Calcifying Tendonitis of the Rotator Cuff

42

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42.1 Introduction

Calcifying tendonitis of the rotator cuff is described as a frequent cause of shoulder pain [1] which is characterized by the presence of carbonate hydroxyapatite deposits mainly located in the supraspinatus tendon [2]. Women aged between 30 and 60 years are most frequently affected [3, 4]. However, the presence of a calcific deposit does not necessarily mean a significant impact on shoulder pain [5]. Louwerens et al. [6] could find a prevalence of approximately 8 % in asymptomatic patients, whereas a prevalence of 42.5 % was found in patients suffering from a subacromial pain syndrome.

Although the etiology is not clearly understood, various etiologies including tendon hypoxia, genetics, or an endocrine disorder have been proposed [7].

Three distinct phases were described [7]:

I. *Pre-calcification phase*:
   The tendon undergoes fibrocartilaginous transformation with metaplasia of tenocytes in chondrocytes.
II. *Calcific phase*:
   The calcific stage is broken down further into a formative phase during which calcium crystals are deposited in matrix vesicles that coalesce to form large deposits.
III. *Post-calcific phase*:
   After a resting phase during which the deposits ceases, a resorptive phase arises during which spontaneous resorption of the calcific deposit may be seen. During the resorptive phase, the expected amount of shoulder impairment as well as shoulder pain is usually the most.

42.2 Diagnosis

42.2.1 Clinical Evaluation

Patients with a symptomatic calcifying tendonitis usually suffer from a subacromial pain syndrome which may be explained by the secondary mechanical outlet impingement and subacromial bursitis caused by swelling and inflammation of the affected tendon.

In patients with a chronic subacromial pain syndrome, range of motion is merely slightly limited due to pain. Patients often present with

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rest and night pain with a variable intensity. Typically, a painful arc [8] between 60 and 120° of abduction exists, and impingement tests like the NEER test [9] or the Hawkins-Kennedy test [10] are positive as well. Clinical tests concerning the supraspinatus tendon or the biceps tendon are often painful, too. However, a weakness of strength is usually not found.

42.2.2 Radiological Evaluation

Radiologic evaluation consists of a true AP, an axial, as well an outlet view X-ray. This series is able to clearly identify the shape as well as the size of the deposit. Moreover, a clear localization of the calcific deposit can be reached, which becomes of high importance if the deposits require further surgical treatment. According to the size and the radiographic appearance, the deposits can be classified. The size of the deposit can be categorized according to the Bosworth [5] classification in three categories of small (<0.5 cm), medium (<1.5 cm), and large (>1.5 cm). Gärtner [2] classified the calcific deposit according to their radiological appearance (Fig. 42.1).

42.2.3 Ultrasound Evaluation

Ultrasound evaluation is also described as a very valuable tool in order to localize the calcific deposit preoperatively. According to the quadrant technique, with the patient's arms placed in a neutral position [11], it may also help to identify the deposit during surgery. Moreover, it offers a fast and cost-effective method to assess the disappearance of the calcific deposit as well as to evaluate the integrity of the rotator cuff after percutaneous needling or arthroscopic/open removal of the deposit.

42.3 Treatment Options

42.3.1 Conservative Treatment

Most authors recommend conservative treatment including nonsteroidal anti-inflammatories, pain medication, physical therapy, subacromial injections of local anesthetics with or without cortisone, needling and lavage (barbotage) of the deposit, or extracorporeal shock wave therapy (ESWT) [12].

42.3.2 Operative Treatment

In patients with persistent symptoms of more than 6 months and failed conservative treatment, surgical treatment may be indicated which can be performed in an open or all arthroscopic technique.

