SUBSPECIALTY PROCEDURES

ARTHROSCOPIC REMOVAL OF ROTATOR
CUFF CALCIFICATIONS

Operative Technique

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Introduction

In this article, we present our operative technique for the removal of rotator cuff calcifications.

Arthroscopic removal of rotator cuff calcifications, which are a frequent cause of shoulder pain and pathology¹, is a highly reliable operation in terms of pain relief and return of function. Calcifications are classified on the basis of their radiographic appearance into different types^{2,3}. Conservative treatment is the first option for the treatment for all types of calcifications⁴. However, for chronic, recalcitrant calcifications, arthroscopic removal has a predictably good clinical outcome⁵⁻⁷. Nevertheless, we have reported high rates of persistent postoperative rotator cuff defects on magnetic resonance imaging (MRI) scans 1 year after arthroscopic removal of calcific deposits⁸. Whether to repair the tendon defect after removal of the calcifications remains controversial⁹.

We perform arthroscopic surgery with the patient in the beach-chair position with a shoulder positioner and placed under general anesthesia in conjunction with an interscalene block. Standard glenohumeral arthroscopy is done to exclude any concomitant pathological condition. Afterward, the subacromial space is inspected, and the subacromial boundaries of the rotator cuff are defined. With a spinal needle, the calcification is localized and fragmented. Then, with a soft-tissue shaver, the calcification is debrided. A subacromial decompression can be considered when subacromial signs of impingement are observed on the bursal side of the cuff or on the coracoacromial ligament.

Indications & Contraindications

Indications

- A dense, homogeneous calcification is the preferred indication.
- All rotator cuff calcifications resistant to conservative treatment can be treated with this technique.

Contraindications

- Dystrophic calcifications at the rotator cuff insertion in continuity with the tuberosity as described by Molé et al.³.

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Step 1: Setup and Patient Positioning

Perform the shoulder arthroscopy with the patient in the beach-chair position with a shoulder positioner.

- Use a shoulder table for unobstructed access to the shoulder region. We use the T-MAX Shoulder Positioner (Smith & Nephew).
- Position the patient in the beach-chair position at an angle of approximately 80° with the acromion parallel to the floor (Fig. 1).
- Expose the shoulder region with the adjustable sliding shoulder pad provided with the T-MAX.
- Pad the pressure zones.
- Test passive shoulder mobility to diagnose any signs of glenohumeral motion restriction.
- Install the shoulder positioner, which can be used to increase the available subdeltoid space. We prefer to use the SPIDER shoulder positioner (Smith & Nephew). Another option is to use a simple pulley system with longitudinal traction to increase the anterior subacromial space, which is useful for calcifications situated in the anterosuperior aspect of the rotator cuff.
- Disinfect and drape the shoulder region. We use a shoulder drape (Beach Chair Shoulder Surgical Drape; Medline) for fast and secure draping (Fig. 2).
- Identify and mark external osseous landmarks (Fig. 3), including the acromion, scapular spine, lateral part of the clavicle, acromioclavicular joint, and coracoid process.

Fig. 1

Fig. 2

Fig. 3

Fig. 1 The patient in the beach-chair position for shoulder arthroscopy.

Fig. 2 The patient in the beach-chair position after disinfecting and draping of the shoulder and application of the shoulder positioner.

Fig. 3 External view of the shoulder region showing osseous landmarks marked with a sterile marker. AC = acromioclavicular.

Step 2: Glenohumeral Inspection

Perform an arthroscopic inspection of the glenohumeral joint to exclude concomitant lesions.

- Identify and mark the following arthroscopic working portals used for arthroscopic removal of calcifications (Fig. 4):
- Posterior portal
- Lateral portal
- Anterior interval portal
- Anterolateral and suprapectoral portal (for removal of subscapularis calcifications).
- Start with a diagnostic glenohumeral arthroscopy using the 30° arthroscope through the posterior portal.
- To determine the correct location of the posterior portal, palpate the posterior soft spot and use a spinal needle that is aimed toward the tip of the coracoid process. Unobstructed passage of the needle and the vacuum sign indicate the correct direction for the posterior portal (Fig. 4).
- After determination of the correct location of the portal, make a small, superficial skin incision and insert the trocar and arthroscope. The first signs of correct intra-articular positioning are the vascular channels of anterior interval tissue (Fig. 5). Fluid can be introduced after confirmation of correct intra-articular placement of the arthroscope.

