Management and Consequences of the Rotator Cuff Calcific Tendinopathy

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Gregorz Adamczyk, Maciej Miszczak, Mustafa Karahan, Radovan Mihelic, Manos Antonogiannakis, Vojtech Havlas, Jakub Kautzner, Oksana Sevastyanova, and Pietro Randelli

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G. Adamczyk • M. Miszczak
Department of Orthopedics, Carolina Medical Center, Warsaw, Poland
e-mail: grzegorz.adamczyk@carolina.pl

M. Karahan
Department of Orthopedics and Traumatology, Marmara University School of Medicíně, Istanbul, Turkey
e-mail: mustafa@karahan.dr.tr

R. Mihelic
Orthopedic Clinic of Lovran Medical School, University of Rijeka, Rijeka, Croatia
e-mail: radovan.mihelic@gmail.com

M. Antonogiannakis
2nd Orthopedic Department, Center for Shoulder Arthroscopy, IASO General Hospital, Athens, Greece
e-mail: manosanton@gmail.com

J. Menetrey et al. (eds.), *ESSKA Instructional Course Lecture Book*,
DOI 10.1007/978-3-642-29446-4_2, © ESSKA 2012

V. Havlas (✉) • J. Kautzner • O. Sevastyanova
Department of Orthopedics and Traumatology,
2nd Faculty of Medicine, Charles University
Prague, Prague, Czech Republic
e-mail: vojtech.havlas@lfmotol.cuni.cz

P. Randelli
Department of Orthopedics,
University of Milan, IRCCS Policlinico
San Donato, Milan, Italy
e-mail: pietro.randelli@unimi.it

2.1 Introduction

Calcific tendinopathy of the rotator cuff represents a treatment challenge since there is no consensus on its treatment. Unfortunately, up to 38% of the calcifications do not disappear with time. The persistence of the calcification is detrimental to the tendon biology and resistance. Thus, it is mandatory to follow up the calcification and to treat it in case it would not reabsorb spontaneously. Nonsteroidal anti-inflammatory drugs, rest, exercises, physiotherapy, and shock wave therapy are being used with varying results. Those who have not benefited from the conservative measures are indicated for nonsurgical invasive interventions or surgical treatment. Invasive interventions include steroid/anesthetic injection, barbotage (multiple needle punctures), aspiration, and ultrasound lavage. Surgical (arthroscopic) treatment should be reserved for chronic cases or for cuff ruptures due to the deposit.

2.2 Pathophysiology and Classification

Grzegorz Adamczyk and Maciej Miszczak

Shoulder pain is a common complaint with the occurrence of more than 20% of population. Calcifying tendinitis (calcific tendinitis, calcific tendinopathy) of the rotator cuff has a prevelance of 2.7–7.3% in asymptomatic population (Fig. 2.1). It accounts for approximately 10% of all painful shoulder consultations. Mainly, it occurs in women's shoulders, dominantly in patients over the age of 50. The relation of the rotator cuff tears and calcifications is very low; the long-term follow-up after complete disappearance of deposits shows only 3.9% rate of full-thickness tears. Supraspinatus and infraspinatus tendons are most commonly affected. Genetic data show increased expression of tissue transglutaminase (tTG2) and osteoponin. The increased HLA-A1 incidence is observed. In the resorbtive phase, the amount of multinucleated giant cell is elevated [1]. The underlying cause is still not fully understood however. There are no proofs for the connection of the calcifying tendinitis with any of systemic diseases. There are also no direct relations with the incidence of frozen shoulder.

2.2.1 Staging

The histopathological findings of calcifying tendinitis have been reported by Uhthoff [2], who described three distinctive stages through which the disease process progresses. The first, the precalcific stage, represents metaplasia of the tendinous tissue into fibrocartilage. The second, the calcific stage, consists of a phase of formation and a phase of resorbtion. And the last, the postcalcific stage, is a resorbtion of the calcium deposit and tendon reconstitution.

Additional injuries occurring with calcifying tendinitis are similar to general population in similar age and are biggest in the partial RC ruptures group. The acromion index and type seems to have no influence in occurrence of calcifying tendinitis [6].