In the arthroscopic procedure, the arthroscopy is typically performed through a standard posterior portal. After the diagnostic round to rule out concomitant pathologies, a 20 gauge needle is used to identify and mark the deposit under arthroscopic control (Fig. 42.2). A suture may be passed through the needle, or the needle can alternatively be left in place while the arthroscope

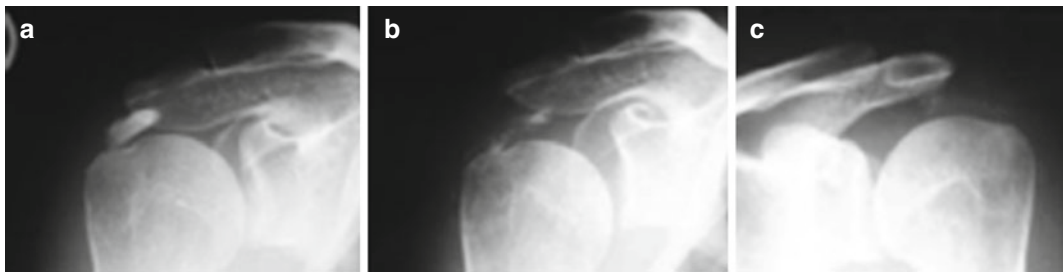

Fig. 42.1 (**a**–**c**) Classification according to Gärtner [2, 43]. (**a**) Sharp/dense contours. (**b**) Poorly defined dense or sharp contours. (**c**) Poorly defined/transparent

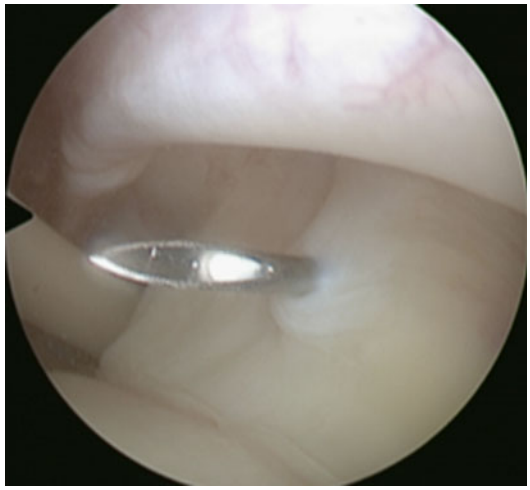

Fig. 42.2 Arthroscopic view intra-articular from the posterior portal. Marking of the calcific deposit using a spinal needle

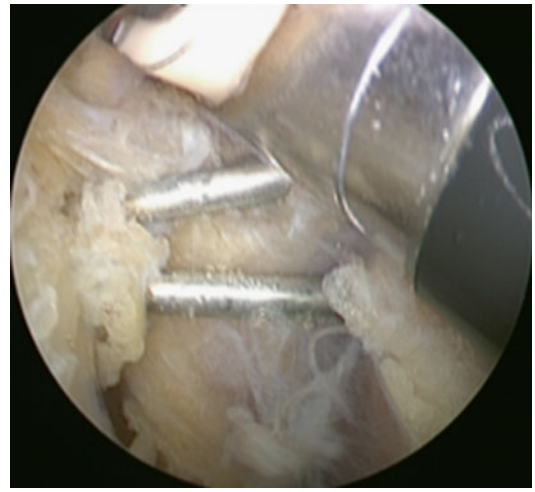

Fig. 42.3 Identification of the spinal needle from the subacromial space

is introduced in the subacromial space through the posterior portal. A subacromial bursectomy is performed to ensure a complete visualization of the rotator cuff tendon using a standard shaver and a radiofrequency device. The needle or, respectively, the suture is identified with special care not to damage it (Fig. 42.3).

After clear localization of the deposit, the tendon is opened with an arthroscopic knife longitudinally and parallel to its direction. The deposit is pressed out with blunt instruments; the typical snowstorm pattern that occurs is removed with the synovial shaver which may also be used to remove loose parts of the deposit within the tendon without damaging the tendon extensively (Fig. 42.4a, b).