Fig. 4

Fig. 5

Fig. 4 External view of the shoulder region with localization of the posterior, lateral, and anterior portals. Correct portal placement should be adapted to the patient's anatomy and localization of calcification.

Fig. 5 Arthroscopic view showing vascular channels of anterior rotator interval tissue, indicating the correct intra-articular placement of the arthroscope.

- Inspect the glenohumeral joint according to the following steps (Video 1):
 - Inspect the subscapularis tendon and footprint by positioning the arthroscope in a high medial position inside the glenohumeral joint. The entire subscapularis footprint can be inspected when the arm is brought into internal rotation, abduction, and retropulsion (Fig. 6).
 - Inspect the long head of the biceps tendon and the biceps pulley.
 - Inspect the footprint of the entire posterosuperior aspect of the rotator cuff.
 - Inspect the inferior glenohumeral recess to detect loose bodies.
 - Inspect the posterior aspect of the labrum.
 - Inspect the superior aspect of the labrum and the biceps insertion.
 - Inspect the glenohumeral cartilage.
 - Inspect the anterior aspect of the labrum.
- If a concomitant intra-articular lesion is found, it should be treated during the same procedure. For example, degeneration in the superior aspect of the labrum is debrided (Video 2).

Fig. 6

Video 1 Arthroscopic video showing all of the steps of glenohumeral inspection.

Fig. 6 Arthroscopic view showing the entire subscapularis footprint with the arthroscope in the posterior portal while the arm is brought into slight retropulsion, internal rotation, and abduction.

Video 2 Arthroscopic video showing debridement of the superior aspect of the labrum.

Step 3: Subacromial Inspection and Identification of Subacromial Landmarks

Ensure that subacromial placement of the arthroscope and identification of the subacromial landmarks are correct as they are necessary for localization of the rotator cuff calcification.

- Use the same posterior portal to enter the subacromial space.
- Place the trocar in the posterior portal and palpate the posterior edge of the acromion. Advance the trocar under the acromion and palpate the coracoacromial ligament. Insert the arthroscope in the bursa and inspect the rotator cuff. Insert a spinal needle (18-gauge, 3.50 in [8.9 cm]; 1.2 × 90 mm) percutaneously in the bursa to determine the precise location of the lateral portal, 2 to 3 cm distal to the lateral border of the acromion. It is important to aim the arthroscope anterolaterally and not in a medial direction. We prefer our arthroscope to have bone contact with the undersurface of the acromion and to have intrabursal placement of the arthroscope, which allows unobstructed inspection of the anterosuperior aspect of the rotator cuff (Video 3).
- Correct bursal placement of the arthroscope allows the surgeon to identify the following subacromial landmarks:
- For supraspinatus calcifications:
 - The anterior border of the supraspinatus (Video 4).
 - Medial bursal reflection (Fig. 7).
 - Lateral, inferior bursal reflection (Fig. 8).
- For infraspinatus calcifications:

Fig. 7

Fig. 8

Video 3 Arthroscopic view showing incorrect medial arthroscope placement in the soft tissues followed by more lateral placement of the scope inside the subacromial bursa.

Video 4 Arthroscopic video showing the anterior border of the supraspinatus.

Fig. 7 Arthroscopic view showing the medial bursal reflection, indicating the medial extent of the supraspinatus tendon.

Fig. 8 Arthroscopic view showing the lateral, inferior reflection of the subacromial bursa.

- Use the same landmarks as used for the supraspinatus; however, for better visualization, switch the arthroscope to the lateral portal (Fig. 9) and remove the posterior bursal reflection with a soft-tissue shaver through the posterior portal (Fig. 10).
- For subscapularis calcifications with the arthroscope in the anterolateral portal:
 - On the medial side, identify the conjoined tendon.
 - On the lateral side, identify the bicipital groove.
 - On the inferior side, identify the pectoralis major upper border and circumflex vessels.
 - On the superior side, identify the rotator cuff interval-subscapularis border.

Fig. 9

Fig. 10

Fig. 9 The external view showing the arthroscope in the lateral portal.

Fig. 10 Arthroscopic view with the arthroscope in the lateral portal and the shaver placed through the posterior portal to remove the posterior bursal reflection.

