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Outcomes of surgical repair of partial thickness rotator cuff tears in patients with calcific tendinitis

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Calcific tendinitis of the rotator cuff is a common disorder and can be successfully treated with non-operative techniques in most cases, although surgical management should be considered in some patients for adequate calcium removal. No clear consensus exists regarding whether the involved tendinous portion to be repaired or not with suture following the deposit removal. The purpose of this study is to evaluate and compare results of re-fixation and debridement of the rotator cuff tendons after calcium removal. Material and methods The study is a retrospective analysis of case histories, operation protocols, magnetic resonance images and radiographs of the shoulder of 19 consecutive patients diagnosed with calcific tendinitis that was surgically treated at our clinic between 2013 and 2016. The median age of the patients was 52 years. All patients were divided into two groups depending on the surgical treatment performed. Calcium deposit was removed and the rotator cuff sutured in patients of the main group, and calcium was removed and the rotator cuff debrided in controls. Results Outcomes were rated as excellent with OSS in 58.3 %, as good in 33.3 % and satisfactory in 8.4 % of the patients in the main group. Controls showed 28.6 % of excellent outcomes and 71.4 % of good results. Excellent ASES shoulder scores were recorded in 91.6 % of the patients in the main group and 8.4 % had satisfactory results. Excellent results were achieved in 71.4 % of controls and 28.6 % had good results. No poor outcomes were observed in the patients. No statistically significant differences were found between the groups. All patients of the main group completely regained the function up to 100 % at a follow-up visit. However, the median time required to regain function by 50 % was 3 months (interquartile range 2:6) after surgery in patients of the main group and 1.5 months in controls. There was a correlation revealed between persistent history of calcific tendinitis and dimensions of the deposit according to the Bosworth classification. **Conclusion** A type of calcium deposit identified with radiological classifications was shown to have no impact on outcomes. Patients who underwent no repair of the rotator cuff achieved 50 % recovery of the shoulder function almost twice as quickly as those with repaired tendon. No statistically significant differences in outcomes were found between the groups but patients of the main group showed higher scores measured with patient-reported outcomes. More research needs to be carried out on a variety of techniques before definitive conclusions can be made on strategies of surgical treatment of calcific tendonitis. Keywords: partial tear of the supraspinatus tendon, rotator cuff, glenohumeral joint, calcific tendonitis

INTRODUCTION

Calcific tendinitis of the rotator cuff is a disorder characterized by deposits of hydroxyapatite in a tendon. Documented incidence by various authors varies from 6.8 to 42.5 % of patients with painful shoulder and from 2.7 to 20 % of asymptomatic patients [1]. 35–45 % of asymptomatic patients are reported to develop pain and functional disorders over time [2]. Pathological changes in the rotator cuff tendon are a most common reason of non-traumatic shoulder pain in calcific tendinitis [3]. It commonly involves supraspinatus tendon (70 %) with "critical zone" in the tendon-bone insertion area, followed by infraspinatus

(15-20 %) rarely affecting subscapularis (10 %) and teres minor [4, 5]. Several cases of atypical localization of calcium deposits in the shoulder were reported [6]. Females are more affected than males and mean age of onset varies between 30 and 60 years, working-age, physically active population [1, 7, 8].

The etiology of calcifying tendinitis remains a debatable topic with multiple theories proposed. The hypothesis was proposed by Seijas O.A. et al. as an initial degeneration within the tendon fibers which was followed by calcification [9]. Uhthoff H.K. et al. considered calcifying tendinitis as a reactive

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calcification within viable, well vascularized tendon [10]. The calcifying tendinitis is hypothesized to occur three following stages: (I) precalcific stage, (II) calcific stage, subdivided into (a) formative phase, (b) resting phase, and (c) resorptive phase and (III) postcalcific/repair stage [11]. Depending on stage of the disease CT would be characterized by specific clinical features, imaging findings including MRI and texture of calcified deposit.

Symptoms commonly resolve on its own, except for some cases where they persist. 9 % of deposits are reported to spontaneously resolve within 3 years [12], with resolution rate of 3 % of deposits per year [13]. About 90 % of patients with calcific tendinitis can be treated successfully nonoperatively using physical therapy, systematic NSAIDs, glucocorticoid injections and a variety of minimally invasive procedures [8, 13, 14, 15, 16, 17, 18].