Dependent on the size and the shape of the deposit, a minor or a major damage may occur in the rotator cuff tendon (Fig. 42.5). In the authors' clinical practice, minor defects are left in situ, whereas more substantially defects like bursa-sided partial rotator cuff tears or subtotal rotator cuff tears were treated with surgical repair of the rotator cuff (Fig. 42.6). A subacromial decompression is only added if signs of subacromial irritation are apparent on the undersurface of the acromion.

The postoperative regimen included passive and active mobilization of the arm as tolerated under physiotherapeutic control during the first 6 weeks. In patients with a more substantive rotator cuff tear that require a rotator cuff repair using bone anchors, patients were treated with an abduction pillow for 6 weeks. Passive range of motion is allowed to 90° of flexion and abduction as well as 30° of external rotation.

42.4 Complications

Subacromial injections and needling may carry the risk of infection, injuries of blood vessels or nerves, as well as allergic reaction mainly caused by the concomitant local anesthetic medication. The needling procedure is associated with slight to moderate pain. Moreover, concomitant damage of the tendon as well as the underlying cartilage cannot be ruled out. However, severe complications are rare in the literature.

Serafini et al. [13] reported a few mild vagal reactions during treatment in their needling group and a painful bursitis in 13.2 % of their patients within the first 3 months. De Witte et al. [12] did not find a similar incidence of posttreatment bursitis but reported two frozen shoulders after needling.

If extracorporeal shockwave therapy (ESWT) is used, the described complications are also rare,

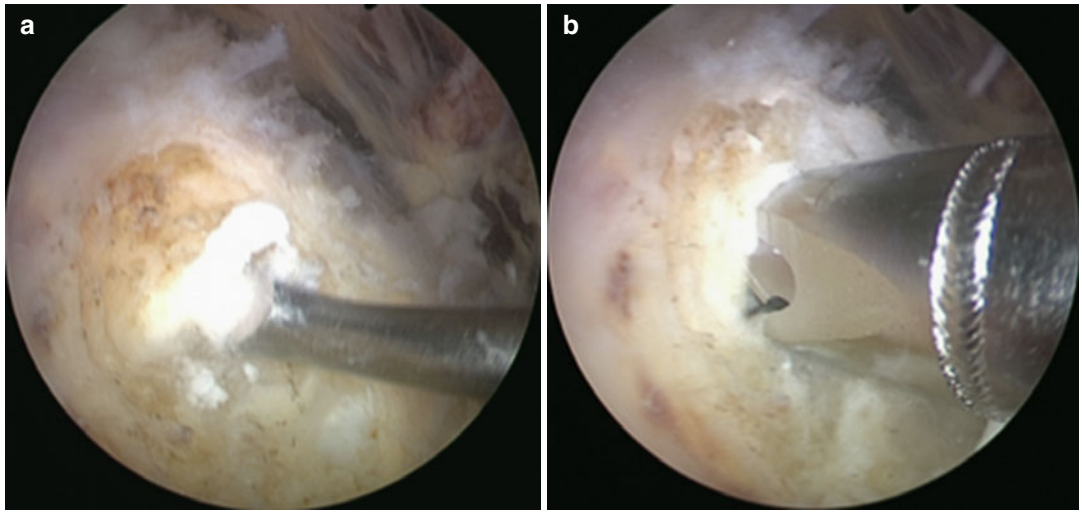

Fig. 42.4 (**a**, **b**) Removal of deposit using arthroscopic instruments with special care not to extensively violate the rotator cuff

