Technical Note

Arthroscopic Management of Arthrofibrosis After Hemiarthroplasty for Proximal Humerus Fracture Dislocation

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Abstract: Poor functional outcomes after hemiarthroplasty for proximal humerus fractures are common, yet revision surgery is relatively rare. Arthroscopic treatment for postoperative stiffness can be considered in the setting of functional limits to glenohumeral range of motion impacting activities of daily living after adequate conservative treatment with physical therapy and in the setting of healed, well-positioned tuberosities and humeral components. This Technical Note illustrates a stepwise approach to an arthroscopic lysis of adhesions and capsular release for the treatment of arthrofibrosis of the shoulder. The advantages of this technique include an alternative approach to entering the glenohumeral joint under direct subacromial visualization and a 2-posterior portal approach to the inferior and anteroinferior capsule, which can be challenging to achieve in the setting of severe postsurgical arthrofibrosis.

Arthrofibrosis represents a broad spectrum of disease and is characterized by excessive periarticular scar formation resulting in joint stiffness and contractures driven by excess collagen production and deposition of extracellular matrix.[1] Capsular contracture and extra-articular adhesions within the subacrominal, subdeltoid, and subcoracoid planes contribute to the pathologic process of shoulder stiffness. Risk factors for arthrofibrosis include diabetes, prolonged immobilization, high-energy trauma, external fixator use, infection and poor or delayed rehabilitation.[1-3] The incidence of arthrofibrosis after proximal humerus fracture fixation is poorly reported in the current literature. However, the incidence of arthrofibrosis after open shoulder procedures is reported anywhere from 0.75% to 4%.[4-6]

Due to the compensatory nature of the periscapular musculature, the shoulder may compensate for motion loss. The functional glenohumeral range of motion required to performed activities of daily living (ADLs) is approximately 120° of forward elevation, 130° of abduction, and 60° of external rotation.[1] Nonoperative treatment focused on physical therapy is the first-line treatment in the management of postoperative arthrofibrosis. Arthroscopic lysis of adhesions should only be considered after hemiarthroplasty for fracture in the setting of a stiff shoulder impeding ADLs living without improvement after 6 months of conservative treatment with physical therapy and in the setting of well-positioned humeral components and healed tuberosities. Manipulation under anesthesia alone is not recommended due to the risk of iatrogenic injury to the shoulder (e.g. fracture or rotator cuff tear). This Technique Note describes a stepwise approach to an arthroscopic lysis of adhesions performed in the setting of arthrofibrosis after hemiarthroplasty for fixation of a proximal humerus fracture dislocation.

Surgical Technique (With Video Illustration)

Patient Evaluation, Imaging, and Surgical Indications

Regardless of mechanism of injury, after sustaining an injury to the proximal humerus, plain radiographs of the shoulder and humerus are required to fully characterize the fracture pattern (Fig 1). In the setting of a proximal humerus fracture–dislocation with significant comminution in an active laborer, primary open reduction

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internal fixation may not be achievable, with high risk of failure, and, therefore, acute hemiarthroplasty is a viable surgical option for treatment (Fig 2). Close clinical follow-up is required for evaluation of postoperative functional recovery, including range of motion and strength testing. There is a greater chance of postoperative stiffness after hemiarthroplasty for fracture, and, therefore, aggressive physical therapy is required after complete healing of the tuberosities to regain functional range of motion. Typically, significantly limited range of motion leading to impaired ADLs is an indication for revision surgery, after completion of 6 months of formal physical therapy. The functional glenohumeral range of motion required to performed activities of ADLs is approximately 120° of forward elevation, 130° of abduction, and 60° of external rotation.[1] In the setting of postoperative shoulder stiffness and arthrofibrosis after a hemiarthroplasty for fracture with healed tuberosities and no hardware issues, lysis of adhesions and capsular release can be performed though an all-arthroscopic approach.

Positioning and Examination Under Anesthesia

The patient is positioned in the lateral decubitus position after induction of general anesthesia with an ultrasound-guided interscalene nerve block. An examination under anesthesia (Video 1) is performed to assess preoperative range of motion of the shoulder to include forward elevation, internal rotation, and external rotation with the arm at the side and at 90° of abduction. After the completion of the examination under anesthesia, the extremity is prepped and draped in standard fashion and placed in suspension.