Fig. 2.1 X-ray findings of calcifying tendinitis

2.2.2 Classifications of the Radiological Changes

Radiological morphology of Calcifying Tendinitis by Molé (1993) [3]

(a) Calcification dense homogenous with clear contours
(b) Calcification dense split/separated with clear contours
(c) Calcification nonhomogenous with serrated contours
(d) Dystrophic calcification of the insertion in continuity with the tuberosity

Radiological classification of Calcifying Tendinitis by Gartner and Heyer [4]:

Type 1: Clearly circumscribed and dense, formative
Type 2: Clearly circumscribed, translucent, cloudy and dense
Type 3: Cloudy and translucent, resorptive

Bosworth's radiological classification of Calcifying Tendinitis [5]:

Small: Barely visible on fluoroscopy
Medium: < 1.5 cm
Large: > 1.5 cm

2.3 Conservative Management Overview

Mustafa Karahan

2.3.1 Introduction

Calcific tendinitis of the rotator cuff has been a painful issue around the shoulder. Nonsteroidal anti-inflammatory drugs, rest, exercises, and physical therapy have been used with varying results [5, 7, 8].

2.3.2 Medication and Physiotherapy

Throughout the years, rest (immobilization), heat, nonsteroidal medication, and physical therapy have been used to decrease pain. There have been varying reports over the success of these measures. Nonsteroidal anti-inflammatory drugs are the initial treatment line, and subacromial steroid injection may be helpful if some of the symptoms come from impingement [9]. A formal physical therapy program or gentle exercises may help maintain range of motion. There is mixed evidence that active therapeutic ultrasound is more effective than placebo ultrasound [10]. In a well-designed, randomized, double-blind comparison study of ultrasonography and insonation in patients with symptomatic calcific tendinitis, ultrasound treatment resulted in greater decreases in pain and greater improvements in quality of life in addition to radiographic decrease in calcium deposit size [11].

2.3.3 Noninvasive Nonsurgical Methods

Extracorporeal shock wave therapy has originated from Europe. Loew et al. [8] randomly assigned patients to control, low-energy, high-energy groups, and high-energy groups that received either one or two sessions. The results showed energy-dependent success, with relief of pain ranging from 5% in the control group to 58% after two high-energy sessions. Daecke et al. [12] determined long-term effects and complications. They concluded that the level of success was energy dependent and that there were significant differences in radiologic changes between the groups in a prospective study evaluating 115 patients at 4-year follow-up. At the end of the 4 years, 20% of the entire patient population had undergone surgery on the involved shoulder.

2.3.4 Invasive Nonsurgical Methods

If pain is not controlled with the measures stated above, invasive interventions or surgical methods are considered. The invasive interventions include steroid/anesthetic injection, barbotage (multiple needle punctures), aspiration, and irrigation [11, 13]. Needle lavage technique is best used in patients with an acutely painful shoulder in the resorptive phase, and it helps decrease the intratendinous pressure that results in pain. Treatment with modified ultrasound-guided fine needle technique has been shown to be an effective therapy with a significant clinical response and perhaps greater precision [13]. Using ultrasound-guided needle puncture, Farin et al. [14] found favorable results in more than 70% of patients.

2.3.5 Conclusion

Although it has been reported that calcific deposits in the rotator cuff can be asymptomatic, symptomatic conservative and invasive management is reported to provide relief of shoulder symptoms [15].

2.4 Extracorporeal Shock-Wave Therapy

Radovan Mihelic

2.4.1 Introduction

Extracorporeal shock-wave therapy (ESWT) has been reported to be effective in the treatment of many tendinopathies, including rotator cuff calcific tendinopathy [8, 16–18]. Some publications find mostly placebo effect, yet the majority of authors agree that there is a positive effect of this treatment regarding night pain, ability scales, and improvement of function [19–22]. The position of the shoulder during the treatment can play a role to achieve more effective result [23]. There is little difference in the therapy effect with high-energy and low-energy ESWT [24].

Meta-analysis of ESWT showed significantly better results in pain relief, range of motion, and deposit resorption [25]. However, these results are susceptible to bias due to differences of wave sources, dosage, etc.

2.4.2 Author's Recent Study

We have done a prospective randomized study of 40 patients with calcified tendinosis of supraspinatus muscle treated with ESWT. The therapy was performed via electromagnetic generator (EMSE, or electromagnetic shock wave emitter).

2.4.2.1 Material and Methods

The patients were treated with three low-energy doses in 1-week interval, using 600–3,000 shocks, 0.21 mj/mm². The therapy was focused on the supraspinatus region in the first session, including later treatment combined with anterior flexion and external rotation. The patients were randomly selected from the group of patients with calcified tendionosis who were previously treated with standard physical therapy. All had more than 6 months history of calcific tendinosis. The primary outcome measures were changes in Constant and ASES score as well as VAS. The diagnosis was confirmed by radiography and ultrasound (US). Patients were reevaluated 2 and 8 months after the treatment.

