Technical Note

Arthroscopic Management of Stiffness and Anterior Shoulder Pain Following Reverse Shoulder Arthroplasty

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Abstract: Arthroscopy following shoulder arthroplasty has primarily been described as a diagnostic tool in the setting of unexplained pain. However, this tool also can be used to potentially manage postoperative stiffness and pain following reverse shoulder arthroplasty. This Technical Note provides a stepwise approach to assessing and addressing limitations in range of motion as well as causes of postoperative impingement following reverse shoulder arthroplasty.

Shoulder arthroscopy following shoulder arthroplasty frequently has been reported as a diagnostic tool. Indications include persistent pain, diagnosis of infection, evaluation for component loosening, and treatment of stiffness. Akgün et al. reported that arthroscopy was highly sensitive and specific for diagnosing infection in patients after shoulder arthroplasty.[1,2] In addition, as described by Tytherleigh-Strong et al.,[3] arthroscopy has shown utility for treatment of pain or limitation of motion after anatomic shoulder arthroplasty. However, little attention has been paid to the use of arthroscopy following reverse shoulder arthroplasty (RSA).

Despite generally positive results, postoperative pain is not uncommon after RSA.[4] In a retrospective review of 87 primary RSAs, Werner et al.[5] reported that 33% to 45% of patients failed to meet a patient acceptable symptom state. The majority of failures were accounted for by postoperative pain, which was greater among patients who did not meet a patient acceptable symptom state (0.3 vs 3.1; $P < .001$). While there are a variety of causes of persistent pain following RSA, 2 noninfectious causes potentially amenable to arthroscopic treatment include stiffness and subcoracoid stenosis. The latter is inherent to the constrained and medialized nature of the RSA design, which predisposes to contact between the coracoid tip and prosthesis while performing adduction, forward flexion (FF), and internal rotation (IR).[6-8] Even in lateralized designs, some patients still experience coracoid impingement or conjoined tendonitis, leading to anterior pain.

We propose that both postoperative stiffness and subcoracoid impingement following RSA have the potential to be addressed with arthroscopy. While the constrained joint requires a unique approach following RSA, the approach can be safely performed with minimal risk to the patient. The objective of this Technical Note is to provide a systematic approach to the arthroscopic management of postoperative pain and stiffness following RSA.

Surgical Technique (With Video Illustration)

Indications

This approach is used to address 2 noninfectious indications for arthroscopy following RSA: (1) debridement

of mechanical impingement (i.e., subcoracoid stenosis); and (2) lysis of postoperative adhesions.

These procedures may be combined and follow a stepwise approach as subsequently outlined. The 2 indications are only considered a minimum of 6 months following RSA and following failure to respond to conservative measures. All other sources of pain are considered before arthroscopic management, ruling out cervical spine issues, stress fracture with the use of computed tomography scans, and infection with laboratory tests and potentially aspiration. In our experience, debridement procedures may be associated with success at time points distant from surgery (i.e., more than a year following RSA). However, lysis of adhesions for postoperative stiffness is best performed within a year following surgery, as prolonged delay is likely to lead to irreversible changes in the muscle (thixotropy).

The diagnosis of subcoracoid impingement is made based on a combination of pain with palpation directly medial to the coracoid tip and pain that is reproduced with cross-body adduction with or without combined IR. The diagnosis of postoperative stiffness is most reliably made when external rotation (ER) at the side is limited both actively and passively, particularly if there is loss of ER compared with preoperative status. Impingement between the acromion and tuberosity are uncommon but also can be assessed by evaluating for a combination of active and passive loss of abduction, and a radiographic explanation for the impingement such as a prominent tuberosity osteophyte or inferior acromial osteophyte. In addition, this is the reason why intraoperative assessment of abduction is only performed after addressing subcoracoid pathology.

Technique Description

The pearls and pitfalls of the procedure are outlined in Table 1. The patient is placed in the in either the beach-chair or lateral decubitus position; the authors favor lateral decubitus. An examination under anesthesia is performed to assess and document passive range of motion (ROM) in FF, abduction, ER at the side, and IR with arm in 90° of abduction. As the constrained joint of the RSA does not allow intra-articular access, diagnostic arthroscopy begins in the subacromial space with a slightly higher posterior portal to avoid implant contact on entry (Video 1).