Step 4: Identification and Removal of Rotator Cuff Calcification

With a spinal needle, localize and needle the rotator cuff calcification.

- Using the preoperative radiographs, determine the location of the calcification. Position the scope directly in front of the calcification. Depending on the location of the rotator cuff calcification, use the lateral or anterior portal for a posterosuperior (supraspinatus-infraspinatus) or an anterior (subscapularis) calcification, respectively.
- Inspect the bursal side of the rotator cuff for any white prominence, which indicates bursal eruption of the calcification (Video 5), or redness, which indicates inflammation (Figs. 11-A and 11-B). In shoulders in which no abnormal areas are present, insert a spinal needle and puncture the cuff to detect the calcium deposit (Figs. 12 and 13).
- Determine the boundaries of the calcification with the spinal needle and open the entire calcification directly with a scalpel or puncture to evacuate as much calcium or calcification substance as possible (Fig. 14).
 - With a soft-tissue shaver, remove the entire zone of calcification. We believe that a thorough debridement of the entire zone is necessary to obtain adequate postoperative pain relief (Videos 6 and 7). We advise that the entire zone be inspected from another viewing portal after debridement to find any residual calcifications with the spinal needle. However, as mentioned in our previous article, care should be taken to maintain the tendon integrity because of the high rate of persistent rotator cuff defects postoperatively⁸. Therefore, in shoulders with large calcifications that span the entire tendon thickness, we opt for a partial debridement to maintain the tendon integrity; however, we try to puncture the entire calcification to stimulate the resorption process. If a large defect exists in the tendon after the removal of the calcium deposit, a rotator cuff repair can be performed^{9,10}.

Fig. 11-A

Fig. 11-B

Fig. 12

Fig. 13

Fig. 14

Figs. 11-A and 11-B Arthroscopic views showing inflammation of the rotator cuff corresponding to the calcium deposit underlying calcification.

Fig. 11-A The redness indicates inflammation. **Fig. 11-B** The white prominence indicates bursal eruption of the calcification.

Fig. 12 Arthroscopic view of the spinal needle.

Fig. 13 Arthroscopic view of the calcific deposit indicating correct localization.

Fig. 14 To remove the calcium deposit, the boundaries of the calcification are first determined with the spinal needle.

Video 5 Arthroscopic video showing the white prominence of calcification projecting on the bursal side of the rotator cuff.

Video 6 Arthroscopic video showing extensive debridement of the rotator cuff calcification.

Video 7 Arthroscopic video showing the entire process of calcium removal.

Results

In our series, all patients undergoing arthroscopic calcification removal exhibited significant improvement in the Constant score ($p = 0.003$), Quick DASH (an abbreviated version of the Disabilities of the Arm, Shoulder and Hand [DASH] questionnaire) ($p < 0.001$), and Simple Shoulder Test ($p < 0.001$) at 1 year after the operation⁸. Arthroscopic removal of a rotator cuff calcification is a highly reliable procedure in terms of pain relief and return of function⁶⁻⁸. However, the amount of calcification that has to be removed remains controversial. Previous research has shown that small residual calcifications have no influence on the clinical outcome^{10,11}. We could confirm this in our series as a high percentage of the patients (90%) demonstrated persistent punctate calcifications on sonography at 6 months postoperatively, but they had no influence on clinical outcome. An MRI scan of the shoulder acquired 1 year after surgery showed a high rate (72%) of persistent rotator cuff defects. Most defects (69%) were small bursal-sided partial defects, although some (31%) of the defects in our series) were full-thickness defects. The presence of a residual defect does not correlate with the clinical outcome in the short-term^{8,9}. However, it remains unclear what the effect of such a defect will be in the long-term.

Pitfalls & Challenges

- Inadequate patient positioning
 - Inadequate clearance of the shoulder region leading to obstructed access to the entire shoulder and impingement of the arthroscope on the shoulder table.
 - Failure to use a shoulder positioner for longitudinal traction to increase the available subdeltoid space.
- Failure to perform an adequate glenohumeral inspection to exclude concomitant intra-articular lesions.
- Failure to identify the correct subacromial landmarks.
- Failure to localize the calcium deposit.
- Failure to inspect the entire rotator cuff after calcium removal and leaving residual collections of calcium in the rotator cuff.

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