Entering the Glenohumeral Joint

In the setting of severe arthrofibrosis, the glenohumeral joint may not be easily accessible through a standard posterior arthroscopic viewing portal. In addition, iatrogenic injury to the shoulder or damage to the arthroplasty component is likely with forceful attempts at inserting the scope sheath and trochar. Therefore, a 30° arthroscope can initially be placed into the subacromial space from a standard posterior viewing portal to begin the work necessary to access the joint under direct visualization.

Preparation of the Subacromial Space

First, a lateral working portal is established in the subacromial space under direct visualization using a spinal needle (Video 1). A bursectomy is performed in the subacromial space to create a working space and identify the appropriate landmarks to create an anterior working portal. The borders of the acromion and coracoacromial (CA) ligament are defined using an electrocautery wand, which serve as important landmarks to establishing the anterior portal under direct visualization from the subacromial space (Video 1).

The view is changed to a 70° arthroscope from lateral, and capsular adhesions at the deltoid, rotator cuff interval, subscapularis, and conjoint tendon are all released (Fig 3). The subacromial space is debrided until the supraspinatus and subscapularis tendons, CA ligament, coracoid bone, and conjoint tendon are all clearly visible, which are the landmarks needed to safely establish an anterior working portal under spinal needle localization (Fig 4).

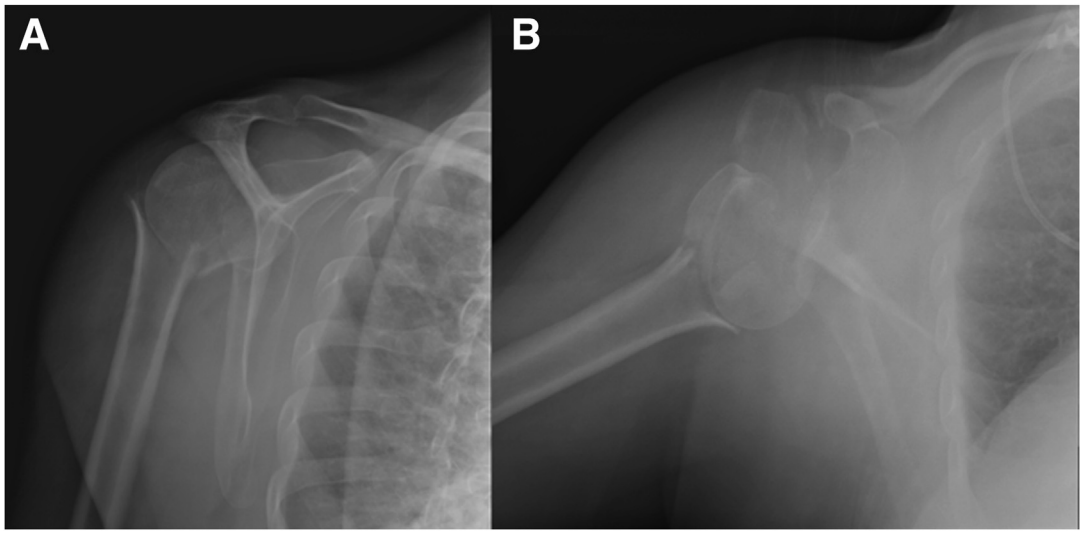

Fig 1. Plain radiographs of the right shoulder including scapular Y (A) and Velpeau (B) views at the time of injury after a 10-foot fall demonstrate a comminuted proximal humerus fracture dislocation with posterior humeral head subluxation. Surgical treatment of fracture dislocation of the proximal humerus with significant comminution using hemiarthroplasty is a safe and effective approach with good overall patient outcomes.

