

Chapter 2

Arthroscopic Management of Rotator Cuff Calcific Tendonitis

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Case Presentation

A 57-year-old female nurse presents with a 6-month history of insidious shoulder pain. She complains of pain with overhead use and activities of daily living. The discomfort wakes her from sleep. She has been treated with anti-inflammatories

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and oral steroids without significant symptom relief. Her past medical history is significant for hypertension and ischemic heart disease.

Upon physical examination, the patient demonstrates painful active forward flexion of the shoulder to 10° short of the contralateral side with a shoulder shrug. Passive forward elevation and external rotation is equal to the asymptomatic side and internal rotation is short two vertebral levels. Provocative testing for signs of impingement (Neers, Hawkins, and Yocum's tests) is positive. She demonstrates 4+/5 strength of forward flexion. Biceps maneuvers are negative, as is cross-arm adduction and tenderness about the distal clavicle. Cervical spine exam shows no limitation to motion, equal reflexes, and negative provocation of myelopathy. Radiographs show a homogenous calcific body with smooth edges measuring 22×7 mm within the subacromial space near the insertion of the supraspinatus tendon (Fig. 2.1a-c).

The patient assents to a trial treatment of corticosteroid injection into the subacromial space and home exercises intended to strengthen the rotator cuff and stabilize the scapula. She reports back in 8 weeks with continued pain. An MRI is ordered to further assess her soft tissues and demonstrates a hypo-intense body on the bursal surface of the supraspinatus tendon that measures 19×6 mm. There is mass effect on the supraspinatus tendon but the rotator cuff tendons are all intact (Fig. 2.2a-c).

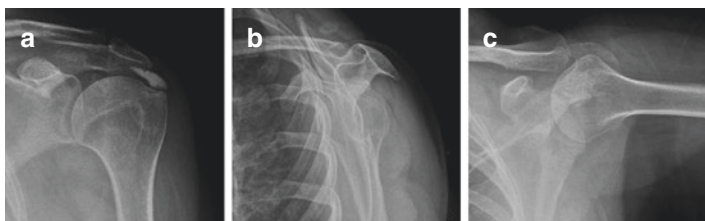


FIGURE 2.1 AP (a), Y view (b) and axillary (c) radiographs obtained after 6 months of shoulder pain show a large homogenous calcific deposit measuring 22×7 mm in the subacromial space. Compared with X-rays obtained 5 months previously, the deposit is unchanged

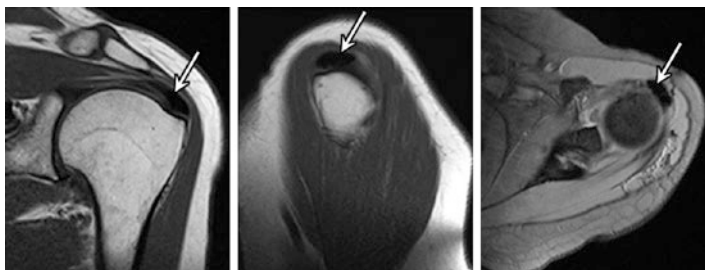


FIGURE 2.2 Coronal (a), sagittal (b), and axial (c) T2-weighted images demonstrate a hypo-intense, margined mass consistent with the calcific deposit (*arrow*) on the bursal side of the rotator cuff with mass effect on the deltoid. It is impossible to tell the degree to which the calcific deposit has replaced or displaced the supraspinatus tendon

Diagnosis/Assessment

This patient presents with a classic history, physical exam, and diagnostic studies consistent with rotator cuff calcific tendonitis (RCCT), also referred to as hydroxyapatite or crystalline calcium phosphate tendon deposition. It is important to take into account the patient's symptoms, signs, and imaging findings, because not all calcific deposits cause pain [1]. The natural history of RCCT can be positive with expected improvement in clinical symptoms and possible eventual absorption of the calcific deposits. We informed our patient that people can respond to conservative treatments consisting of relative rest, anti-inflammatory medications, histamine blockers, and physical therapy and home exercise regimens [2]. Other nonsurgical but invasive management options are reviewed including therapeutic ultrasound, extracorporeal shock wave therapy, and ultrasound-guided barbotage and aspiration [3–5]. However, we also discussed that patients can fail conservative care and may continue to have unchanging pain, which would be an indication for surgical management. Level II evidence found that while radiographically inhomogeneous deposits responded well to both surgical and nonsurgical treatments, homogenous deposits responded better to arthroscopic removal [6]. The current thinking on RCCT pathogenesis and pain generators is metaplasia of tenocytes

leading to cell-mediated calcification with pain mediated by swelling, neoinnervation, and neovascularization [7, 8].