2.4.2.2 Results

Our results show better ASES and Constant score in treated patients. There was a significant pain relief measured on VAS. US control showed partial deposit resorption only in 40% of cases.

2.4.2.3 Conclusion

In our experience, ESWT showed good clinical results in matter of pain relief and range of motion, although calcium deposit was still present. Higher energy doses of shock wave should be considered to provoke the calcium deposit resorption in further treatment.

Noninvasive ESWT is considered an alternative method to operative treatment. Future investigations with higher numbers of cases, good randomization, blinding, and treatment provider bias exclusion are needed [9].

2.5 Percutaneous Needle Lavage Technique

Mustafa Karahan

2.5.1 Introduction

Percutaneous needle lavage technique is a good alternative in the management of calcified tendinitis. Ultrasonographic intervention seems to be more feasible than fluoroscopic guidance. The technique is described in detail in the following text. When conservative medical treatment fails, percutaneous needle lavage technique may be performed. A technique consisting of percutaneous needle aspiration of calcium deposits with fluoroscopic guidance was introduced by Comfort et al. [26]. Later, it was shown that ultrasonography (US) has a high sensitivity to accurately depict and localize rotator cuff calcifications without radiation exposure from fluoroscopy [27]. It was also shown that it is feasible to treat the calcification [28].

2.5.2 Technique

The percutaneous needle lavage technique routinely used represents puncturing the calcium deposited in the rotator cuff up to 15–20 times to break it into pieces and eventually aspirate the calcification during a single procedure. The shoulder is evaluated for the presence of accompanying tear, bursitis, or other associated conditions before initiation of the procedure [13]. Two needles (18–19 gauge) are used simultaneously; saline solution is injected for lavage through one needle and reaspirated through the other needle [28]. The lavage is continued until the aspirate is cleaned of calcified material followed by water-soluble cortisone injection into the subacromial-subdeltoid bursa.

2.5.3 Results

The technique provides quick and significant pain relief in about two-thirds of the cases, with clinical success rates varying from 60% to 74% [29, 30]. Because the punctures in the tendon are manipulated through ultrasonographic guidance, there is concern for potential injury to the tendon.

The results of US-guided percutaneous treatment of calcified tendinitis is better than those of calcium lavage under fluoroscopic monitoring [26, 29, 30]. US intervention has the advantage of avoiding radiation and having direct real-time three-dimensional imaging of the needle tip on the calcification during the procedure.

2.5.4 Conclusion

Residual status of the tendon fibers after repeated punctures may be a concern. Repetitive needle puncturing of the tendon to extract the calcium may potentially damage the tendon fibers and increase the risk of a rotator cuff tear [28]. The risk of a tear is no clear, as data about long-term follow-up of the tendon is not present in the literature. Short-term follow-up studies are not sufficient to show the effect of percutaneous treatment of rotator cuff calcifications on the rotator cuff tendon in the long run.

2.6 Indications for Surgery

Manos Antonogiannakis

2.6.1 Introduction

In those patients who have not benefited from the conservative measures above, invasive interventions and/or surgical treatment methods are considered. Surgery includes either open revision or arthroscopic procedure involving deposits removal and/or treatment of any other concomitant pathologies (rupture, impingement, etc.) [5, 7, 8, 31].

2.6.2 Indications

1. Symptomatic patients after failed conservative treatment following the chronic stage of calcification. In that case, arthroscopic removal of the calcium deposits brings pain relief. Acute inflammatory crisis may be responsive to needle lavage.
2. Patients with diagnosed rotator cuff tears based on calcific tendinopathy.
3. Calcifying tendinitis complicated by adhesive capsulitis is considered another indication for surgery [5, 7, 31–33].

2.6.3 Outcomes

The pain relief is not immediate; it usually occurs after months, and the strength improvement comes even later. Bursectomy and possible acromioplasty seems to improve the long-lasting result and are fully indicated in arthroscopic procedure. Approximately 15–35% of patients demonstrate persistence of some degree of postoperative stiffness [32].