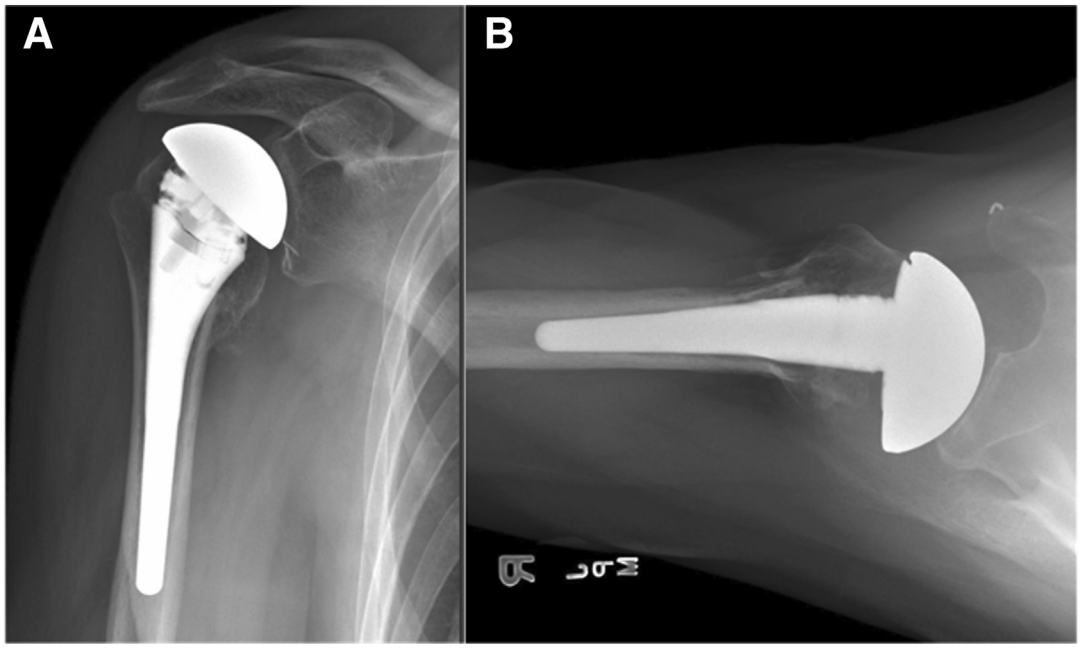

Fig 2. Plain radiographs of the right shoulder including Grashey (A) and axillary lateral (B) views at 6 months after hemiarthroplasty (Arthrex, Naples, FL) for the treatment of a proximal humerus fracture dislocation demonstrate appropriate healing of the tuberosities and well-fixed implant. Immediate postoperative recovery included abduction sling for 6 weeks with passive range of motion initiated at 2 weeks. At the time of initial fixation, close attention should be paid to the quality of anatomic reduction of the greater and lesser tuberosities, which can be anatomically fixed to the humeral shaft through the implant using high strength suture.

Intra-articular Access Through an Anterior Portal

To establish an anterior portal to access the glenohumeral joint, the spinal needle is positioned lateral to the conjoint tendon and into the soft area of the rotator cuff interval, superior to the subscapularis tendon. A switching stick is then placed through the portal incision and bluntly placed thought the interval and into the joint. An extra scope sheath is placed over the switching stick (Video 1) to establish the intra-articular view using a 30° arthroscope. Next, a posterior working portal is established under direct visualization. A pencil-tip monopolar cautery device is used through the posterior working portal to release the inferior capsule (Fig 5), followed by the posterior capsule (Fig 6). Care must be taken at all times in releasing the inferior capsule due to the proximity of the axillary nerve. A postage stamp—type perforation of the inferior capsule can be made if there is danger suspected to the axillary nerve during release.

Posterior Viewing Portal With 30° and 70° Arthroscopes

Next, the arthroscope is moved to the posterior portal. Initially, the rotator interval and middle glenohumeral ligament (MGHL) are released through the anterior or anterosuperior portal using electrocautery viewing with a 30° arthroscope. However, once the landmarks of the coracoid, subscapularis, conjoint tendon, and CA ligament are clearly visualized, a 70° arthroscope can be safely used to perform lysis of adhesions around the subscapularis, in the subcoracoid space and of the superior part of the anterior capsule (MGHL) (Video 1).

