complete and balanced than if done by manipulation alone. Following a release, less force is required for the final manipulation to restore full motion. If the arthroscopic capsular release is performed with an electrocautery device, there is less hemorrhage and swelling, with, possibly, less postoperative pain. If the subacromial space or the acromioclavicular joint is involved, these areas can typically be addressed arthroscopically.

To properly and safely complete the procedure, the surgeon must realize that this is a difficult arthroscopy. Initial mobility and therefore, space within the joint is limited, and the synovium can be very friable and cause nuisance bleeding. An arthroscopic pump is vital, and it helps to be able to independently control flow and pressure. A 1:300 000 dilution of adrenaline in the arthroscopic fluid will limit bleeding. A smooth bore cannula for instruments and shavers is easier to pass into the joint than a threaded cannula. One electrocautery device that is preferable is the ArthroWand. The 3.0 mm 90 degrees attachment is relatively stiff and small enough to access tight spots. The 90 degrees direction of the electrodes facilitates cutting into the thickened capsule, and going around corners. The 3 mm width divides and releases a thicker 'stripe' of tissue. The bipolar mechanism arcs the electric current between the electrodes in the tip. This ablates and cuts tissue, as well as coagulates, while not penetrating into the tissue beyond the bipolar zone. This is in contrast to a monopolar hook-type device. This allows for use of a bipolar device in the inferior capsule with less risk to the axillary nerve. However, other types of electrocautery devices can be utilized to effectively release the capsule, as can manual arthroscopic basket forceps or shavers.

An experienced assistant to control the arm is helpful. The joint is initially very tight and small arm movements can facilitate exposure to begin the capsular release. An anesthesiologist who understands the problem the surgical procedure, and the rehabilitation afterwards is an asset, in that a long-acting interscalene regional anesthetic allows for immediate therapy without pain. If an interscalene catheter is used, or if repeat blocks are planned, a good relationship with anesthesiology is essential.

Pitfalls can occur just trying to insert the arthroscopic sheath into the joint in significantly stiff shoulders. The sheath must be directed toward the origin of the long head of the biceps tendon and superior labrum. This will allow for visualization of the contracted arthroscopic triangle anteriorly and, most importantly, avoids direct injury to the articular surfaces. Care must be taken to release the capsule and not the labrum or the rotator cuff tendons. The subscapularis is at particular risk as it is covered by thickened capsular tissue. We have not felt it necessary to release intraarticular portion of its tendon in every case unless there is gross restriction of external rotation. Inferiorly, the axillary nerve has the potential for injury if overzealous release or debridement is performed.

Additional potential complications include inadequate restoration of motion, as well as a slow 'refreezing' of the shoulder. This has been shown to be more likely in the diabetic population. On the other hand, glenohumeral joint instability has not been a problem even after a complete capsule release. Neurologic injury to the axillary or musculocutaneous nerves from the procedure itself or due to the increased joint excursion after the prolonged stiffness is released can occur. Another problem can arise if involvement of the subacromial space or

acromioclavicular joint arthralgia is not recognized and addressed at the time of the arthroscopic capsular release. If left behind as a source of pain, these conditions can lead to treatment failure. Therefore, a preoperative clinical assessment for involvement of the subacromial space and acromioclavicular joint is routine. Radiographs, including a true AP, axillary, outlet, and Zanca projections, will assess the glenohumeral joint, acromion morphology and the acromioclavicular joint. An MRI is also obtained preoperatively to identify any associated or unrecognized pathology.

Surgical technique

We perform this procedure in the lateral decubitus position. A long-acting interscalene block is used. A general anesthetic may also be used in combination. Once anesthesia is established, range of motion is documented for both the involved and uninvolved shoulders. It is of value to note whether the shoulder is as stiff as it was in the office. The planes of motion for measurement are glenohumeral elevation, external rotation at the side and internal rotation. Internal rotation is sometimes difficult, as patients cannot rotate behind their back, and 90 degrees of abduction may not be possible. We try to abduct to at least 45 degrees and assess the magnitude of rotation of the forearm as it drops into internal rotation, which allows us to assess the amount of posterior capsular involvement. Posterior capsular tightness is also evaluated by comparing cross-chest adduction in both shoulders.

Landmarks are outlined and an 18 gauge spinal needle is inserted into the glenohumeral joint from posterior and directed toward the coracoid tip, to allow for infiltration of saline. The capsule is thicker and less compliant than in other shoulder conditions and the humeral head will be tightly opposed to the glenoid. The needle is angled over the humeral head toward the superior labrum biceps tendon origin. Only about 10-15 ml will go into the joint easily, and then significant backpressure will be felt. The arthroscopic sheath and matching trocar, with a blunt tip, are carefully introduced at the same angle and position as the needle. This will help to avoid joint surface damage. If there is a bevel on the arthroscopic cannula, the longer portion is placed superior to further decrease any chance of damaging the articular cartilage. Intra-articular placement is then confirmed by fluid backflow through the sheath.