A posterior portal is first created in the standard fashion and a diagnostic examination is performed with a 30° arthroscope. A 70° arthroscopy can be helpful if it is difficult to visualize low anterior when performing coracoid debridement and release. A lateral portal is established and the subacromial space is re-established. The subacromial space is typically free from adhesions and easily identified. In the setting of substantial postoperative adhesions, we find it most predictable to locate the space by driving the scope to the anterolateral

portion of the acromion and pulling back slightly. Then, a spinal needle can be inserted and the space re-established with a shaver (Bone Cutter; Arthrex, Naples, FL) beginning above the greater tuberosity and progressing posteriorly (Fig 1). In the absence of the rotator cuff direct access to the components allows assessment and cultures if needed. In a rotator cuff intact RSA, the joint is not readily accessible. In this case, the scope may need to be directed more inferior (Fig 2).

Next, an anterior portal is established to access the rotator interval region and subcoracoid space. This space is typically the largest focus of pathology and debridement. The goal is clear the entire space between the coracoid and the anterior aspect of the prosthesis. It is helpful to establish the anterior portal slightly lateral to allow access to the posterior coracoid. If there are extensive adhesions, 1 of 2 progressions (coracoid tip to anterior glenoid or vice versa) are carried out based on whichever is most easily identifiable. The first approach is to identify the coracoid tip and work medial to the base of the coracoid, then back to the anterior glenoid. The first step of this approach is to identify the coracoacromial ligament while working from the lateral portal. In this space, a combination of a shaver and radiofrequency (RF) ablator (Apollo RF MP90; Arthrex) are used to follow the coracoacromial ligament inferior and medial to the tip of the coracoid. We prefer to begin with RF dissection (cut level setting of 7 [225 W power and 200 Ohms resistive load]) until bony landmarks are clearly visualized, as the RF provides feedback when in proximity to neurologic structures and limits bleeding common with scar tissue. The shaver can be used for more thorough clearing of adhesions once the bony landmarks are clearly visualized. Dissection then proceeds from the tip of the coracoid to the base, and then back laterally to the anterior glenoid. In the second approach, the superior aspect of the glenoid is identified. Dissection is carried out between the 12-o'clock and 3-o'clock positions (rotator interval region) until the anterior glenoid and glenosphere are identified. In the second approach, the anterior aspect of the greater tuberosity is first identified. Subsequent dissection is then carried medially along the anterior aspect of the prosthesis until to the glenosphere is observed. Then, dissection continues toward the base of coracoid. Finally, dissection is continued until the tip of the coracoid is reached while taking care to keep the dissection on bone and not to stray medial to the coracoid process.

With either approach dissection is carried out via an anterolateral working portal typically 2 to 3 cm inferior to the anterolateral tip of the acromion; the portal is typically lower than a standard anterolateral portal due to distalization following RSA. This portal is established with an outside-in technique using a spinal needle as a

Table 1. Pearls and Pitfalls of Arthroscopy After RSA

Pearls
    Assess passive range of motion in patient under anesthesia
    Establish diagnosis using posterior portal
    Enter subacromial space with lateral portal and re-establish as necessary
    Re-establish the subcoracoid space via anterolateral portal inferior to anterolateral tip of acromion
    Take biopsies if indicated
    Perform coracoplasty if indicated
    Reassess internal and external rotation
        If external rotation remains limited, consider release of subscapularis tendon
    Reassess abduction and forward flexion
        If both remain limited, consider tuberoplasty
Pitfalls
    Failure to begin in the subacromial space with a slightly higher posterior portal may result in implant contact
    When dissecting, straying medially from the coracoid and extending beyond 3 cm inferior to the upper border of the subscapularis tendon may
        lead to neurovascular damage
    Debriding the greater tuberosity excessively may violate the polyethylene liner

RSA, reverse shoulder arthroplasty.

guide. The spinal needle is used to obtain an angle of approach that is parallel to the coracoid and anterior to the prosthesis, and angled toward the base of the coracoid. We typically use a 70° arthroscope to visualize subsequent dissection, although another option is to move the 30° arthroscope to the lateral portal at this stage.