Accessory Posterior Inferior Working Portal

Next, the arthroscope is placed back through the anterior portal (30° view) and posterior inferior working portal is established under direct visualization with a spinal needle. Pencil tip cautery is used to continue the inferior capsular release through the anterior band of the inferior glenohumeral ligament (Fig 7) connecting this to the MGHL and to the rotator cuff interval release, essentially creating a 360° pancapsular release. In the current case, one final portal change (posterior viewing, anterosuperior working) was necessary to complete the release. Again, the subscapularis and axillary nerve are the structures most at risk with the procedure, and care must be taken to respect these structures when completing the pancapsular release in the setting of previous surgery and altered anatomy.

Manipulation Under Anesthesia and Final Arthroscopic Work

The procedure is completed by bringing the arm out of suspension and placed through gentle manipulation. Any remaining adhesions can be broken up during this

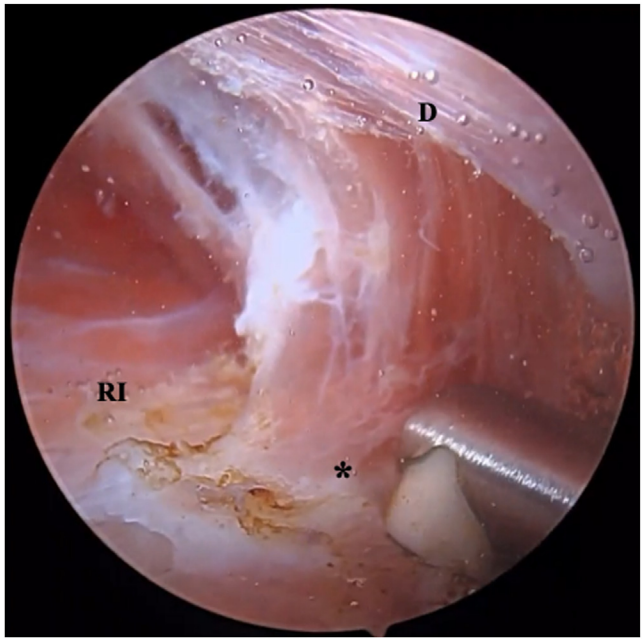

Fig 3. Arthroscopic view of the subacromial space in a right shoulder through a posterior viewing portal and lateral working portal using a 70° arthroscope and arthroscopic cautery device demonstrates release of extra-articular adhesions (*) between the deltoid (D) and tissue of the rotator interval (RI) and rotator cuff. Preparation of the subacromial space begins with a thorough bursectomy to identify the appropriate landmarks to create an anterior working portal.

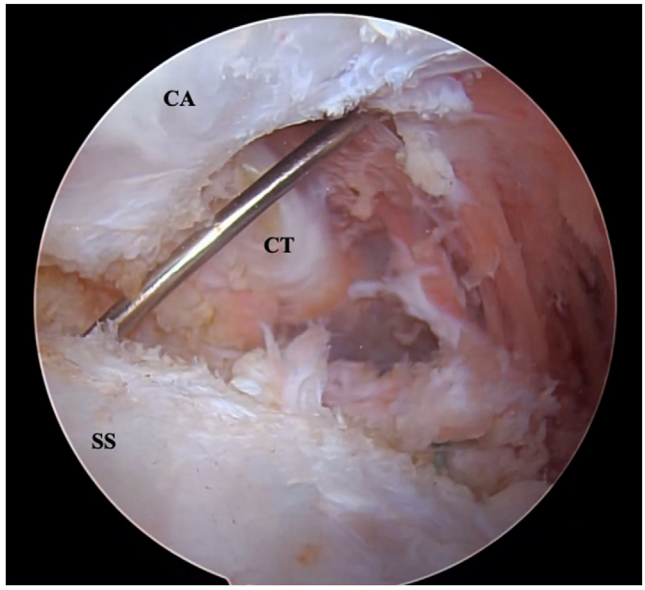

Fig 4. Arthroscopic view of a right shoulder with a spinal needle through a posterior viewing portal and lateral working portal using a 30° arthroscope is being used to localize the correct placement of an anterior portal which is below the coracoacromial ligament (CA), lateral to the conjoint tendon (CT), superior to the subscapularis tendon, and inferior to the supraspinatus tendon (SS). After appropriate landmarks are identified within the subacromial space, intra-articular access to the glenohumeral joint can be achieved through an anterior working portal under spinal needle localization.

step, as well as addressing muscular thixotrophy from disuse. A glenohumeral joint diagnostic arthroscopy is repeated utilizing a posterior portal (70° arthroscopic view, shown in Video 1) to document no iatrogenic injury during manipulation. Debridement and lysis of adhesions in the subacromial space is finished through a posterior working portal using a lateral portal 30° arthroscopic view to release any final adhesions in the subacromial space (Fig 8).