The pump is typically set at a flow of 200 ml per minute and pressure of 20 mmHg. The contracted, inflamed synovium in the arthroscopic triangle between the long head of the biceps, the upper surface of the subscapularis and the glenoid rim will be visualized. Alternating irrigating and suctioning a few times can improve the view. To establish an anterior portal in an 'outside-in' method, a spinal needle is placed through the skin from just lateral to the coracoid tip into the arthroscopic triangle under direct observation. After a skin incision in this position, a smooth 7 mm cannula is inserted into the joint.

Gelatinous synovial material, at the root of the biceps over the rotator cuff interval and typically down the anterior capsule into the axillary pouch, will be encountered in the majority of cases. This material is debrided with a motorized shaver, usually a 4.0 or 4.5 mm size. It is interesting to note that as this material is debrided it does not bleed. As much synovial hyperplasia as can easily be debrided is removed at this time. The capsular release begins with the rotator cuff interval. The release of the interval and anterosuperior capsule creates space to work in and allows us to proceed with the release inferiorly under direct visualization. At this point, the cannula is removed anteriorly and a 3.0 mm 90 degree AthroWand is introduced down the track of the cannula into the joint. A 90 degree tip allows the surgeon to rotate the instrument and cut in 360 degrees, including back towards the entry point of the instrument. This is especially helpful in the rotator cuff interval, where the coracohumeral ligament and interval tissues are usually quite thick and shortened. The interval is released along the 'base' of the arthroscopic triangle medially, from just anterior to the biceps down to the upper subscapularis, paralleling the glenoid rim. Electrocautery is used to release the tissue parallel to the thickened upper border of the subscapularis. The capsule is released just off the glenoid rim, preserving the labrum. As the thickened capsule is released from superior to inferior, the superior glenohumeral ligament, middle glenohumeral ligament, and the very thickened anterior (superior) band of the inferior glenohumeral ligament are divided. In the normal shoulder, this region of the inferior glenohumeral ligament is approximately 3 mm thick. However, it typically is very difficult to identify differences in the capsule as it is more like a wall of collagen'. At times, thickened tissue above the biceps can be released with a shaver or basket forceps.

By lowering the arthroscope into the joint parallel to the glenoid surface, the joint can be gently distracted, facilitating exposure as the release moves into the anteroinferior area. The electrocautery tip is oriented parallel to the anterior glenoid surface and placed between the labrum and capsular attachment. The goal is an extralabral capsular release off the glenoid, creating a sleeve of capsule. The subscapularis tendon is not routinely released or violated, and we have not found it necessary to involve this structure in the release. Exposure can be maintained with mild abduction of approximately 30-40 degrees and alternating between 20 and 30 degrees of internal and external rotation. With the release down to the 7 o'clock position in a left shoulder, the electrocautery is now used to release the inferior capsule. The ArthroWand tip, being bipolar, can now be oriented up, away from the axillary nerve, and placed in the 'axilla' of the capsular release. The capsule is released off the inferior glenoid rim around to the 6 o'clock position, as the pathology allows. If the inferior capsule is dramatically thickened, the electrocautery will debulk this tissue and allow for an easier dehiscence of this tissue during the final manipulation. Alternatively, a basket forceps can be used carefully, under direct visualization, to release tissue adjacent to the glenoid rim in this region. The posterior capsule is now assessed for involvement which is found in the majority of patients. In the setting of an

isolated posterior capsular contracture, the procedure has essentially been a diagnostic arthroscopy until this point. If additional pathology has been encountered, such as a partial tear requiring debridement, it should be addressed prior to proceeding with the posterior capsular release. The arthroscope is now placed in the anterior portal. The electrocautery is placed through the posterior portal. The posterior capsular release begins over the posterosuperior recess where the disease can obliterate this recess and tether the supraspinatus tendon to the glenoid rim. A good landmark is to start the release just posterior to the biceps tendon insertion. The release is carried down posteriorly to meet the previous anterior release. Division of the posterior capsule is performed adjacent to the glenoid rim, because the muscle of the posterior cuff tendons is superficial to the capsule at this level. Therefore, the depth of the capsular division is completed when one visualizes the muscle fibers. An arthroscopic shaver can be inserted to remove the edges of the capsule to clearly identify the release and rotator cuff muscle. If the capsule is divided more laterally, there is risk of injuring the rotator cuff tendons, which become conjoined with the capsule in this location.