Once the tip of the coracoid and anterior glenosphere have been visualized, there are clear landmarks for clearing the subcoracoid space. Medially, the dissection is limited to the base of the coracoid. Anteriorly, the border is the coracoid tip and conjoined tendon, which we preserve. Inferiorly, dissection is carried out to the inferior aspect of the lesser tuberosity at the level of the humerus. However, medial to the joint line dissection should proceed no more than 3 cm inferior the upper border of the subscapularis tendon to avoid neuro-vascular damage (Fig 3). If the subscapularis is absent the base of the coracoid can be used as landmark from which dissection should not proceed 3 cm inferior medial to the joint line. The subcoracoid space is then re-established. Care is taken to preserve the conjoined tendon anteriorly. Recession of the tendon slightly to allow for appropriate resection of bone is performed.

At this point, the coracohumeral interval is assessed. In the setting of subcoracoid impingement, there is sometimes evidence of metallosis from mechanical impingement of the humeral component upon the coracoid. Any prominence of the coracoid that projects posterior to the conjoined tendon is treated with a coracoplasty using a 5.0-mm bone cutter shaver. With the scope remaining in the space, the arm is removed from traction and internal rotation is assessed with the arm in 90° of abduction in the plane of the scapula and then with cross body adduction. If there is persistent impingement despite coracoplasty, it is an option to debride the lesser tuberosity. Release of the sub-scapularis is performed at this stage as well to mitigate any pain related to potential subscapularis issues.

Next, the scope is removed, and manipulation of the arm is performed in progressing from ER at the side, to abduction, to FF, to IR with the arm at 90° of abduction.

Fig 1. Right shoulder posterior subacromial view portal. (A) Dense adhesions (blue arrow) are initially present in the subacromial space. (B) Following reestablishment of the subacromial space, the superior aspect of the rotator cuff (RC) can be visualized.
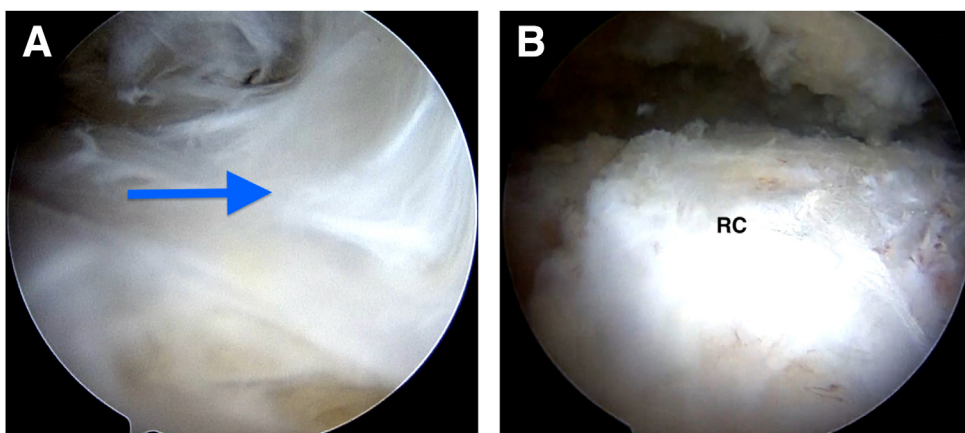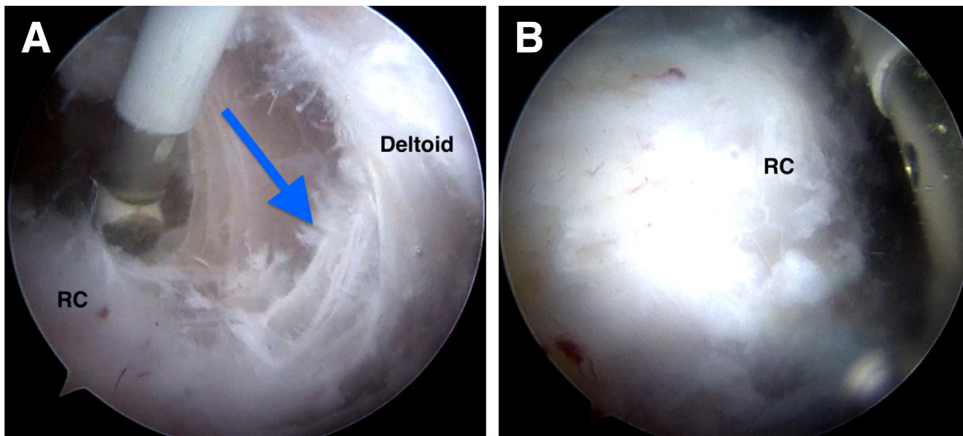
Fig 2. Right shoulder posterior subcromial view portal. (A) Lateral adhesions (blue arrow) between the rotator cuff (RC) and deltoid. (B) Following re-establishment of the lateral gutter.