Closure and Postoperative Care

The arthroscopic portal incisions are closed transcutaneous and the extremity is placed in a shoulder sling. Adequate postoperative pain control and adherence to an immediate, rigorous physical therapy protocol is integral to the clinical success of the procedure. The patient is allowed to use the extremity as tolerated without restriction with physical therapy initiated immediately postoperatively for active and passive range of motion of the shoulder. The shoulder sling is discontinued within 3 days of surgery. After 4 to 6 weeks of maintained range of motion, shoulder strengthening exercises are initiated.

Discussion

Although the pathogenesis of arthrofibrosis is not fully understood, arthroscopic lysis of adhesions has been shown to be an effective treatment method.[1,3] However, in severe cases (e.g. with post-traumatic and postsurgical fibrosis) intra-articular access to the glenohumeral joint is a challenge. The current case demonstrates an arthroscopic technique for arthroscopic pan-capsular release with lysis of adhesions in the management of glenohumeral arthrofibrosis after hemiarthroplasty for a proximal humerus fracture dislocation. This technique offers an alternative method to gain intra-articular access by starting in the subacromial space, as opposed to the standard intra-articular posterior viewing portal, by identifying bony landmarks to establish an intra-articular portal through the subacromial space. This technique also describes a 2 posterior portal technique, which can facilitate the inferior capsular release anteriorly where this work can be a technical challenge. In this fashion, a 360° controlled release can be safely accomplished. The key pearls and pitfalls of this technique are outlined in Table 1.

Arthroscopic treatment of arthrofibrosis of the glenohumeral joint is rarely described in the published literature after open treatment of a proximal humerus fracture, yet poor outcomes to include postoperative stiffness are common after fixation or arthroplasty for the treatment of proximal humerus fractures. The

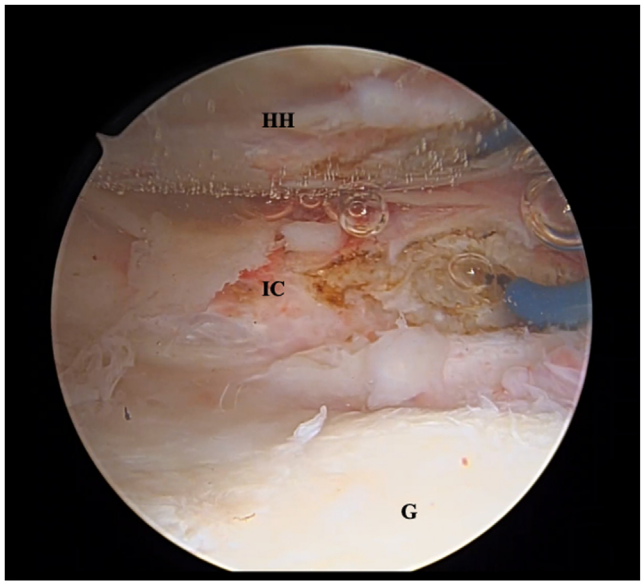

Fig 5. Anterior portal 30° intra-articular view in the beach-chair position of a right shoulder demonstrates an inferior capsule (IC) release from a posterior working portal using a pencil tip monopolar cautery device. Care must be always taken in releasing the inferior capsule due to the proximity of the axillary nerve. A postage stamp–type perforation of the inferior capsule can be made if there is danger suspected to the axillary nerve during release. (G, glenoid; HH, prosthetic humeral head.)

