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Arthroscopic treatment of calcific tendinitis without rotator cuff repair using prospectively collected results

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The treatment of calcific tendinitis can be either non-operative, which should always be the first step of treatment, or operative. In chronic calcifying tendinitis with insufficient conservative treatment, an arthroscopic excision of the calcification deposit may help, however, there is controversy about how it should be performed. This retrospective study, with prospectively collected results using the Surgical Outcome System™ (SOS, Arthrex®), evaluated the outcome of arthroscopic treatment of calcific tendinitis without rotator cuff repair. Outcome was measured by different scores such as Visual Analogue Scale (VAS), American Shoulder and Elbow Surgeons Evaluation Form (ASES) and Single Assessment Numeric Scale (SANE). 54 patients were included in the analysis (male: 19; female: 35), mean age at surgery was 51 (range, 37-68) years. All scores improved compared with final follow-up. VAS score improved from 5,3 ± 2,2 to 0,9 ± 1,3 (p<0,001). ASES score improved from 53,0 ± 17,0 to 92,2 ± 11,1 (p<0,001) and SANE score from 47,2 ± 17,8 to 92,1 ± 10,6 (p<0,001). Most improvement is seen in the first 3 months postoperatively but gradual progress is to be expected up until 2 years. No frozen shoulders or cuff tears were reported postoperatively. No reoperations were necessary during follow-up. A noticeable fast pain relief and functional recovery are seen when treating a patient with calcific tendinitis without repairing the rotator cuff. There were no patients with frozen shoulder postoperatively.

Key words: calcific tendinitis, rotator cuff, arthroscopy, shoulder.

INTRODUCTION

Calcific tendinitis is a common and painful condition that was first described by *Codman et al*[1]. Until now, the etiology of this condition is not completely understood. Several authors have formulated a hypothesis, but none have been fully proven yet. There have been proposed two different processes for the formation of calcifications: degenerative and reactive calcification[2]. The hypothesis of the disease stages with currently the most interest is formulated by *Uhthoff et al*, stating that the disease can be separated into three stages. The pre calcific stage, in which symptoms are rare. The calcific stage which can be divided into a formative, resting and reabsorption phase in which symptoms of pain mostly exist. In the post calcific stage, the calcific deposit dissolves and the healing of the rotator cuff occurs[2]. *Molé et al* described in 1999 a radiological classification of the deposits, that characterise the different phases. Type A lesions are dense homogenous lesions, while type B lesions are also dense but with multiple different fragments. Type C is a heterogenous lesion with a cloud-like appearance and type D are dystrophic calcifications. It can be summarized that type A and B suggest a chronic resorptive phase and type C and D are associated with an evolving resorptive phase[3].

The treatment of calcific tendinitis can be either non-operative or operative. It is of paramount importance to emphasize that conservative treatment should always be the first step of treatment. In most patients, the deposits dissolve spontaneously during the post calcific stage, but in some cases, the pain can persist for months without showing signs of improvement using conservative treatment. Conservative treatment consists of systematic NSAIDs or a subacromial cortisone injection in the acute phase, in combination with physical therapy using cold or heat and manual therapy with exercises improving range of motion[4]. More recently, new conservative treatments have emerged such as extracorporeal shock wave therapy (ESWT) and ultrasound-guided needling (UGN) and can be administered if earlier conservative treatments failed to succeed[5-7]. Upon this moment, an operative

treatment, in which the tendon is incised and the calcific deposit is removed, is found to be the last remaining treatment option in chronic calcific tendinitis when all conservative treatments have failed. *Uthoff et al* described that a surgical removal of the calcific deposit may be performed during the formative phase, thus in the calcific stage[2].

There is still a lot of controversy about the way the operative treatment should be performed. Debate exists if an acromioplasty should be executed in all patients and if the rotator cuff should be repaired after removal of the deposits[4].