If all planes are considered satisfactory, the procedure is complete. If ER is improved but FF and/or abduction remains limited, further attention is later directed toward the acromion. If neither are improved, the subscapularis is released (if present) from its attachment on the lesser tuberosity and then ROM is reassessed.

If FF and/or abduction are limited, the arthroscope is reinserted into the subacromial space and motion is assessed under direct visualization. If there are signs of impingement between the acromion and tuberosity, then a tuberoplasty can be performed. The greater tuberosity may be debrided until the superior aspect of the humeral cup or polyethylene is identified. With an inlay prosthesis, the humeral cup is usually easily identified before reaching the polyethylene. Throughout the procedure, extra care is taken to not violate the polyethylene liner. Following debridement, ROM is reassessed.

Postoperatively, patients are placed in a sling for comfort only and allowed to return to previous activities as tolerated. If treatment was carried out for postoperative adhesions, they are instructed to attend physical therapy 3 times per week for 3 weeks postoperatively to maintain passive ROM.

Discussion

The incidence of RSA has increased significantly in the United States in recent years and currently comprises more than one-half of shoulder arthroplasties.[9] Although RSA results are generally excellent, a number of patients may experience persistent pain and poor ROM after surgery.

Several reports have described the use of arthroscopy for diagnosing infection following shoulder arthroplasty. Dilisio et al.[10] conducted a retrospective review of 19 patients who had undergone anatomic shoulder arthroplasty to evaluate for postoperative infection in the setting of pain. After arthroscopy, all patients had revision surgery. Arthroscopy culture results coincided with tissue samples obtained during revision surgery, thereby, yielding 100% sensitivity and specificity. Doherty et al.[11] conducted a retrospective analysis of 14 patients to assess the need for arthroscopy after hemiarthroplasty, RSA, or total shoulder arthroplasty in
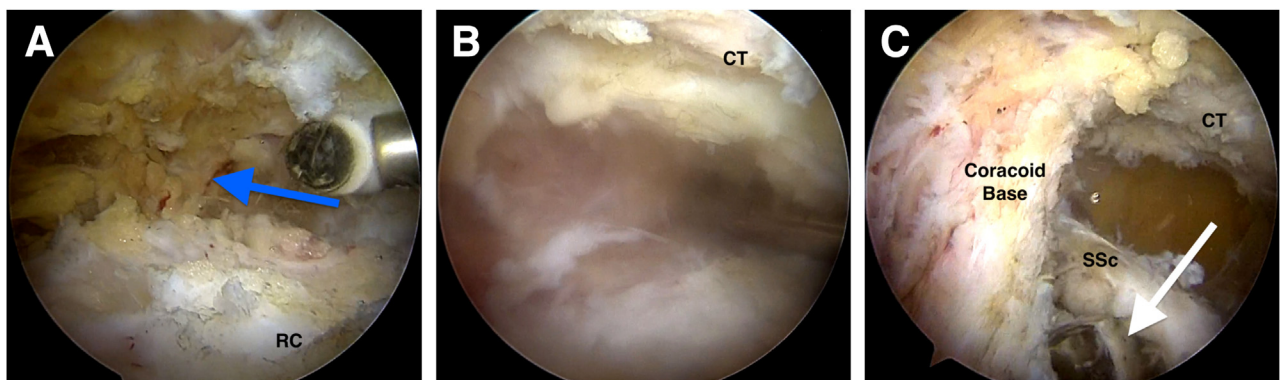