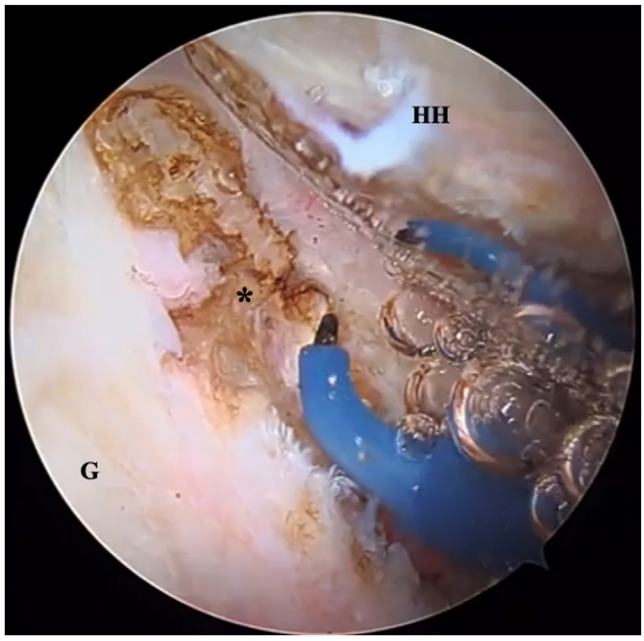

Fig 7. Posterosuperior 30° intra-articular view in the beach-chair position of a right shoulder demonstrates release of the anterior band of the inferior glenohumeral ligament (AIGHL) (*) using a posteroinferior working portal. An accessory posterior inferior working portal is established to continue the inferior capsular release from the AIGHL to the middle glenohumeral ligament and the rotator interval, creating a 360° pancapsular release. (G, glenoid; HH, prosthetic humeral head.)

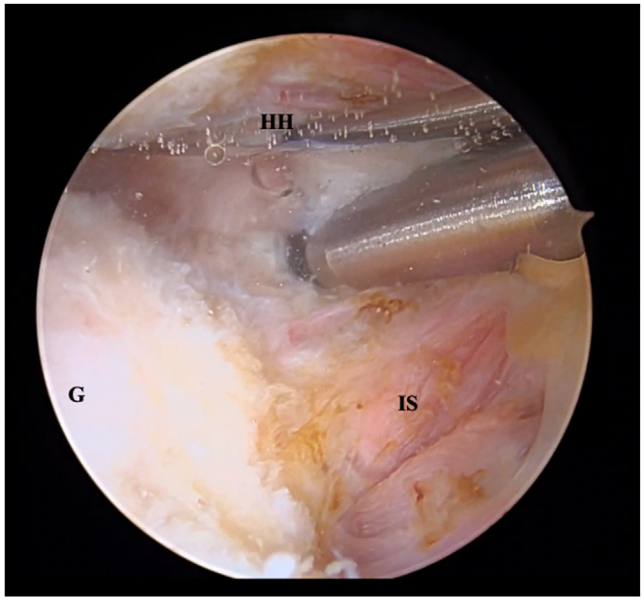

Fig 6. Anterior portal 30° intra-articular view in the beach-chair position of a right shoulder demonstrates the posterior capsule release and the exposed muscular fibers of the infraspinatus (IS). A step-wise approach should be taken to perform a complete capsular release, starting with the inferior and posterior release performed from the anterior portal. (G, glenoid; HH, prosthetic humeral head.)

balance between immobilization for fracture healing and early active motion can be difficult to achieve. Barth and Burkhart[7] suggested that adequate immobilization to prioritize bone healing should be the primary goal, especially in highly comminuted fracture patterns, as healing of the tuberosities is critical to postoperative function and range of motion.[8] Furthermore, arthrofibrosis can be treated effectively with a subsequent arthroscopic capsular release, whereas the sequela of a proximal humerus fracture nonunion or loss of fixation can be catastrophic. Katthagen et al.[8] demonstrated greater than 100% improvement in forward elevation, abduction, internal rotation, and external rotation 2 years after arthroscopic capsular release to treat postoperative shoulder stiffness following proximal humerus locking plate fixation for fracture.

