Management of calcific rotator cuff tendonitis defects using a bio-inductive implant

Introduction

Calcific tendonitis is an idiopathic disorder of the shoulder joint. It is characterized by the multifocal accumulation of basic calcium phosphate crystals within the rotator cuff tendons. In most cases, the multifocal calcifications are located 1-2 cm from the insertion of the supraspinatus tendon on the greater tuberosity. The etiology is still unknown, however various endocrine disorders have been associated with calcific tendonitis, such as diabetes and hypothyroidism. Other risk factors may include repetitive impingement and rotator cuff ischemia. Calcific tendonitis is usually found in patients ages 30-50, while being more common in women than men. It is found to be asymptomatic in 3-20% of patients and accounts for 7% of all painful shoulders.

Treatment

Initial treatment of calcific tendonitis should be non-operative. Several articles have been published demonstrating good to excellent results with conservative care consisting of any or all of the following: physical therapy, anti-inflammatory medications, sub-acromial corticosteroid injection, and ultrasound guided injection with trephination. Less common treatments that have offered intermediate results include low dose irradiation treatments and extracorporeal shockwave treatments.

Recalcitrant calcific tendinopathy has been shown to have favorable results when treated with arthroscopic debridement. Balke et al. showed good clinical outcomes when treating 70 shoulders in 62 patients with arthroscopic debridement; however, even with good clinical results there was reported weakness and inferior results when compared to the non-affected shoulder. One possible reason for this could be that lack of attention paid to the resultant rotator cuff defects after the calcium debridement. Barber et al. in 2014 described an algorithm for the arthroscopic management of rotator cuff defects after debridement. Within this article the authors recommend that defects greater than 5mm in depth be repaired to optimize outcomes. Considerations that must be given when performing a repair in patients with calcific tendinopathy include the location of the defect being addressed. In defects that occur 1-2 cm medial to the tuberosity, as historically reported, care must be given to the potential side effects from medialization of the rotator cuff tendon. Furthermore, attempts to repair these lesions with simple side to side sutures may be fraught with pitfalls due to the poor quality tissue remaining.

Rotation Medical Bio-Inductive Implant

A novel, highly porous, high purity, bio-inductive implant made with reconstituted collagen fibers obtained from bovine Achilles tendon has been developed by Rotation Medical (Plymouth, MN) for the management of tendon injuries including partial thickness rotator cuff tears and rotator cuff repairs via biological augmentation. The implant is placed on the bursal
side of the rotator cuff and addresses bursal, intrasubstance, or articular sided injuries. The implant allows for rapid infiltration of fibroblasts and new blood vessels facilitating the formation of new tendon-like tissue. The new tissue reduces the peak strain at the site of the defect and creates an environment conducive of healing. Applications for the implant include the full spectrum of rotator cuff pathology; from low grade partial tears through massive rotator cuff repairs via augmentation of the lateral footprint.

Case Report

A 49 year old right hand dominant female presented with a chief complaint of recalcitrant left shoulder pain for 9 months. She noted the symptoms had intensified over the last 3 months. X-rays were obtained which demonstrated a 17mm x 13 mm calcium deposit within the left shoulder at the level of the subacromial space (Figure 1). The patient self-reported a Visual Analog Score of (VAS) 8 and was concerned due to increasing sleep disturbance and declining function with recreational activities, such as working out.

Initial physical examination demonstrated range of motion deficits in all planes, with the most significant loss being seen with internal rotation (-30 degrees) versus the unaffected arm. Rotator cuff testing revealed 4/5 strength in forward flexion, internal rotation and external rotation, and abduction. Of note was a painful arc of motion from 70 to 110 degrees in forward flexion and abduction. Neer Impingement testing was also noted to be positive. There was not appreciated scapular winging or atrophy observed. Baseline testing was recorded and the patient was found to have a UCLA shoulder score of 16 and a DASH score of 40.

Conservative treatment was initiated consisting of NSAIDS and physical therapy. Further intervention was undertaken, after failure to obtain relief of pain, consisting of a blind subacrominal cortisone injection and a subsequent ultrasound guided injection with trephination. Despite this, the patient self-reported continued pain on the VAS system of 6 and an MRI was ordered (Figure 2).

MRI review again demonstrated a large calcium deposit within the rotator cuff measuring over 1.5 cm X 1 cm. A full thickness defect noted within the rotator cuff was not seen, however there was a paucity of articular and bursal sided tissue surrounding the deposit. The patient, having failed conservative measures, was indicated for a left shoulder arthroscopic debridement of the calcific deposition and rotator cuff repair / augmentation using the bio-inductive implant.

Operative Technique

The patient was taken to the OR and administered an interscalene nerve block followed by general anesthesia. She was placed in the lateral position with care taken to pad all of her down bony prominences. Next she was prepped and draped in a sterile manner and the operative arm was hung with 10 pounds of lateral arm traction.
A standard posterior viewing portal was made, followed by a rotator internal portal. Intra-articular inspection was performed according to Snyder’s’ 15 point review. Next, the scope was repositioned into the sub-acromial space and a lateral portal was created. Bursectomy alone was performed. Inspection of the acromion revealed no overt spurring.

A switching stick was used through the lateral portal to palpate the calcium deposit within the supraspinatus. It was identified 1.5cm medial to the greater tuberosity insertion. An 18 gauge spinal needle was then utilized percutaneously to trephinate the deposit. A shaver was then used to bluntly milk out the “toothpaste-like” deposit and remove it (Figure 3). Following debridement of the rotator cuff, a defect was noted within the tissues approximately 6-7 mm in depth.