Calcium deposits of the rotator cuff occur most commonly in the supraspinatus tendon, followed by the infraspinatus tendon [9]. Rarely, the deposit can occur in the subscapularis tendon [10]. The primary surgical goal is to express the calcific body to hasten the recovery process of the tendon and thus alleviate pain. Arthroscopically assisted removal of calcium deposits has largely replaced traditional open approaches to calcium removal.

Management

The patient underwent shoulder arthroscopy after 7 months of failed conservative management. Preoperatively, the patient's MRI is reviewed. Axial, sagittal, and coronal plane MRI cuts are used in conjunction to map out the location of the calcium deposit. Most deposits will be encountered on the bursal side and/or within the substance of the tendon; rarely deposits can be visualized from the articular side, but secondary changes of inflammation may be noted from the articular view [1, 11].

We position the patient in the beach chair as for standard rotator cuff-related arthroscopies. First, an arthroscopy of the glenohumeral joint is performed to evaluate for associated pathologies and to evaluate for partial articular sided or complete rotator cuff tears. If articular sided calcifications are visualized, they are tagged with a monofilament stitch outside to inside using a spinal needle that is inserted off the lateral edge of the acromion.

The arthroscope is then placed into the subacromial space. The subacromial arthroscopy is performed with anterolateral and posterolateral portals, with the arthroscope placed in the posterolateral portal and the anterolateral portal as the primary working portal. This optimizes visualization of the rotator cuff and facilitates an efficient bursectomy. After bursectomy, the calcium deposit is visualized on the bursal side of the rotator cuff tendon. Calcium deposits are detected as white or yellow patches on the cuff with surrounding areas of hyper-vascularity on the cuff, as well as hemorrhagic bursa (Fig. 2.3a, b). Most deposits present as topographic bulges