The main risks of this technique are incomplete visualization of extra-articular adhesions and capsular contractures due to inadequate identification of the bony landmarks within the subacromial space. In addition, the axillary nerve is most at-risk during connection of the inferior capsular release to the anterior capsule release through the posterior inferior working portal, which can be mitigated by staying within approximately 1 cm of the inferior glenoid rim during the release and by using a

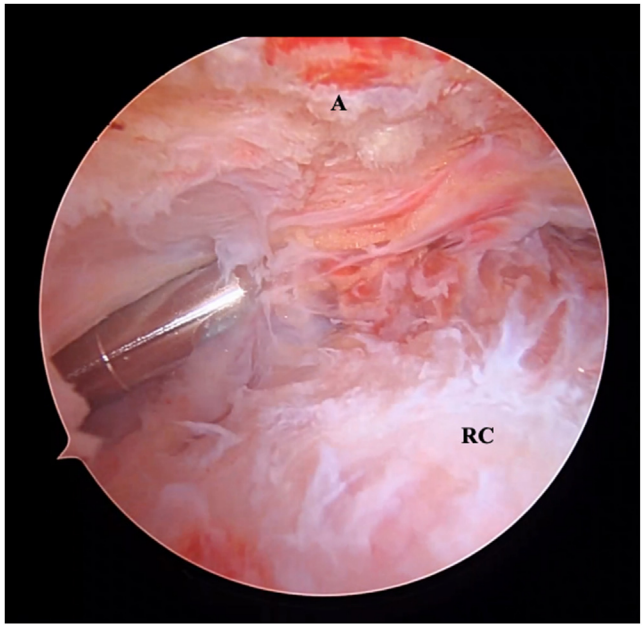

Fig 8. Lysis of adhesion and debridement taking place in the subacromial space over the posterosuperior rotator cuff, which is completed through a posterior working portal using a lateral 30° subacromial view in the beach-chair position of a right shoulder to release any final adhesions After gentle manipulation, a glenohumeral joint diagnostic arthroscopy is repeated to document no iatrogenic injury during manipulation. (A, acromion; RC, rotator cuff.)

pencil tip hooked electrocautery probe for a controlled release. Overall, this technique describes a safe and effective method for arthroscopic treatment of arthrofibrosis after hemiarthroplasty for a proximal humerus fracture dislocation.

Disclosures

The authors report the following potential conflicts of interest or sources of funding: M.T.D. reports editorial board member, *Arthroscopy*; and board or committee member, American Academy of Orthopaedic Surgeons and Society of Military Orthopaedic Surgeons, outside the submitted work. D.J.C. reports editorial board member, *Arthroscopy*, outside the submitted work. A.J.S. reports stock from Springbok Analytics; personal fees from Stryker, outside the submitted work; editorial board member, *Arthroscopy*; and board or committee member, American Orthopaedic Society for Sports Medicine and Society of Military Orthopaedic Surgeons, outside the submitted work. R.U.H. reports personal fees from Wolters Kluwer Health—Lippincott Williams & Wilkins; personal fees and research support from Stryker; editorial board member, *Arthroscopy*; and board or committee member, American Shoulder and Elbow Surgeons and AANA, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Table 1. Key Points to Arthroscopic Lysis of Adhesions for Arthrofibrosis of the Glenohumeral Joint

Pearls	Pitfalls
Begin by placing the arthroscope in the SAS through a posterior viewing portal in severe cases.	Failing to recognize/address implant malpositioning as a contributor to loss of motion.
Establish the bony landmarks of the SAS before introducing the 70° arthroscope (acromion, CA ligament and coracoid).	Causing iatrogenic damage to the metal prosthesis during arthroscopy.
Use an additional scope sheath placed over a switching stick to quickly move between viewing portals in the SAS.	Causing intraoperative fracture or injury to the rotator interval with an aggressive MUA.
An accessory posterior inferior portal is helpful for complete release of the inferior capsule.	Failing to release tight capsular tissue in 360° fashion.
Use all portals interchangeably for optimal visualization and access to a 360° pancapsular release.	Failing to perform controlled release of the inferior capsule causing injury to the axillar nerve.
Adequate pain control postoperatively and immediate physical therapy are critical to a successful outcome.	Having poor visualization in the SAS due to incomplete bursectomy and debridement.

CA, coracoacromial; MUA, manipulation under anesthesia; SAS, subacromial space.

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