Our goal was to evaluate the functionality and pain after removal of a calcified tendinitis without repair of the rotator cuff in patients who were non-responsive to at least six months of conservative treatment and were in the calcific stage. Moreover, the influence of concomitant acromioplasty on the clinical outcomes was assessed. Lastly, the impact of some patient-related factors was assessed on the clinical outcomes.

METHODS

In this retrospective study, but with prospectively collected results, we followed patients who underwent arthroscopic surgery for calcific tendinitis from January 2018 until February 2021. All these patients reported pain in the affected shoulder for a minimum of 6 months with conservative treatment and with preoperatively a confirmed diagnosis of calcific tendinitis. All patients who underwent arthroscopic surgery to resect the calcific nodules were included and gave consent to follow-up with the digital application named Surgical Outcome System™ (SOS, Arthrex®). A minimum follow-up period of 6 months was defined with a mean follow-up in the patient population of at least one year. Exclusion criteria were defined as follows: rotator cuff repair at surgery, prior surgery in the affected shoulder, concomitant shoulder lesions or new trauma during follow-up.

All patients had an arthroscopic removal of the calcified nodules in the same manner, performed by one single senior orthopaedic surgeon (D.P.). Informed consent was obtained and the surgical safety checklist was verified. The patients were operated using an interscalene block and general anesthesia and were installed in lateral decubitus with traction on the operated arm using a 3-point shoulder distraction system (AR-1600M Arthrex®). A standard posterior viewing portal was created directly in the subacromial space. There was no attempt at all to do a routine inspection of the glenohumeral joint. Previous experiences of the senior author (D.P.) as well as a recent study have shown that this routine inspection might cause capsulitis or frozen shoulder[8]. Under direct vision in the subacromial space, a standard lateral portal was created outside-in with the aid of a needle to check if the calcified deposit is reachable using this portal. After a thorough bursectomy the deposit was visible and was incised longitudinally using a no. 11 blade. Afterwards, the calcified nodule was tried to be removed using pressure or with the use of a blunt hook. The motorised shaver was inserted into the defect if no sufficient removal was succeeded with a primary goal of removing as many calcific deposits as possible without harming the rotator cuff tendon. Therefore, there was no control with intra- or postoperative fluoroscopy for complete removal. Lastly, the motorised shaver was used to make sure that all the calcareous material was aspirated in the subacromial space. Furthermore, an assessment of impingement was made regarding the damage to the supraspinatus tendon and the extent of the acromion and the overlying coracoacromial ligament. These signs were a kissing lesion between the rotator cuff and acromion, fraying of the rotator cuff at the coracoacromial ligament and when present acromioplasty was performed.

The operated arm is protected in a sling until the block eases off. Elbow, wrist and hand exercises start on the first postoperative day. Pendulum exercises and active mobilisation are initiated as tolerated. Progressive resistance exercises are allowed once that the patient has a pain-free range of motion of the shoulder. Sutures were removed approximately 14 days after surgery. A consultation with the surgeon was planned at 6 weeks, 3 months and 6 months postoperatively.

Patient-reported outcome measures were recorded using the Surgical Outcome System™ (SOS, Arthrex®) combined with a clinical evaluation at the hospital at 6 week-intervals. There was a minimal follow-up of 6 months. To allow for a correct prospective follow-up using the SOS, we used different scores which were calculated after self-assessment by the patients at 2 weeks, 6 weeks, 3 months, 6 months, 1 year and 2 years postoperatively. These scores consisted of the Visual Analogue Scale (VAS), American Shoulder and Elbow Surgeons Evaluation Form (ASES) and the Single Assessment Numeric Scale (SANE). The ASES score consists of 17 questions to assess shoulder function and is rated on a scale between 0 and 100 after calculation. The SANE score is relatively new and asks the patient to score the function of a joint as a percentage of normal between 0 and 100. *Retzky et al* already showed there is a great correlation with the frequently used

ASES score[9]. To complete our data collection and to better understand our patient population and the factors influencing the outcome we collected age, gender, smoking, side of the operation, dominant side, duration of follow-up, preoperative and postoperative frozen shoulder pathology and whether acromioplasty was performed during surgery.