Surgical treatment of calcific tendinitis is generally indicated in patients with failure of nonoperative treatment and around 10 % of patients with persistent

pain require active intervention. This can be carried out by open surgery or arthroscopy. Arthroscopy being less aggressive on tissues is associated with less surgical morbity and early recovery. The rate of full thickness rotator cuff tears is reported to be 3.9 % at an average of nine-year follow-up [19], and partial thickness tears are more common and likely to occur at the subacromial space [1, 20]. There is no clear benefit with the addition of suture repair of severed tendons reported after removal of the calcium deposits with higher risk of postoperative stiffness and delayed recovery [21]. Intraoperative tendon status was shown to be essential for optimal outcome and function [22].

The purpose of this study is to evaluate and compare results of re-fixation and debridement of the rotator cuff tendons after calcium removal. The hypothesis that will be tested is that shoulder function evaluated by shoulder-specific patient-reported outcome measures would be better after removal of the calcium deposits and suture repair than that in patients without the rotator cuff re-fixation.

MATERIAL AND METHODS

The study is a retrospective analysis of medical records, operation protocols, imaging findings of the glenohumeral joints including conventional radiography and magnetic resonance imaging. The study included 19 consecutive patients with calcifying tendinitis of the rotator cuff tendons surgically treated at the ECSTO clinic between 2013 and 2016. Depending on surgical technique applied the patients were subdivided into two groups: the rotator cuff was reconstructed after removal of calcium deposit in patients of the main group; debridement was carried out in controls without tendon suture repair. Controls refused suture repair of the rotator cuff tendons after calcium removal because they could not consider long term postoperative rehabilitation. There were 12 patients (5 males and 7 females) in the main group and 7 controls (5 males and 2 females). The median age was 52 years and interquartile range (IRR) 47:57 years.

Surgical treatment

Standard arthroscopic procedure was carried out with patient lying down in a beach chair position at edge of the table under combined endotracheal and conduction anesthesia. Arthroscopy included extra-

articular and intraarticular approaches. Standard posterior portal was established and evaluation of the glenohumeral joint and the subacromial space done. The site of calcification was identified under scopy guidance and removed using arthroscopic shaver and ablator. Acromioplasty, correction of the lateral acromion angle, removal of calcified deposit and suture repair of the torn rotator cuff tendons were produced for patients of the main group. Biceps tenotomy (n = 3) and tenodesis in the proximal portions of the bicipital groove (n = 1)were performed due to instability of the long head of the biceps tendon. Controls were treated with similar technique of acromioplasty, correction of the lateral acromion angle, removal of calcified deposit and rotator cuff debridement to a stable tendon base. SpeedFix knotless single row rotator cuff repair was produced with retension suture added if needed (Fig. 1). Postoperative standard radiography of the glenohumeral joint was produced for all patients to confirm 100 % removal of calcium in both groups.

The affected arm was immobilized in arm sling for 3–5 days followed by rehabilitation and exercises to improve range of movements initiated.



Fig. 1 Calcium deposit removed and the rotator cuff repaired: *a* intra-articular view of the supraspinatus tendon; *b* calcium deposit visualized in the supraspinatus tendon from the subacromion space; *c* partial thickness rotator cuff tendon tear after calcium deposit removal; *d* SpeedFix knotless single row rotator cuff repair added by 1 retension suture

Standardized postoperative protocol of rehabilitation allowed full range of motion in the operated glenohumeral joint from the first day postsurgery for non-suture repair group and the affected arm immobilized in arm sling for 7 days. The affected arm of patients with suture repair was immobilized with Gilchrist sling for 6 weeks. Table slides and cane-assisted external rotation execrises were allowed after two weeks postsurgery. Immobilization was followed by rehabilitation under supervision of rehabilitation physician.

Ananlysis of the material

Medical records and clinical cases were thoroughly reviewed and classified using radiological, CT and MRI findings.

- <u>Radiological classification of Bosworth</u>: large size > 1.5 cm, medium size < 1.5 cm, small size rarely seen.
- Radiological classification of Gartner and Heyer: type I dense calcifications with well defined borders, type II soft contour and dense or sharp contours and transparent, type III soft contours, translucent and cloudy, resorption phase.
- <u>Radiological classification of Mole</u>: type A dense, rounded, sharply delineated, type B multilobular, radiodense, sharp, type C radiolucent, heterogeneous, irregular outline, type D dystrophic calcific deposits at tendon origin.