The decision was made at this point to augment the rotator cuff defect with the Rotation Medical bio-inductive implant. A spinal needle was utilized to localize a low lateral starting point 5mm inferior to the native rotator cuff insertion on the greater tuberosity. After a portal was created, the guidewire was placed into the humeral head and the implant was delivered over the wire. It should be noted that prior to placement of the guidewire, the defect size was measured using a standard shaver and a medium size implant was selected.

After delivery into the sub-acromial space, the implant was placed over the defect location and deployed. Care was taken to ensure the implant adequately covered the lateral footprint of the native rotator cuff. The implant was next secured to the rotator cuff with the Rotation Medical Tendon Staples at the medial, anterior and posterior borders. Once secured, the implant delivery system and guidewire were removed and attention was turned to the lateral fixation. The lateral fixation punch was inserted into the shoulder and two Rotation Medical Bone Staples were placed, anteriorly and posteriorly, along the lateral margin of the graft (Figure 4). The shoulder was next taken through a full range of motion to ensure stability of the implant, without impingement.

**Post-Operative Course**

The patient was placed into a sling for a period of 48 hours and immediate motion was begun thereafter as tolerated. A 5 pound weight restriction was placed on the patient for 6 weeks. Active strengthening was begin at the 6 week post-surgery mark. Narcotics were discontinued within 10 days post-surgery.

The patient at 6 weeks post-surgery noted a decrease in her VAS score from 6 to 2 and was sleeping through the night in a bed. At her 3 month post-operative she reported that she had returned to the gym for workouts and was able to hold herself up for planks. Full range of motion was observed with near 5/5 rotator cuff strength versus the contralateral side.

At the 6 month post-surgery visit the patient was administered the DASH and UCLA shoulder scoring tests. Her DASH score had improved from 40 pre-operatively to 3.3. Likewise, improvement was noted in her UCLA score (16 to 33). An MRI was obtained at the 6
month visit which demonstrated thickening of the bursal side of the rotator cuff with implant incorporation. Minimal evidence of the calcium deposit was found (Figure 5).

At the 1 year post-surgical evaluation the patient again maintained the same level of improvement on her DASH and UCLA scores, and reported a VAS of 1 with activity. A 12 month MRI demonstrated further reconstitution of the native rotator cuff tissue without evidence of calcium deposition (Figure 6).

Discussion

Arthroscopic treatment of calcific tendonitis of the rotator cuff can be a challenging procedure for both the surgeon and the patient. While good to excellent results have been demonstrated within the literature with simple arthroscopic debridement, inferior results were still noted in regards to strength versus the unaffected arm. Furthermore, Kumagi et al noted that the outcomes post rotator cuff debridement were not as successful as anticipated. They hypothesized that this was due to the body’s inability to stimulate the reparative process originally postulated. As such, the rotator cuff was therefore unable to appropriately load bear, causing pain and potential rotator cuff failure. Barber et al. recommended the repair of the rotator cuff if the defect created was greater than 5 mm in depth. Unfortunately, this oftentimes leads to medialization of the rotator cuff given the defect location. Gerber noted that the goal of a rotator cuff repair should be to restore continuity without excessive tension. As such, attempts to lateralize the healthy rotator cuff tissue medial to the defect should also be avoided when possible.

The Rotation Medical bio-inductive implant allows for the surgeon to address the defect within the rotator cuff created after debridement of a calcific deposit. By placing the implant over the defect, which allows for rapid infiltration of fibroblasts and new blood vessels facilitating the formation of new tendon-like tissue, the strain across the remaining articular sided tissue can be reduced and thus allow for an environment for healing. MRI follow up at 6 months and 1 year confirmed an induction of a new integrated layer of tendon like tissue across the previous defect site. Furthermore that patient experienced exceptional improvement across the VAS, DASH and UCLA scoring systems.

In addition to the regeneration of the native rotator cuff tissue, the chief benefit seen with use of the implant was an accelerated recovery time compared to a traditional rotator cuff repair. The patient’s sling time was decreased from 6 weeks to 48 hours with early motion begun immediately. Furthermore, by maintaining the native rotator cuff fibers with their tuberosity attachment, the patient was able to begin active movement and strengthening significantly quicker. The concept behind the safety of this lies in the fact that the implant moves in unison with the native rotator cuff and thus concerns over loosening do not exist like in a traditional tendon to bone repair. The accelerated recovery is a significant deviation from previous elongated recovery time reported by Seil et al with simple debridement. Other benefits noted included decreased pain post-operatively with a short narcotic utilization.
Attempts to protect the integrity of the native rotator cuff should be paramount when treating rotator cuff disease. When addressing the defects created within the rotator cuff after debridement of a calcific deposit, consideration of augmentation of the defect utilizing the Rotation Medical bio-inductive implant is warranted. MRI evaluation and patient outcomes have pointed toward a very favorable alternative to traditional methodology for arthroscopic treatment of calcific tendonitis of the rotator cuff.

Figure 1.

Figure 1.

AP X-ray of a left shoulder demonstrating a mature calcium deposit within the rotator cuff.
Figure 2.

T2 weighted MRI of a left shoulder demonstrating a large calcium deposit with distortion of the native rotator cuff tissue.

Figure 3.

Arthroscopic view of the subacromial space demonstrating the “toothpaste-like” consistency of the calcium deposit during removal.
Figure 4.

Arthroscopic view of the bio-inductive implant secured to the rotator cuff.

Figure 5.

6 month post-surgery MRI follow-up demonstrating thickening of the native rotator cuff tissue and near complete absence of the previous calcium deposit.
12 month post-surgery MRI follow-up demonstrating restoration of the previously injured rotator cuff with increased tendon depth versus the baseline and 6 month MRI examinations.
References