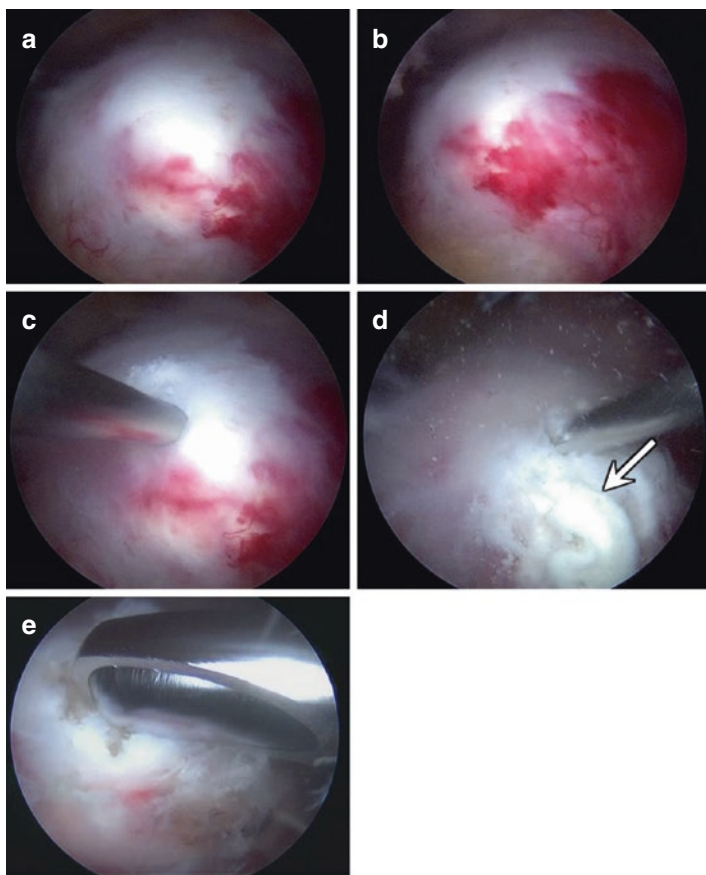


FIGURE 2.3 The subacromial space is viewed from the posterior lateral portal. After bursectomy, the calcific deposit is revealed as a large, white plaque bulging from the bursal side of the rotator cuff (a). Surrounding area of hyper-vascularity is also seen (b). An 18-gauge spinal needle is introduced into the deposit (c), and the toothpaste-like calcium initially fountains out as if under pressure (d) (arrow). The process is repeated with the spinal needle several times, re-creating several “geysers of toothpaste” and a “snow-storm” appearance in the subacromial space. Calcium hydroxyapatite is completely expressed with a blunt instrument such as a probe or Wissinger rod (d). The expressed deposit is collected and the surrounding abraded rotator cuff edge is trimmed and lavaged with an arthroscopic shaver (e)

adjacent to normal rotator cuff, but depending on their depth, hidden calcifications may also be present.

An 18-gauge needle is introduced percutaneously off the lateral edge of the acromion and the deposit is needled (Fig. 2.3c). The needle can be connected to a syringe and aspirated, but in this case the needle is withdrawn and the deposit expressed itself as stream of putty, similar to “toothpaste” (Fig. 2.3d). The paste is expressed with a Wissinger rod producing a snowstorm appearance within the subacromial space, which is removed with a shaver (Fig. 2.3e). Care is taken to preserve rotator cuff tendon at the expense of complete removal of the calcium deposits. Despite our care to maintain integrity to the cuff, a high-grade partial-thickness tear of the supraspinatus tendon was identified.

The high-grade rotator cuff tear on the bursal side is repaired with an arthroscopic Mason-Allen stitch (Fig. 2.4a–d) [12]. Antegrade passage of rotator cuff stitches with a suture lasso device through Neviaser’s portal does not require take-down of intact articular sided rotator cuff fibers (Fig. 2.4b).

The need for acromioplasty is determined by the morphology of the acromion, wear on the coracoacromial (CA) ligament, condition of the bursa, and dynamic evaluation of the rotator cuff (Fig. 2.5a, b). There is abrasion of the undersurface of the CA ligament and passive elevation of the arm reveals abutment between the cuff and the lateral acromion are signs suggesting impingement and indications for acromioplasty. The subacromial decompression is performed with the use of an arthroscopic electrocautery wand and a 5.0 mm barrel burr (Fig. 2.5b). A final lavage is performed to remove any remaining bone fragments and calcium crystals.

The patient was immobilized in a sling for 4 weeks. During that time she was allowed passive supine straight-arm raises. Gentle active range of motion was started at 4 weeks and strengthening at 10 weeks following repair.