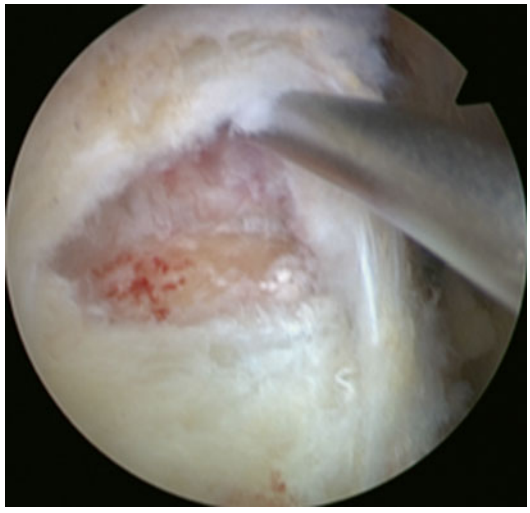

Fig. 42.5 After removal of the deposit, a bursa-sided tear of the rotator cuff is evident

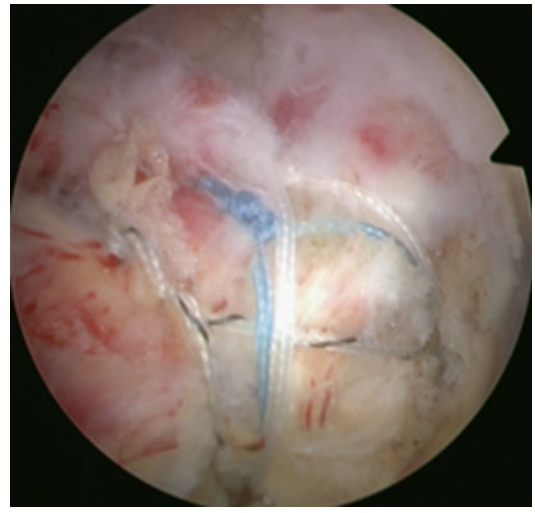

Fig. 42.6 Arthroscopic repair of the bursa-sided partial rotator cuff tear using a triple-loaded suture anchor (5.5 mm Bio-Composite Corkscrew, Arthrex, Naples, USA) medial performing a triple-mattress repair as well as two press-fit anchors (4.5 mm Bio-PushLock, Arthrex, Naples, USA) to realize a double-row suture bridge repair

mainly less severe such as reddening of the skin, pain, as well as the development of small hematomas.

In a systematic review by Louwerens et al. [4] concerning the evidence of minimally invasive therapies in the management of chronic calcific tendonitis of the rotator cuff, the most reported side effects were pain during treatment [14–16], soreness [17], local subcutaneous hematomas [18, 19], and small petechial hemorrhages [15, 20]. All of these affected only a small number of the treated participants, and all of the adverse side effects resolved within a few days.

However, also more severe complications were described in the literature. Liu et al. [21] presented a patient developing a humeral head osteonecrosis 3 months after ESWT treatment

without any predisposing factors in clinical history such as injury, use of steroid medication, blood disorders such as sickle cell anemia, excessive alcohol abuse, Gaucher's disease, radiation treatment, chemotherapy or others, connective tissue diseases, or dyslipoproteinemia. Durst et al. [22] also reported on the development of an osteonecrosis of the humeral head after ESWT. Therefore, even if rare, the possibility of such a complication should be considered if ESWT is used.

The reported complications after arthroscopic removal of the deposit are low.

Seil et al. [23] reported in their study group one patient with a subcutaneous hematoma which resolved spontaneously and two patients who suffered from shoulder stiffness which was treated with intra-articular cortisone injections. Both complications did not have a significant impact on the postoperative results. However, two patients showed a persistence of pain requiring additional subacromial decompression [23].

Similar findings were reported by others [24].

42.5 Results

Wang et al. [25] reported on the clinical results of 37 patients with calcific tendonitis that were treated with shock wave therapy. Patients were observed 24 and 30 months after initial treatment. In the study group, 20 shoulders (60 %) were complaint-free, 10 were significantly better (30 %), and 2 patients were unchanged (6 %). Radiological evaluation revealed a significant reduction in deposit size with a complete elimination in 57 % of the patients. The authors concluded that ESWT in the treatment of calcific tendonitis of the shoulder is a safe and effective treatment option.