Once the circumferential release is completed, the instruments are removed and the shoulder is put through a gentle range of motion with proximal humeral pressure. The manipulation proceeds in the following sequence: scapular elevation, abduction, external rotation at the side, external rotation in abduction, and internal rotation in abduction. Typically, there is a small sensation of giving way as opposed to the sudden snap felt in a traditional manipulation. The arthroscope is reintroduced into the glenohumeral joint. Typically, there is minimal bleeding. The subscapularis tendon is now seen to be freely mobile and visible anteriorly. The arthroscope can now navigate more easily through the joint, allowing for complete visualization of the cartilage surfaces and the rotator cuff superiorly.

Attention is now turned to the subacromial space. Standard bursal portals are utilized and the subacromial space is evaluated. In only approximately 20% of idiopathic frozen shoulder cases will there be significant involvement. In patients with a history of impingement syndrome, trauma such as non-displaced greater tuberosity fractures, or postsurgery, the subacromial space may require debridement and acromioplasty particularly if a prominent acromion or osteophyte is detected on the preoperative outlet radiograph. If the subacromial space is just mildly involved and the clinical preoperative symptoms were felt to be due to the altered mechanics of frozen shoulder, then the subacromial space does not require further intervention. This is to minimize the surgical trauma, reduce bleeding, and avoid further postoperative pain and swelling. If acromioclavicular joint arthralgia is identified preoperatively, an arthroscopic acromioclavicular joint resection is performed.

The portals are closed in a routine fashion. A sling and swathe are applied to protect the arm for the duration of the interscalene regional block. The arm is

kept in an abducted position and neutral rotation, and not internal rotation, using an attachment to the sling, such as the Apex derotation wedge . A passive cold compressive device, such as the Cryocuff , is applied to the shoulder. If general anesthesia has not been utilized, the patient with the long-acting interscalene block in place goes immediately to the ward for bedside physiotherapy.

Postoperative protocol

We have used a 23-hour observation stay, and always attempt to do the capsular release procedures as the first case of the day. This allows for physical therapy to be performed twice on the operative day and once the following morning. If permitted, an additional hospital day may be considered. Some studies have reported protocols with repeat interscalene blocks in the morning on postoperative days 1 and 2 to allow for additional inpatient passive range of motion exercises with the physical therapist. The interscalene block allows the patient and the therapist to begin immediately. This vividly demonstrates to the patient that their shoulder can be moved in a more normal range without pain, which is positive reinforcement in two ways. First, patients are pain free and see their shoulder move, especially when it is placed overhead. Second, mentally it is a tremendous experience for these patients who have suffered through time and effort and have not been able to restore motion. Clearly, a good relationship with the physical therapists is beneficial. Intramuscular and oral narcotics are utilized, as is intramuscular tramadol, in the hospital. Oral tramadol is continued for 4 more days. After the block has resolved, patients are encouraged to use the shoulder out of the sling and wedge device for dressing, eating, and activities of daily living. Pendulums, pulley exercises, passive external rotation with a stick and internal rotation both cross body and behind the back are emphasized. A home physical therapists is beneficial. Intramuscular and oral narcotics are utilized, as is intramuscular tramadol, in the hospital. Oral tramadol is continued for 4 more days. After the block has resolved, patients are encouraged to use the shoulder out of the sling and wedge device for dressing, eating, and activities of daily living. Pendulums, pulley exercises, passive external rotation with a stick and internal rotation both cross body and behind the back are emphasized. A home exercise kit, with a pulley and stick, should be available. Patients are instructed to do their exercises at home three to four times a day with each session lasting only 15-20 minutes. Warm moist heat prior to, and ice after, the sessions are utilized. Pre-medicating with analgesics is helpful prior to home exercises and physical therapy.

Outpatient rehabilitation, with a physical therapist that appreciates the underlying problem and treatment goals, is initiated immediately upon discharge at three times per week for the first 3 weeks, then two or three times a week for the next 3 weeks. A more frequent therapy program may be considered, if permitted. Motion only is emphasized. No machines, no therabands for resistive exercises and no weights are lowered until pain free motion has been restored. Patients will only irritate their shoulder and lose motion if strengthening is started too soon.

Usually at 6-8 weeks, light theraband exercises can begin. The average time to restore pain-free final motion was 3 months, with a range from 3 weeks to 5 months, in a prospective study on arthroscopic capsular release. Insulin dependent diabetics had a somewhat longer average time to achieve pain-free motion. Strengthening exercises tended to irritate the diabetic shoulders even at 3 months following capsular release. We have reserved the use of home shoulder CPM for those patients that we feel are higher risk, such as insulin-dependent diabetic patients, and those who have a failed previous intervention, such as a manipulation. Return to normal activities of daily living, sporting activities, and full duty employment has averaged approximately 3 months. However, patients are able to return to modified duty or lighter activity around 3 weeks, but the emphasis is always upon the rehabilitation task first.

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