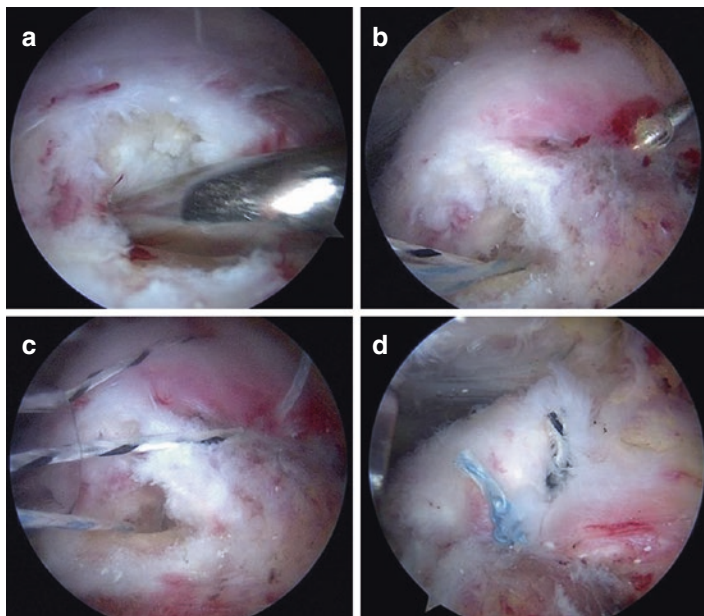


FIGURE 2.4 A high-grade bursal sided tear with intact articular supraspinatus tear is discovered after removal of the deposit from the footprint (**a**). After preparation of the denuded footprint, a 4.75 mm double-loaded anchor is placed into the tuberosity. A sturdy suture lasso (Banana SutureLasso, Arthrex, Naples, FL, USA) is used to penetrate the cuff in antegrade fashion (**b**) (*upper right corner*). Both limbs of the *black* and *white* suture and one limb of the *blue* and *white* suture are passed sequentially in a modified arthroscopic Mason-Allen configuration; in this picture the *black* and *white* suture creates a horizontal mattress after which the passed limb of the *blue* and *white* suture is thrown on the unpassed limb medial to the horizontal mattress (**c**); when tied this creates a rip-stop suture repair (**d**)

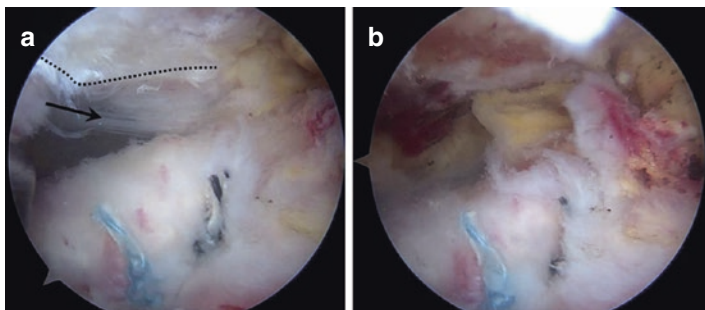


FIGURE 2.5 Arthroscopic evaluation after rotator cuff reveals a downsloping acromion (*dotted line*), which upon dynamic evaluation shows impingement on the cuff near the site of repair as well as abrasion of the coracoacromial ligament (*arrow*) suggesting signs of chronic impingement (**a**). Near-identical view after arthroscopic decompression shows impingement-free arc of rotation (**b**)

Outcome

The patient's pain resolved over the first 8 weeks and her motion returned to normal by 12 weeks. The ASES score at 4 months was 94. The patient's 2-week postoperative X-ray showed diminished but residual calcifications within the rotator cuff tendon (Fig. 2.6).

Literature Review

In a radiographic cross-sectional study, Bosworth found that the prevalence of calcific deposits was 2.7% in a group of asymptomatic patients [13]. The finding emphasizes the need to methodically rule out other sources of pain such as adhesive capsulitis, biceps tendinopathy, and rotator cuff dysfunction. The disease is more common in middle-aged women, and those with a history of diabetes mellitus, thyroid disorders, hypertension, and heart disease, but it is not associated with calcium or phosphate disorders [9, 14]. It is important to distinguish calcific tendinitis from dystrophic calcification of



FIGURE 2.6 AP X-ray obtained at the 2-week postoperative visit shows residual calcification

the rotator cuff as the latter is age related and not generally a painful finding. Louwerens and coworkers compared the prevalence of calcifications of the rotator cuff in an asymptomatic cohort with another group of patients with impingement symptoms. The asymptomatic group had a lower overall rate of calcifications present (7.8% versus 42.5%), and the symptomatic group had larger deposits [9]. These authors did not distinguish between dystrophic and reactive calcifications. The history and physical exam of RCCT match those of subacromial impingement, but pain with RCCT is typically more severe and may resemble gout or other reactive arthritis. Past authors have suggested that there are different stages of calcification, which have different radiographic and clinical characteristics [1, 15].

However, a patient may fail nonoperative treatment at any point along the continuum of disease [1, 12, 15, 16]. It is our opinion that staging the disease is not as important as clinically correlating the disease to the patient's symptoms, treating with appropriate conservative measures, and offering surgery to those who have failed a course of conservative care.