• MR – classification of Loew: type A – dense, with well defined borders, type B – dense, circumscribed, well defined, type C – nonhomogenous, denticulated contours.

The Oxford Shoulder Scale (OSS) and the American Shoulder and Elbow Surgeons (ASES) questionnaires were used to evaluate postoperative shoulder function. All patients were interveiwed on a time period of functional recovery by 50 and 100 % postsurgery. The scores were entered on a standardized MS Office table. Kolmogorov-Smirnov statistical test was used to determine a type of sample distribution. Non-parametric statistical procedures were employed for the hypotheses because distribution of all the study parameters was different from the norm. Mann-Whitney U test was used for analysis of quantitative data of two unrelated samples (see Table). The quantitative data were presented as the median and percentiles Me [25 %;75 %]. The significance level was set at 5 % (p = 0.05). For categorical values, Pearson's Chi-square, Chi-square corrected for continuity, the likelihood-ratio Chi-square test and Fisher's exact tests (see contingency tables) were used to assess statistical hypothesis of equal occurrences in the groups. The Spearman Rank correlation was used to analyze the correlation between the volume of surgical intervention performed and other factors on clinical outcomes. Statistical data analysis was produced with IBM SPSS Statistics 21 program.

RESULTS

Patients of the main group and controls were comparable by gender, age, duration of the disease, length of postoperative period, diagnosis, comobidities, side of the involvement as well as by localization, characteristics and size of calcium deposits (Fig. 2). No statistically significant differences in the study parameters were detected, p > 0.05.

There were 58 % female and 42 % male patients in the main group. Control group consisted of 71.4 % males and 28.6 % females. The median age was 50.5 years at the time of surgery in the main group (IQR 45:57) and 52 years (IQR 48:60) in controls. Median

disease duration was 6.5 months (IQR 1:48) and 6 months (IQR 1:12) in the main and control groups, respectively (Fig. 3). Median interval between surgery and the latest follow-up visit was 12 months in the main (IQR 6:19) and control (IQR 7:18) groups (Fig. 3).

Calcium deposits were mostly detected in the supraspinatus tendon of patients of the main and control groups (Table 1).

Distributions by classifications of Bosworth, Gartner-Heyer, Mole and Loew are presented in histograms below (Fig. 4–7).

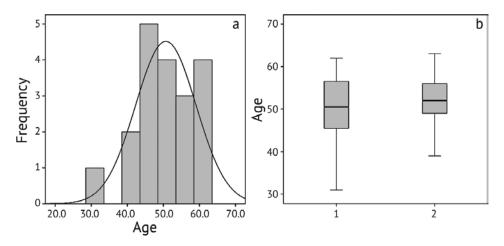


Fig. 2 Distribution of patients by age is presented in the histogram (a) and in the box-plot (b) (1 - main group, 2 - control group)

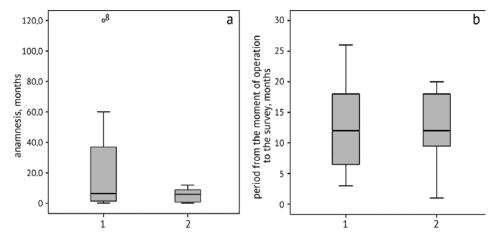


Fig. 3 Duration of pain prior to surgery (a) and interval between surgery and latest follow-up visit (b) presented in the boxplot (1 – main group, 2 — control group)

Table 1 Localization of calcium deposits in patients of the main and control groups (SST – supraspinatus tendon , SSC – subscapularis tendon, IST – infraspinatus tendon , SDB – subdeltoid bursa)

Localization	Main group	Control group	
SST	83.4 %	71.4 %	
SSC + SDB	8.3 %	14.3 %	
SST + SSC	8.3 %	0 %	
SST + IST	0 %	14.3 %	

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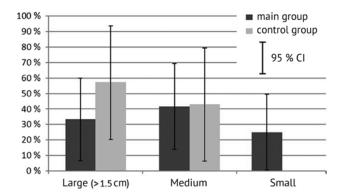


Fig. 4 Distribution of calcium deposits by size identified with Bosworth radiological classification