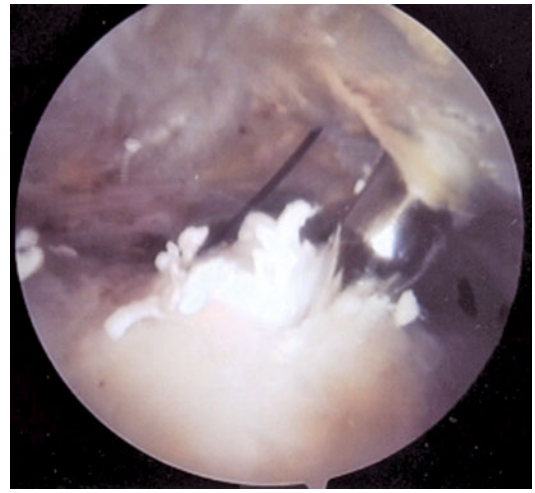

Fig. 2.2 Supraspinatus calcific tendinopathy – arthroscopic view

2.6.4 Conclusion

Although open removal of the calcium deposits can be considered, arthroscopic removal nowadays is the treatment of the choice. There are still controversies concerning the need for complete removal of the deposits and the need for repairing the tendon after deposit removal [5, 7, 31] (Fig. 2.2).

2.7 Surgical Treatment: Arthroscopic Versus Open Surgery

Vojtech Havlas, Jakub Kautzner, and Oksana Sevastyanova

2.7.1 Introduction

In the treatment algorithm, surgical treatment of the calcific tendinopathy should be reserved for patients with chronic appearance nonresponding to conservative treatment measures, while majority of cases are satisfactorily cured conservatively [7, 33–35]. Open surgical treatment is proven to reduce the size of calcific deposits on radiographic examination as well as the symptoms [36]. Arthroscopic treatment provides good clinical results when combined with rotator cuff reconstruction [37] and provides less invasive method compared to open surgery.

2.7.2 Surgical Treatment Methods

There are several treatment options; these may be performed either by means of open surgery or arthroscopically.

2.7.3 Open Surgery

Deltoid split approach is used to perform calcific deposit excision through a longitudinal incision through the rotator cuff. This procedure is usually combined with acromioplasty to avoid further impingement of the tendon. Eventual rotator cuff reconstruction with side-to-side sutures may be performed if necessary [35]. It is a technically simple and fast method of treatment. A disadvantage of open method is the relatively large surgical exposure with a risk of postoperative complications such as deltoid hypotrophy or wound infection.

2.7.4 Arthroscopic Surgery

With the development of arthroscopic techniques, arthroscopically assisted procedures produce very good clinical results [33] (Fig. 2.2). Arthroscopic methods are less invasive, and earlier functional outcome is regained. The disadvantage may be longer surgical time and certain technical demands. Learning curve of arthroscopic procedures is longer compared to open procedures.

The most commonly used treatment method is calcific deposit removal. At first, calcific deposit is localized using needle under direct arthroscopic view or using fluoroscopy; after localization of calcific lesion, it is perforated by needle or knife tip. If the calcific deposit has a paste-like structure, then a needle or blunt curette is used to evacuate the calcific deposit. If the deposit is hard, a soft tissue shaver is used to remove it.

Acromioplasty is performed after excision of subacromial bursa using a burr. The indication of acromioplasty is discussed. Marder [38] found that the removal of the calcific deposits without acromioplasty has better clinical outcomes. Therefore, acromioplasty should be performed in patients with intraoperative or radiological evidence of impingement.

Rotator cuff repair is indicated if rotator cuff tear is diagnosed during surgical procedure, or there is residual defect after deposit removal. Simple techniques should be preferred to allow faster postoperative recovery. Simple side-to-side suture or suture anchor reconstruction methods are used [37].

2.7.5 Arthroscopic Radiofrequency Stimulation: Author's Own Technique

A new technique, using previously published technique [39] of subscapularis tendon stimulation by bipolar radiofrequency-based microtenotomy (microdebridement), can be used in attempt to improve the healing potential after the arthroscopic

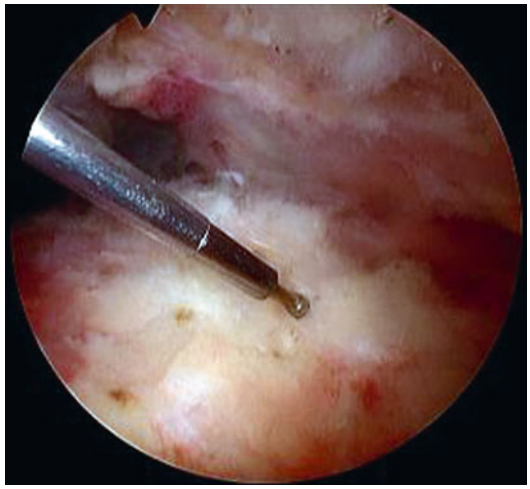

Fig. 2.3 Bursal side view of the left rotator cuff with a radiofrequency wand

treatment (Fig. 2.3). In a prospective study comparing the standard arthroscopic needle technique with a technique using radiofrequency-induced plasma microtenotomy as enhancement of the arthroscopic treatment of the calcific tendonitis on cohort of 20 patients, results measured by Constant score showed significantly better outcome in a group of patients after combined – arthroscopic and radiofrequency stimulation technique compared to a simple arthroscopic deposit removal [40].