Statistical analysis was performed using IBM® SPSS® Statistics 26 (IBM, Co., Armonk, NY, USA). Descriptive statistics like mean, standard deviation and range were calculated for continuous data. Percentage and count were calculated for categorical data. To analyse between preoperative and postoperative data the paired T-test was conducted. The Mann-Whitney U-test was used to detect specific factors influencing the outcome. The correlation between the ASES and SANE score was analysed by the Pearson correlation coefficient. A p-value less than 0,05 was defined to be statistically significant.

RESULTS

Fifty-four patients met the inclusion criteria as stated above to be enrolled in the study. The mean age was 51 years with a minimum of 37 years and a maximum of 68 years. Nineteen patients (35,2%) were male and 35 (64,8%) were women. Twelve (22,2%) admitted smoking daily. The mean follow-up was 22,6 months (almost two years) with a minimum of 6 months and a maximum of 38 months. The mean age was 51 years and ranged from 37 to 68 years. Twenty-one (38,9%) patients underwent surgery on their dominant side while 43 (79,6%) patients received additional acromioplasty. Patients' characteristics are summarized in table I.

Table I. — Patient characteristics.

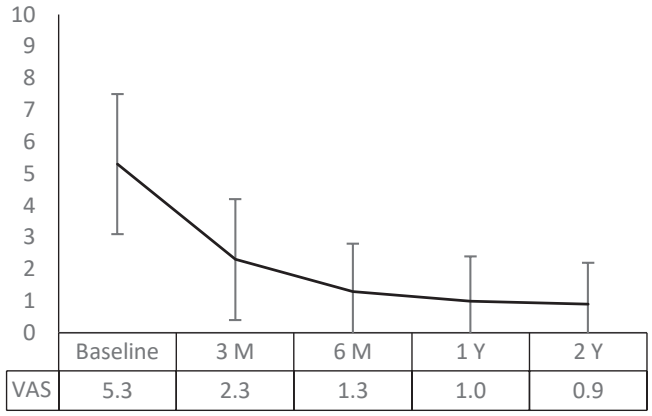
Patient characteristic	n (%) or mean [MIN; MAX]
Age (years)	51 [37; 68]
Sex (male / female)	19 (35,2%) / 35 (64,8%)
Follow-up time (months)	22,6 [6; 38]
Smoker (yes / no)	12 (22,2%) / 42 (77,8%)
Side (left / right)	32 (59,3%) / 22 (40,7%)
Dominant side (yes / no)	22 (40,7%) / 32 (59,3%)
Subacromial decompression (yes / no)	43 (79,6%) / 11 (20,3%)
n = number of patients. MIN = minimum. MAX = maximum.	

In terms of pain, a mean VAS score of 5,3 ± 2,2 at baseline which improved to 0,9 ± 1,3 at final follow-up ($p<0,001$) was observed. At 6 months, which is the minimum follow-up of the patients included in this paper, a mean VAS score of 1,3 ± 1,5 was reported, marking an improvement of more than 75% compared to baseline ($p<0,001$). As illustrated in both figure 1 and table II there is a gradual decline in VAS score until final follow-up at 24 months with most progress made in the first 3 months postoperatively.

In terms of functionality, a great improvement was seen from baseline until the final follow-up at 2 years. Preoperatively a mean ASES score of 53,0 ± 17,0 was seen, improving to 92,2 ± 11,1 at final follow-up ($p<0,001$). Most improvement was observed in the

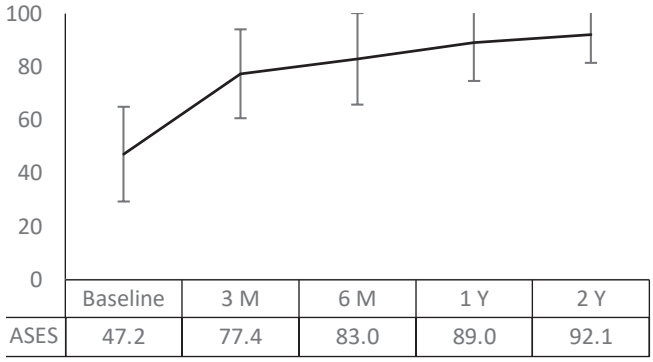
Table II. — Clinical outcomes at baseline pre-operatively and at different time points during follow-up.