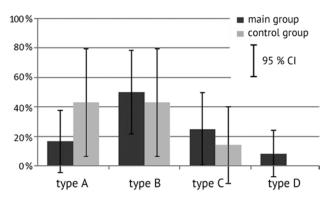


Fig. 6 Distribution of calcium deposits by Mole classification

Correlation analysis revealed relationship between duration of calcific tendinitis and the size of calcium deposit identified with Bosworth classification (average direct correlation, p = -0.498)*. Larger deposits were seen in patients with longer duration of the disease. There was no correlation found between duration of the disease, size and type of calcium deposits identified with classifications of Mole and Loew (MRI), comorbidities and preoperative conservative treatment and patient reported clinical outcomes (p < 0.3). The OSS median scored 12 (IQR 12:14) and 14 (IQR 12:16) in the main and control

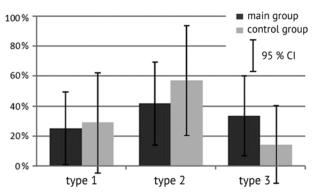


Fig. 5 Distribution of calcium deposits by radiological classification of Gartner and Heyer

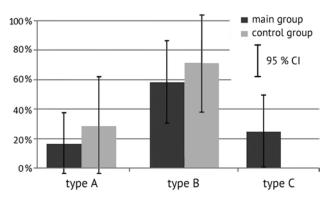


Fig. 7 Distribution of MRI-types of calcium deposits by Loew classification

groups, respectively (Fig. 8). The ASES median scored 100 (IQR 90:100) and 91.6 (IQR 77:95) in the main and control groups, respectively (Fig. 8).

OSS scores were rated as excellent in 58.3 % (n = 7), as good in 33.3 % (n = 4) and fair in 8.4 % (n = 1) of the main group. Controls showed excellent results in 28.6 % (n = 2), and good outcomes in 71.4 % (n = 5). ASES scores were rated as excellent in 91.6 % (n = 11), as fair in 8.4 % (n = 1) of patients of the main group. No poor outcomes were recorded. Controls showed excellent results in 71.4 % (n = 5), and good outcomes in 28.6 % (n = 2) (Table 2).

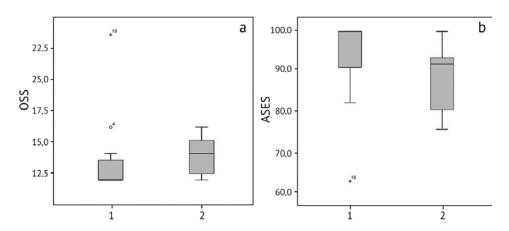


Fig. 8 OSS (A) and ASES (B) scores in both groups presented in the boxplot (1 - main group, 2 - control group)

Table 2

Patient reported outcome measures in patients of the main and control groups

Scales	Groups	Results		
		excellent	good	fair
oss	Main group	58.3 %	33.3%	8.4 %
	Control group	28.6 %	71.4 %	0 %
ASES	Main group	91.6 %	0 %	8.4 %
	Control group	71.4 %	28.6 %	0 %

OSS and ASES questionnaires exhibited more excellent results in the main group as compared to controls. However, there were no statistically significant differences in scores of patient reported outcome measures between the groups (p > 0.05).

Only one control patient took NSAID at the time of the latest follow-up visit. All patients of the main group could regain full range of motion (100 %) by the time of the latest follow-up appointment. The median functional recovery by 50 % was 3 months (IQR 2:6) and 1.5 months (IQR 1:3) in the main group and in controls, respectively. Statistically significant differences in shoulder functional recovery by 50 % assessed by Mann-Whitney U test were revealed between the groups (p = 0.022). Controls were twice as likely to recover shoulder function by 50 % than patients in the main group (p < 0.05). No statistically significant differences in shoulder functional recovery by 100 % were observed between the groups (p > 0.05).

Radiological type of calcium deposit was found to have mild correlation with duration of shoulder functional recovery to achieve full range of motion and patient reported outcome measures (0.3 . Type of deposit classified by Loew(MR-classification) was shown to have an impact on duration of the shoulder functional recovery by 100 % (correlation being higher than medium, p = 0.58)¹, and no impact on the shoulder functional recovery by 50 % and final outcome. The type of surgical treatment (volume of surgery) appeared to influence the shoulder functional recovery by 50 % (inverse correlation being higher than medium, $R = -0.537)^2$. Shoulder function was shown to recover faster with debridement of the rotator cuff tendons without suture repair.