2.7.6 Results

Clinical results of surgical treatment are very good, there is a significant improvement in shoulder function according to Constant score [34]; however, the postoperative recovery is very irregular and may take several months to complete recovery regardless of selected surgical technique [35, 41]. Long-term clinical results of rotator cuff surgery are comparable for both the open and the arthroscopic techniques, while short- and mid-term functional outcomes are better for arthroscopic treatment [7].

2.7.7 Conclusion

Surgical treatment is reserved for chronic cases not responding to conservative therapy. The treatment involves calcific deposit removal and rotator cuff reconstruction where necessary. Arthroscopic approach is preferred as it is less invasive and enables faster postoperative recovery compared to the open surgery. Radiofrequency stimulation of the affected tendon in addition to primary arthroscopic procedure shows better clinical outcome as documented on a small cohort of patients [40].

2.8 Practical Treatment Algorithm

Pietro Randelli

2.8.1 Introduction

Calcific tendinitis represents a treatment challenge since there is no consensus on its treatment. Uthoff [42] described three different phases: precalcific, calcific, and postcalcific. He postulated that, finally, the calcification reabsorbs and the tendon is able to restore.

Unfortunately, we know that up to 38% of the calcification do not disappear with time [43].

In particular, medial and anterior localization of the calcification is a negative prognostic factor for self reabsorption of the deposit [44].

The persistence of the calcification is detrimental to the tendon biology and resistance.

Thus, it is mandatory to follow up the calcification and to treat it in case it would not reabsorb spontaneously.

2.8.2 Diagnosis

Actually, X-ray represents the gold standard as diagnostic tool in calcific tendinitis (Fig. 2.1), together with the ultrasound. MRI can lead to diagnostic errors; thus, we do not suggest its use as a single tool.

2.8.3 Methods of Treatment

Several methods of treatment are listed in the literature. Among the most known are shock waves [45], US lavage [46, 47], needling [15], and arthroscopy [48] (Fig. 2.2).

Patient compliance is the key in the treatment algorithm for this disease. As a matter of fact, shock waves are not well tolerated by patients, as like as the surgical treatment is not well perceived. Recently, US-guided lavage offers an easy way of treatment of the tendinitis, washing out the entire deposit. Unfortunately, US lavage is suitable only in acute calcific tendinitis when the deposit is pretty fluid. On the other hand, the arthroscopic treatment allows to repair a cuff tear related to a chronic calcific tendinitis.

2.8.4 Practical Treatment Algorithm

We developed a practical treatment algorithm following the main concepts of:

1. Pain reduction
2. Treatment of the tendon avoiding a subsequent cuff tear

In case of acute onset of calcific tendonitis diagnosed by X-rays, the patients are sent to the radiology department for US lavage. The lavage is performed in local anesthesia and in an outpatient way. Two days after the treatment, the patients start physical therapy for passive range of motion (ROM) exercises, with a full ROM recovery at 7 days after treatment. Active ROM exercises will start only 15–20 days after treatment, depending on the residual pain.

The patients will repeat an X-ray at 2 months after treatment plus an MRI in case of persistent pain.

If the tendon is torn, the patients are scheduled for surgery; if not, they continue follow-up surveillance. In case of chronic calcific tendonitis, we suggest an arthroscopic treatment with or without rotator cuff repair.

2.8.5 Conclusion

Calcific tendinopathy should be treated to avoid subsequent cuff damages.

A well-accepted and successful technique is the US lavage. Arthroscopic treatment should be reserved for chronic cases or for cuff ruptures due to the deposit.

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ESSKA Instructional Course Lecture Book
Geneva 2012
Menetrey, J.; Zaffagnini, S.; Fritschy, D.; van Dijk, C.N. (Eds.)
2012, VI, 293 p., Hardcover
ISBN: 978-3-642-29445-7