Mean ± SD (n patients) [P value]					
Score		3M	6M	1Y	2Y
VAS pain					
Value	5,3 ± 2,2 (54)	2,3 ± 1,9 (54)	1,3 ± 1,5 (54)	1,0 ± 1,4 (45)	0,9 ± 1,3 (28)
Change from baseline		3,0 ± 2,5 (54) [P<0,001]	4,0 ± 2,4 (54) [P<0,001]	4,2 ± 2,5 (45) [P<0,001]	4,5 ± 2,3 (28) [P<0,001]
ASES score					
Value	53,0 ± 17,0 (54)	76,2 ± 17,9 (54)	85,5 ± 14,7 (54)	90,3 ± 11,1 (45)	92,2 ± 11,1 (28)
Change from baseline		23,2 ± 21,0 (54) [P<0,001]	32,5 ± 19,8 (54) [P<0,001]	36,2 ± 18,2 (45) [P<0,001]	39,4 ± 14,8 (28) [P<0,001]
SANE score					
Value	47,2 ± 17,8 (53)	77,4 ± 16,7 (53)	83,0 ± 17,2 (53)	89,0 ± 14,3 (44)	92,1 ± 10,6 (28)
Change from baseline		30,2 ± 22,2 (53) [P<0,001]	35,8 ± 21,6 (53) [P<0,001]	41,3 ± 21,6 (44) [P<0,001]	45,3 ± 16,4 (28) [P<0,001]
VAS: Visual Analogue Scale; ASES: American Shoulder and Elbow Surgeons Evaluation Form; SANE: Single Assessment Numeric Scale.					



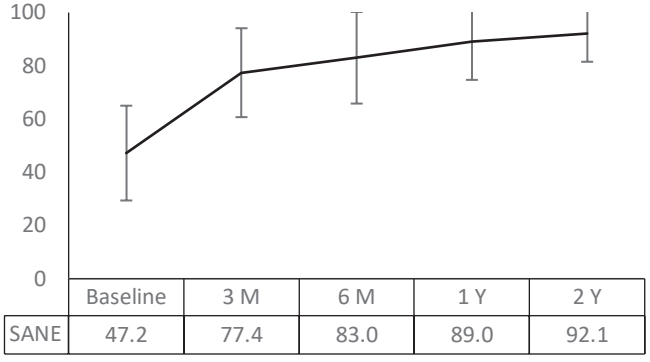
	Baseline	3 M	6 M	1 Y	2 Y
VAS	5.3	2.3	1.3	1.0	0.9

Figure 1 — Mean VAS score during follow-up.



	Baseline	3 M	6 M	1 Y	2 Y
ASES	47.2	77.4	83.0	89.0	92.1

Figure 2 — Mean ASES score during follow-up.



	Baseline	3 M	6 M	1 Y	2 Y
SANE	47.2	77.4	83.0	89.0	92.1

Figure 3 — Mean SANE score during follow-up.

first 3 months after surgery with a mean change from baseline of 23,2 ± 21,0 ($p<0,001$) giving a mean ASES score of 76,2 ± 17,9 after 3 months, although gradual improvement is to be expected up until 2 years. There is a statistically significant ($p<0,001$) improvement between on one hand the baseline assessment pre-operatively and on the other hand the follow-up assessment points at 3, 6, 12 and 24 months. At 6 months of follow-up, 76% of the patients reached an ASES score of 80 and 56% reached a score of 90. At final follow-up, 70% of the patients reached an ASES score of 90 and one in 10 patients failed to reach 80 points at final follow-up.