The reported results may be dose dependent as Albert et al. [26] performed a prospective randomized trial of 40 patients in each group who underwent high-energy versus low-energy ESWT for calcifying tendonitis of the shoulder. In their results at a mean of 112 days after initial treatment, patients treated with high-energy ESWT showed significantly higher Constant scores, more improvement from the baseline level, as well as significantly more total or subtotal resorption of the calcification. However, even in the high-energy group, only 15 % of the calcific deposits were changed in appearance on X-rays.

Castillo-Gonzalez et al. [27] reported on a 2-year longitudinal prospective study of 121 patients suffering from calcific tendonitis of the shoulder. All patients were treated with US-guided needling and lavage. In the results significant reduction of pain as well as of the size of the deposit was observed at 3 months, 6 months, as well as 2-year follow-up. In conclusion of their results, the authors considered this technique as a valid alternative as a first-choice treatment of calcific tendonitis of the shoulder.

Gatt and Charambolus [28] performed a systematic review on the outcomes and complications of US-guided barbotage for calcific tendonitis of the shoulder. Based on their findings, they concluded that ultrasound-guided barbotage is a safe technique, with a high success rate and low complication rate. However, they did not find evidence assessing its effectiveness compared with other major treatment modalities.

In a randomized controlled trial, De Witte et al. [12] compared two groups of patients with calcifying tendonitis of the shoulder that were either treated with US-guided needling and lavage or subacromial steroids alone. At final follow-up after 1 year, both treatment groups showed an improvement in the clinical scores with no significant differences at 3 and 6 months follow-up. However, at final follow-up, clinical and radiological results were significantly better in the barbotage group.

Kim et al. [29] compared the clinical results of US-guided needing and additional cortisone injection to a group of patients who received ESWT three times a week. At 1-year follow-up, the US-needling group had significantly better clinical scores evaluated by the ASES score, simple shoulder test, as well as visual analog scales for pain compared to the group treated with ESWT.

However, another recently published systemic review [4] concerning the evidence of minimally invasive therapies for calcifying tendonitis of the

shoulder options pointed out that there is only a moderate quality of studies supporting the effect of ESWT on pain relief and functional status compared to other interventions. Moreover, needling has not been proven to be more effective than US-guided subacromial corticosteroid injections; therefore, further research may be necessary to prove its effectiveness.

Hence, US-guided needling with barbotage as well as ESWT both seem to be a safe and effective treatment option in patients with symptomatic calcifying tendonitis of the shoulder. However, a randomized trial comparing ultrasound-guided barbotage and extracorporeal shock wave therapy would be of great value, as current literature cannot support a clear trend toward one of the treatment options.

If conservative treatment fails, arthroscopic removal has been reported with excellent midterm to long-term results [23, 24, 30–32]. However, the question if the damage to the rotator cuff needs to be repaired or not as well as the question if a complete removal of the deposit is necessary or an additional acromioplasty needs to be performed is still a matter of discussion.

Seil et al. [23] investigated the clinical and radiological results of 54 patients after arthroscopic removal of calcific deposits of the shoulder without repair of the rotator cuff. In their results, the Constant score could be significantly improved from 33 to 91 points after 2 years, and 92 % were satisfied with their clinical outcome. However, only 31 % of the patients reached their minimum pain level after 3 months and 17 % after 6 months whereas another 20 % needed 9 months and 28 % 12 months for their minimum pain level. Although this study could reveal the previously reported excellent clinical results, a prolonged postoperative phase until a complete pain-free recovery was achieved could be seen. Moreover, 66 % of the patients showed irregularities within the rotator cuff on postoperative ultrasound examination even if this did not have any significant influence on the reported short-term results.