It is important to remember that RCCT may occur with other disorders of the shoulder. Orthogonal X-rays are adequate to make the diagnosis of RCCT when combined with physical exam. Advanced imaging is useful for identifying the location of the deposit and associated disorders, particularly of the rotator cuff. MRI is a readily available diagnostic test that is useful for evaluation of the entire shoulder joint. Ultrasound is another diagnostic tool that has distinct advantages for RCCT, (1) Doppler signals within calcific deposits have been shown to correlate with pain [17], and (2) ultrasound can be used to guide therapeutic injections or attempt aspiration of the calcium deposits, and for dynamic evaluation of associated subacromial impingement.

Originally, the surgical management of calcific tendinitis consisted of open subacromial decompression and removal of the calcific bodies with a longitudinal incision in the rotator cuff. Arthroscopic surgery facilitates the same goals with less damage to the deltoid muscle and potentially with improved visualization of the calcific deposit, theoretically limiting damage to the rotator cuff. Numerous studies show significant improvement with arthroscopic treatment of painful calcium deposits [11, 16, 18–21].

For optimal recovery, the arthroscopist must confront a few controversies when approaching RCCT surgically. Considerations are (1) whether one must completely remove all the calcific deposits and in doing so possibly damaging intact rotator cuff; (2) if, in removing a calcific body, a complete or an incomplete rotator cuff tear is encountered, should this be fixed at that time of removal; and (3) should one routinely perform subacromial decompression as part of the procedure.

The question of how much of the calcific deposit needs to be removed is unanswered. Two studies in particular question the need for any removal of calcific deposits [15, 22].

In contrast, in a 2-year follow-up review of arthroscopically removed deposits, Porcellini found that patients' Constant scores were correlated to the amount of residual calcifications seen on follow-up X-rays [16]. The average 2-year follow-up Constant score of patients with no calcifications was 96.8, compared to 84.4 for patients with microcalcifications and 79 for calcifications measuring <10 mm ($p < 0.01$). Maier and associates evaluated for residual calcifications on X-rays in the immediate postoperative period. Eighty-two patients had complete removal; 17 had residual calcifications visualized [20]. At final follow-up, there was no difference in average Constant score (89.6 versus 86.1, $p > 0.05$). Furthermore, only 3 of 17 patients with residual calcifications showed continued calcifications at final follow-up. Based on equivalent results in patients with residual calcifications seen on X-ray, Seil et al. speculated that residual calcifications correspond to a shell of the deposit and lesion decompression relieves the pain [11]. Softer collections of crystalline calcium are easier to express than firm deposits [20]. Based on the results of others and our own experience, our recommendation is that the calcific deposits should be unroofed and soft deposits thoroughly expressed using blunt instruments, while firm calcifications within the rotator cuff do not need to be completely removed. Clinical improvement can be slower than expected whether or not the calcifications are completely removed.

Inevitably, removal of some calcium deposits will result in partial and even complete rotator cuff defects in many cases. Neer commented that in cases of RCCT the residual cuff does not need to be sutured [23]. Other authors have reported side-to-side repairs and anchored repairs for defects left in the cuff [16, 19, 21]. In Porcellini et al.'s study, all longitudinal tears <1 cm had no rotator cuff defects seen at follow-up ultrasound done at a minimum of 2 years. It is worth noting that none of the 63 patients followed in this study had a postoperative rotator cuff tear diagnosed by ultrasound in the postoperative period. In a study of 54 patients undergoing arthroscopic excision of deposits, El Shewy used a less aggressive technique to remove the deposit in order to maintain integrity of the rotator cuff, leaving partial-thickness

tears (up to 50% thickness) unrepaired [19]. Two of the 54 cuffs (3.7%) required revision surgery for rotator cuff repair. Overall, the patients in this study had good outcomes with average ASES score of 95, but patients were not subclassified into treatment arms by degree of damage to the rotator cuff. Yoo et al. shared the experience of 35 consecutive calcific deposits having undergone arthroscopic removal, commenting that following thorough debridement of calcific deposits as well as local degenerative tissue (82% having no residual calcification on immediate follow-up X-ray), most rotator tendons were left with defects [21]. Low-grade tears were simply debrided or stitched in a side-to-side manner, and high-grade tears were fixed to bone with suture anchors. There was no statistical difference between those in the low-grade versus high-grade treatment arms of the study (mean Constant score 87 versus 86.2). Ten patients experienced postoperative stiffness, but there was no difference in the suture anchor group versus the non-suture anchor group. A prospective study of 17 patients reviewing the results of needling without repair reported that 13/17 (76%) of the patients had rotator cuff defects and 5/17 (29%) were full-thickness tears at 1 year following surgery [24]. Keener prospectively observed 56 partial-thickness tears over 5 years, and 44% of partial-thickness tears showed progression of the tear [25]. When we debride calcific lesion that results in a defect of the rotator cuff, we treat the defect as we normally treat rotator cuff tears; low-grade defects are left alone and high-grade or complete tears are treated with suture anchor fixation to bone [12].