Recently the SANE score is being used more as an easier score to assess clinical outcome compared to the more complex ASES score. In this paper, a baseline SANE of 47,2 ± 17,8 which improves significantly ($p<0,001$) to 92,1 ± 10,6 at final follow-up is reported. Similar to the ASES score gradual improvement of the score up until 24 months is observed with the most improvement to be made in the first 3 months of follow-up represented by a mean SANE score of 77,4 ± 16,7 marking a change from baseline of 30,2 ± 22,2. There is statistically significant ($p<0,001$) improvement compared to baseline at each follow-up time. A statistically significant ($p<0,001$) correlation between the SANE and ASES score at baseline ($r=0,440$), 3 months ($r=0,795$), 6 months ($r=0,758$), 1 year ($r=0,710$) and 2 years ($r=0,904$) is reported.

An analysis of potential influencing factors on the clinical outcome was performed. As these prospective results were retrospectively collected, randomisation was impossible. However, analysing for differences in clinical outcome influenced by these factors remained a possibility. No difference in outcome was observed between patients that had an additional acromioplasty and those that did not, both in terms of pain and functionality. Whether treatment was performed on the dominant side does not seem to influence the clinical outcome. At 1 year of follow-up, men showed slightly higher ASES scores than women ($p=0,006$) and reported lower VAS scores ($p=0,027$) however this was not observed in any of the other follow-up points. Smokers seem to report a lower ASES score at 1 year ($p=0,037$) but also this was not a consistent finding among the other time points. No patients required additional rotator cuff repair during follow-up. There were no reports of frozen shoulder postoperatively.

DISCUSSION

There have only been published a few studies that assess the postoperative clinical outcomes in a serial manner[10-13]. None of these studies used prospectively collected data. In this paper, we found that arthroscopic removal of calcific deposits shows significant improvement in pain and functionality from three months postoperatively.

In recent literature, an arthroscopic treatment for chronic calcific tendinitis resulted in significant pain relief in most patients. However, this reduction in pain was typically limited in the first three months of the postoperative period. This prolonged period of pain

results in a longer postoperative rehabilitation program and a longer period of limited functionality[10,13,14]. In contrast, we found a significant improvement using the VAS scale after a period of 3 months compared to the VAS score at baseline measurements with the most remarkable decline in pain being in the first 3 months postoperatively. There is still a debate concerning the perioperative factors influencing the pain and functionality postoperatively, such as a concomitant acromioplasty, a rotator cuff repair after calcific removal or the degree of calcific removal. *Lee et al* reported significant pain relief after six months. In their study, they retrospectively evaluated pain and ROM in 39 patients and investigated the influence of the degree of calcific removal and rotator cuff repair on the clinical outcome[14]. They concluded that both factors did not influence the postoperative clinical outcome and calcific deposits should be removed as much as possible but without damaging the rotator cuff. Unlike *Lee et al*, other authors have shown an improvement in pain when large cuff lesions (> 1cm) are repaired[15]. A downside is that increased stiffness and reduction of ROM in the early stages are reported if a cuff repair is performed. Therefore, early rehabilitation is indicated in case of cuff tear repair[14,15]. However, in our study, all patients had complete removal of the calcific deposit with the least possible damage to the tendon and none of the patients received a rotator cuff repair, suggesting that repair of the rotator cuff tendon does not have a noticeable impact on the functionality.