DISCUSSION

Effective surgical treatment of the calcific tendinitis can be carried out by open surgery or arthroscopy. Nowadays, open surgery is rarely used to remove calcium deposits as arthroscopy offers a much better choice with less trauma to the deltoid muscle and faster postoperative recovery [23]. No clear consensus exists regarding different surgical strategies, acromioplasty, total removal of the calcium deposit and suture repair of the torn rotator cuff tendons. Molé et al. reported benefits of acromioplasty [24]. Similarly, S.L. Afanasiev showed a significant correlation between subacromial impingement and pathogenesis of the calcifying tendinitis and an important role of acromioplasty for the extrinsic factor [25]. Jacobs and Debeer detected no statistically significant differences in outcomes of patients who underwent isolated calcium deposit removal and deposit removal and acromioplasty [26], and Balke supported the findings [27].

Total calcium deposit removal was widely discussed. Porcellini et al., studying 58 patients followed up for three years, highlighted the importance of removing all the calcific deposit, finding better shoulder function at

follow-up in patients in whom complete removal of the calcifications had been achieved [24]. Burkhart et al. demonstrated optimal recovery with totally removed calcium deposits [28]. Recently, Maier et al. studied 93 patients with mean follow-up of 37.3 months. They showed that it was not important to remove all the calcific deposit; residual calcification was resorbed within 6-12 months of the surgical treatment and there were no significant differences in outcomes between patients with and those without complete removal of calcific deposits. Seil et al. in a follow up of over 24 months found complete resolution of residual calcium in all his cases along with an excellent clinical score in more than 90 % of the patients [29]. Seil used a 1 cm longitudinal incision (along the fibers) to remove calcium deposit without employing aggressive technique and arthroscopic shaver. Ultrasound examination showed no significant structural changes in the rotator cuff, however, 66 % demonstrated either thinned tendon or heterogenic signal from it. Moreover, in a recent retrospective study, Balke et al reviewed 48 patients who were available for ultrasound examination after arthroscopic removal of calcium deposits without

¹ correlation being significant at 0.01 (2-tail)

² correlation being significant at 0.05 (2-tail)

tendon repair, showing a partial tendon tear of the supraspinatus in 11 patients [28]. Studies performed by El Shewy showed that the rate of full-thickness rotator cuff tears after calcium deposits removal was quite low. He used a less aggressive technique to remove the deposit in order to maintain integrity of the rotator cuff, with suture repair to be produced in the depth of the partial tears greater that 50 % (Ellman 3) (3.5 %) [23]. Two patients (3.7 %) who needed later rotator cuff repair showed obvious degeneration of the rotator cuff during the removal of the deposits. El Shewy recommended to repair the rotator cuff after the removal of calcium deposits, whenever the cuff appeared to be noticeably degenerative.

There are several reports on suture repair of the rotator cuff tendon calcifications documenting higher risk of postoperative contractures and delayed symptomatic recovery [28]. Faster recovery in our series was observed in controls whose rotator cuff tendons were not repaired following calcium deposits removal. Normal repair of partial thickness rotator cuff tear can be extended in 14–55 % of the cases depending on the pattern of injury [30].

No statistically significant differences in outcomes of our series were found between the groups but patients of the suture repair group showed higher scores measured with patient-reported outcomes. Indications to rotator cuff tendon repair remain obscure: suture repair is advocated either for full thickness tear [15] or for Ellman grade 3 tears [1]. Suture repair in our series was produced for Ellman grades 2 and 3 tears. No statistically significant differences in outcomes of both groups were detected and this can be explained by a number of patients recruited. With the above in mind, we can recommend suture repair of the torn rotator cuff tendons in Ellman grades greater than grade I. Burkhart suggested that rotator cuff reconstruction must be performed in any case following calcium removal even with poor bone quality [28]. Limitations of the research include a small cohort of patients reviewed retrospectively, so that efficacy of the method can be underestimated.

CONCLUSION

- A type of calcium deposit identified with radiological classifications was shown to have no impact on outcomes.
- Patients who underwent no repair of the rotator cuff achieved 50 % recovery of the shoulder function almost twice as quickly as those with repaired tendon as measured with shoulder specific scales.
- No statistically significant differences in outcomes were found between the groups but patients of the main group showed higher scores measured with patient-reported outcomes.
- More research needs to be carried out on a variety of techniques before definitive conclusions can be made on strategies of surgical treatment of calcific tendonitis.

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