The role of subacromial decompression for RCCT has been debated, with the focus of arguments for and against having focused on the pathogenesis and pain generators. Just as these factors are undecided, so too is the answer as to whether or not to perform subacromial decompression. The sheer volume of hydroxyapatite, along with swelling and local invasion of blood vessels, may predispose the patient to subacromial impingement. Recent histologic work by Hackett shows that the calcific deposit results in a substantial inflammatory response, which suggests that pain is intrinsic to the

rotator cuff [7]. In 1998, Tillander and Norlin published the results of 25 patients with calcific deposits who underwent simple arthroscopic subacromial decompression leaving the calcific deposits intact [15]. Seventy-nine percent of the calcifications had disappeared or diminished on follow-up X-ray. Furthermore, there was no clinical difference between patients who had radiographic resolution and those who did not (average Constant score 78 versus 75). Balke and coworkers retrospectively compared shoulders with arthroscopic removal of calcific deposits and subacromial decompression with those who did not have subacromial decompression [18]. The decision whether or not to perform subacromial decompression was based on preoperative X-ray and findings of scuffing on the undersurface of the coracoacromial ligament. There was no statistically significant difference in improvement of shoulder scores at final follow-up between subacromial decompression and not as the Constant score was 74.8 versus 79.4. However, subitem evaluation pain was significantly better in the subacromial decompression group (11.4 versus 12.9, $p = 0.048$). The authors attributed this to possible selection bias as the study was not randomized and decompression was performed on patients with arthroscopically evident signs of impingement. While the question of the need for calcium removal remains, and if subacromial decompression alone is sufficient, the reason why subacromial decompression alone is successful remains unclear [16, 22]. Marder and coworkers retrospectively compared 25 shoulders that had arthroscopic removal of calcifications with subacromial decompression with 25 that did not [26]. At a mean of 5-year follow-up, quick DASH (11.1 versus 6.3, $p = 0.191$) and UCLA scores (32.4 versus 32, $p = 0.678$) showed no statistical difference. Contrary to the findings of Balke et al., these authors found that patients who underwent removal of the calcific body alone had earlier reduction of pain and return to normal activity (mean 11 weeks versus 18 weeks, $p < 0.006$). Given the body of evidence, we recommend that calcific deposits be removed along with subacromial decompression if there is impingement on physical examination, or radiographic evidence of a hooked

acromion (i.e., type III). We end up doing a subacromial decompression in the majority of cases as we also perform it if we think that the RCCT is a risk factor predisposing the patient to impingement.

Clinical Pearls and Pitfalls

- Most patients presenting with acute RCCT can be treated with time, rehabilitation, and subacromial injection of steroids, but patients may require surgery if there is impingement after 3–6 months of debilitating symptoms.
- At arthroscopy the calcific deposits do not need to be completely removed, but can be decompressed by needling and expressing with blunt instruments.
- Small partial-thickness rotator cuff tears that can be debrided and high-grade tears (>50% of the thickness) should be repaired as in standard arthroscopy to limit the chance of tear progression. Patients should be counseled preoperatively about the possibility of rotator cuff repair and the differences in postoperative rehabilitation compared to debridement alone.
- One should consider the patient with calcific deposits as at risk for impingement. However, subacromial decompression can be performed on a case-by-case basis, if there are impingement signs on physical examination, a hooked (i.e., grade 3) acromial undersurface on preoperative imaging, scuffing on the undersurface of the coracoacromial ligament, or a rotator cuff tear that needs repair after calcium removal and we think that the tear is from impingement.
- Patients should be counseled that clinical improvement and radiographic resolution happens over a course of a year.

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