There is still debate if acromioplasty is useful in patients with calcific tendinitis and intra-operative signs of impingement as defined above. Several other authors have investigated if a concomitant acromioplasty is necessary or not. In 1998, *Jerosch et al* described in their article that an additional acromioplasty had no benefit on the clinical results[16]. An important sidenote on that article addressed by L.B *Braun-Munzinger et al* is that they resected the coracoacromial ligament as a part of the standard procedure in both groups, which is already a broadening procedure of the subacromial space[17]. Alike, *Gleyze et al* found no difference in clinical outcomes with or without acromioplasty[18]. Contrary, *Balke et al* reported better pain scores with a concomitant acromioplasty[19]. *Molé et al* even suggested an isolated acromioplasty without calcific removal as a plausible treatment modality in small calcifications (type C)[20]. *Marder et al* assessed the difference in pain between patients receiving a concomitant acromioplasty or not and found no benefit with an acromioplasty and on top of that a retarded return to unrestricted activity without pain[12]. In our study, patients who received acromioplasty do not report more pain postoperatively than patients who did not. Also, functional outcomes show no difference. Since randomization was not possible due to the retrospective design of the study no conclusions can be made on the need for acromioplasty. In our opinion, a concomitant acromioplasty should be considered in case of intra-operative impingement signs however future research is needed. In a recent article, L.B *Braun-Munzinger et al* agreed with this point of view and showed that there was a high incidence (92.5%) of outlet impingement syndrome in patients with calcific tendinitis[17]. *Porcellini et al* only found in 10% of their study population signs of subacromial impingement and however they recommended a concomitant acromioplasty if signs of subacromial impingement are present, this did not affect the clinical outcome[15]. In our study, nearly 80% of the population had signs of subacromial impingement and subsequently received a concomitant acromioplasty, which gave results comparable to those of *L.B Braun-Munzinger et al*[17].

Just as pain decreased significantly, functionality improved significantly after 3 months postoperatively. This result shows a noticeably faster functional recovery than similar recent articles in which no significant improvement in range of motion was found[10,11,14,19]. In *Cho et al* their recent retrospective study examining 35 patients with a mean follow-up of 50.6 months, a negative correlation was found for rotator cuff repair and functionality, and for acromioplasty and pain. They found that it required up to six months for significant recovery of shoulder function[10]. The reason for a faster functional recovery in our study population is not completely understood but some important factors are described below. In our study, there was no negative correlation between acromioplasty and post-operative pain. Moreover, none of the rotator cuffs were repaired after removal of the calcific deposits which led to a short time between operation and first physiotherapy session. As described earlier, short-term functional results may be worse in patients receiving a rotator cuff repair after calcific deposit removal. Additionally, there were no cases of frozen shoulder reported in our series. The postoperative rehabilitation protocol in our study population consisted of a period of two weeks with an immobilisation sling and early passive mobilisation.

For many years, authors have recommended that arthroscopic removal of calcific deposits should remain a last resort treatment. However, several studies have shown worse clinical outcomes in patients with long-standing symptoms. Moreover, *Richard et al* have recommended a faster surgical treatment for the reason

that smaller type A and C deposits are easier and less injurious than debridement of dense, fragmented deposits (type B) involving surrounding tissues[12,13]. Therefore, a paradigm shift may occur in which patients might have earlier arthroscopic removal after at least six months of conservative treatment which may improve clinical outcomes. On the other hand, *Maier et al* found that postoperative recovery is not related to preoperative duration of symptoms[11].

Our study has several limitations. First, there is a limited study population. Secondly, this is a retrospective study, but with patient-reported prospectively collected results, therefore an important bias was excluded, which is indirectly a strength of this paper. There is no control group treated with alternate approaches as well as a lack of randomisation for the acromioplasty. There was no postoperative radiological assessment to control full removal of calcific deposits, but *Seil et al* have suggested that a thin shell of adherent calcifications at the periphery of the deposit might show remaining calcifications at a postoperative radiograph without any clinical significance and moreover they have shown that despite remaining calcific deposits, progressive calcific resorption can be expected in the first postoperative year[13].

CONCLUSION

In conclusion, a noticeable fast pain relief and functional recovery are seen when treating a patient with calcific tendinitis without repairing the rotator cuff. There have been no limitations in range of motion nor did a frozen shoulder occur postoperatively in our patients. We stretch the importance to remove as many of the calcific deposits as possible without harming the rotator cuff too much as a repair requires a longer rehabilitation. Arthroscopic removal of calcific tendinitis remains a possible treatment with good results when conservative treatment has failed.

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