The prolonged postoperative period, until pain relief is reached, is supported by other studies as well [24, 30, 31, 33, 34]. Balke and coworkers [30] reported on the midterm results of 62 patients after arthroscopic treatment of calcifying tendonitis of the shoulder. Comparable to the work of Seil et al. [23], they tried to minimize the damage to the rotator cuff tendon and did not perform a rotator cuff repair in their patients. After a mean follow-up of 6 years, patients showed a significantly lower Constant as well as ASES scores compared to their healthy contralateral shoulder. Ultrasound examination at final follow-up revealed a partial rotator cuff tear in 11 patients whereas only 3 contralateral shoulders showed a partial tear. The authors concluded that even if good midterm results were achieved, the clinical scores were lower than the scores of the healthy contralateral shoulder. Furthermore, the amount of partial rotator cuff tears seemed to be higher in the operated shoulders. Comparable to the study of Seil et al. [23], the minor changes on the rotator cuff did not seem to have a clinical impact on the results. However, Porcellini et al. [31] did not find any partial rotator cuff tears on postoperative ultrasound examination in their patients at 2 years follow-up and recommended repair of the tendon after resection of bigger calcific deposits.

Especially in large deficits, the damage on the rotator cuff may be underestimated if the defect is not carefully inspected.

The impact on the amount of removal is also discussed controversially in the literature. Seil et al. [23] did not find any correlation of postoperative shoulder function and the amount of remaining calcific deposit on postoperative X-ray controls. Moreover, they could find a progressive resorption of the deposits even if they had not been completely removed during surgery. This is in conclusion with the findings of other authors who did not find evidence that a complete removal of the deposit is necessary to achieve good clinical results [23, 24, 33, 35].

In contrast to that, Porcellini et al. [31] found in their study a strong correlation of the presence of residual calcific depots after surgery with an inferior clinical outcome. These findings were confirmed by other authors as well [32, 36, 37].

Therefore, it seems reasonable to remove as much of the deposit as possible without extensively damaging the tendon in order to achieve a sufficient decompression and clinical result.

Several authors do recommend an acromioplasty only in patients' signs of mechanical irritation on the undersurface of the acromion [23, 30, 31] as they could not find any significant benefit in their clinical results compared to patients without additional acromioplasty.

However, others have reported a significant benefit in their patients when performing acromioplasty even without removal of the calcific deposit [38–40] with disappearance of the deposit in the majority of patients.

As the results of patients with acromioplasty and an additional removal of the deposit did not show any significant differences compared to an isolated acromioplasty [41, 42], some authors concluded that additional removal of the calcific deposit does not further improve the clinical outcome.

Balke et al. [30] performed an additional acromioplasty compared to isolated removal of the deposit in 44 of their 62 patients. Although additional acromioplasty did not have a significant influence of the total Constant and ASES scores, the "subitem" pain was significantly lower in the acromioplasty group.

Acromioplasty as well as partial or complete removal of the calcific deposit seems to have a significant benefit on the clinical results in patients with calcifying tendonitis of the shoulder. Therefore, reduction of subacromial irritation by decompression seems to be the major step in order to reduce shoulder pain as well as to induce dissolution of the calcific deposit. A combination of both treatment options, however, does not seem to add additional benefit on the clinical results.

42.6 Summary

Calcifying tendonitis of the shoulder is a common cause of shoulder pain mainly affecting women between the age of 30–60 years. In patients with a symptomatic calcifying tendonitis of the shoulder, conservative treatment using needling of the deposits with barbotage or ESWT has shown to achieve satisfactory results in a significant amount of patients. If conservative treatment fails, arthroscopic treatment is recommended. Based on the current literature, arthroscopic complete or subtotal removal of the deposit is recommended without making substantial damage to the rotator cuff. In patients where a more substantial defect is found after removal, arthroscopic repair of the rotator cuff is indicated. Subacromial decompression is recommended in patients with additional signs of subacromial impingement such as of fraying on the undersurface of the acromion. Moreover, it may be added in patients with insufficient removal of the persistent calcific deposits.

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