Fig 3. Right shoulder posterior subacromial view portal viewed with a 70° arthroscope. (A) There are initially dense adhesions (red arrow) in the subcoracoid space which are gently cleared by following the rotator cuff (RC) medially until, (B) the tip of the coracoid (CT) is identified. (C) Dissection continues along bone until the base of the coracoid is identified, the subscapularis (SSc) is seen if intact, and the glenosphere is visualized posterior to the subscapularis (white arrow).

Table 2. Advantages and Disadvantages

Advantages	Disadvantages
Subcoracoid space can be decompressed without releasing the conjoined tendon	Risk of iatrogenic injury to implant components
Additional causes of pain (i.e., stiffness) can be addressed concomitantly	Difficulty in arthroscopic assessment of a constrained joint
Minimally invasive compared to an open approach	Limited visualization while debriding a stiff joint can predispose to neurovascular damage

patients with stiffness. In this study, 21% had positive biopsy results for infection and 64% underwent revision surgery.

The constrained nature of RSA is inherently prone to restricted motion, particularly in IR.[7,12-14] In a retrospective study of 161 primary RSAs, Haidamous et al.[15] noted that, 22.5% of patients were categorized as having poor ROM postoperatively (defined as FF <100° and ER <15°). In addition, while glenoid lateralization improves IR, a high percentage of patients remain unable to reach to the L4 level postoperatively.[13] Although limitation in IR is multifactorial, the ability of RSA to re-establish IR has been correlated with the extent of impingement-free ROM between the anterior humerus and coracoid.[16] This mechanical conflict, or subcoracoid impingement, can be one cause of limitation in IR and also lead to postoperative pain.[17] Tashjian et al.[17] suggested that coracoid pain following RSA could be reduced with an open conjoined tendon release. In a series of 12 patients, they reported that 55% of patients had no residual pain (visual analog scale score 0/10) postoperatively. We suggest that an arthroscopic approach has several advantages. First, the subcoracoid space can be decompressed without releasing the conjoined tendon. Second, additional causes of pain (i.e., stiffness) can be addressed simultaneously. Third, an arthroscopic approach is less invasive than an open approach. The advantages and disadvantages of this technique are summarized in Table 2.

Few reports have described the therapeutic use of arthroscopy after RSA. Aguilar-Gonzalez et al.[18] described a circumferential arthroscopic release to manage stiffness in patients after RSA. However, their technique primarily concentrated on the importance of tissue sampling in multiple areas to evaluate for infection and clearing the subacromial space, rather than the subcoracoid space. Guild et al.[19] described 6 cases of arthroscopy used for the treatment of subacromial impingement, adhesive capsulitis, synovitis, and acromioclavicular joint arthritis in patients after RSA. In this case series, arthroscopy alleviated pain, enhanced range of motion, and prevented revision surgery in 4 of the 6 patients. The mean visual analog scale score improved from 8.2 of 10 to 2.5 of 10, and ROM increased by 67% in FF and 62.5% in ER. Although outcomes were

positive, no clear description of the technique was provided.

One limitation of an arthroscopic approach is the possibility of increasing the risk for postoperative infection by performing a second surgery. However, we have not observed this, and the overall risk of infection following shoulder arthroscopy is exceedingly low.[1,20] Another technical limitation is the potential for extensive adhesions, which limit visualization and can pose an increased risk of neurovascular damage, particularly with dissection in the subcoracoid space. Nevertheless, our technique offers a stepwise approach to maintain the integrity of neurovascular structures and prosthetic components while dissecting though anatomical spaces. Furthermore, this technique could potentially improve range of motion and address postoperative pain following RSA.

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