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Original article

Recovery pattern after arthroscopic treatment for calcific tendinitis of the shoulder

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ABSTRACT

Introduction: The purpose of this study was to investigate serial outcomes in the early postoperative period in patients who have undergone arthroscopic treatment for calcific tendinitis of the shoulder and to determine prognostic factors affecting outcomes.
Hypothesis: Our hypothesis was that functional recovery will take more than three months but additional procedures such as rotator cuff repair and subacromial decompression will have a slower recovery and poorer outcomes.
Material and methods: We retrospectively reviewed 35 patients with a mean follow-up of 50.6 months. Arthroscopic surgery was performed in all patients. The visual analog scale (VAS) pain score; University of California, Los Angeles (UCLA) score; American Shoulder and Elbow Surgeons (ASES) score were evaluated preoperatively; 3, 6, and 12 months after surgery; and at the final follow-up. To evaluate the extent of calcific deposit removal and recurrence of calcification, we conducted plain radiography at each follow-up.
Results: Nine patients had complete removal of all calcium deposits, and 26 had partial removal. At the final follow-up, all patients sustained complete resorption without any recurrence. All clinical scores showed improvement significantly in each follow-up period ($p < 0.001$). However, VAS pain score decreased to less than 3 points at 6 months after surgery, UCLA and ASES scores also increased more than 75 percent at 6 months. Subacromial decompression was negatively correlated with VAS pain score and rotator cuff repair was negatively correlated with UCLA score, respectively ($p = 0.041$ and $p = 0.028$). On multivariate analysis, rotator cuff repair was negatively correlated with the final UCLA score ($p = 0.009$).
Conclusion: This study revealed that all clinical scores were significantly improved from 3 months after arthroscopic treatment for calcific tendinitis of shoulder. However, clinical scores improved slowly, recovery of shoulder function and pain relief required up to 6 months. Subacromial decompression and rotator cuff repair were poor prognostic factors after arthroscopic treatment.
Level of evidence: IV, Retrospective Case Series.

1. Introduction

Calcific tendinitis of the shoulder is a common and painful disorder of unknown etiology characterized by calcifications within the tendons of the rotator cuff. Treatment is usually nonoperative (e.g., rest, nonsteroidal anti-inflammatory drugs, analgesics, physiotherapy, subacromial infiltrations with corticosteroids and anesthetics, needle aspiration of the calcium deposits, ultrasound-guided percutaneous calcium removal) [1–5]. Some authors advocate extracorporeal shock wave therapy, particularly when deposits are inhomogeneous [6–8].

When nonoperative treatment fails over a prolonged time, surgical treatment should be considered. However, the patterns of recovery following surgical treatment for calcific tendinitis vary greatly, and there has been little documentation of the related serial outcomes [9–11]. Several studies have reported delayed recovery following surgical removal for calcific tendinitis. Ark et al. reported that only seven out of 22 patients experienced almost complete pain relief within three weeks [9], and Seil et al. noted that only 15% of the patients experienced a sudden and nearly complete reduction of pain within the first three months [10]. However, Maier et al. reported that the average period required for the remission of shoulder pain was 2.24 weeks [11].

Additional acromioplasty, concomitant rotator cuff repair, duration of symptom, type of acromion, and residual calcific deposits are considered potential prognostic factors for outcomes of

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surgical treatment of calcific tendinitis [1,11–13]. However, it is largely unknown which factors influence postoperative clinical outcomes following surgical treatment of calcific tendinitis.

The primary purpose of this study was to investigate serial outcomes in the early postoperative period in patients who have undergone arthroscopic treatment for calcific tendinitis of the shoulder. And our secondary purpose was to determine prognostic factors affecting clinical outcomes.

2. Material and methods

This retrospective study was approved by our institutional review board. Between December 2009 and March 2017, patients with calcific tendinitis who underwent arthroscopic treatment were retrospectively reviewed. The following inclusion criteria were used:

- recalcitrant pain despite at least three months of conservative treatment;
- constant pain interfering with daily living;
- mechanical impingement pain due to calcific deposit;
- follow-up period of 12 months.

We excluded:

- patients with preoperative MRI findings that revealed presence of concomitant shoulder lesions (e.g., rotator cuff tear, osteoarthritis, infection) and patients with a history of shoulder surgery;
- patients in whom identification of the calcific deposit by arthroscopy was not possible, were converted to mini-open surgery.

2.1. Surgical technique

A single surgeon performed all operative procedures and all patients were operated on in the lateral decubitus position under general anesthesia. First, diagnostic arthroscopy of the glenohumeral joint was performed to identify any intra-articular pathology with standard posterior portal. Then, we moved the arthroscope to the subacromial space. A lateral portal was created above the calcific deposit and bursectomy was performed around the calcific deposit. After bursal tissue debridement, the calcium deposit was located using percutaneous needling. The overlying tendon was carefully incised longitudinally using a No. 11 blade and the calcific deposit was removed using a probe and motorized shaver. And we performed subacromial decompression if fraying or erosions of the undersurface of the acromion was observed. Single-row repair using suture anchor was undertaken in the case of a relatively large full-thickness defect and partial-thickness tear greater than Ellman grade III after removal of calcific material. The side-to-side repair was performed in partial tears of Ellman grade II to avoid propagation of a rotator cuff tear.

2.2. Postoperative rehabilitation

After surgery, shoulders were immobilized by a sling, and patients were immediately allowed a passive range of motion. An abduction brace was applied for three to six weeks after surgery in those who had undergone repair and needed protection. Active and passive range of motion exercises and rehabilitation were then undertaken.

2.3. Radiologic assessment

To evaluate the size, location, and resorption of the calcific deposits, all patients took preoperative radiographs. Films of the affected shoulder were taken in six positions, anteroposterior (AP) views in neutral, internal, and external rotation; a lateral view in the scapular plane; an axillary view; and a caudal tilting view. We measured the greatest deposit diameters on any of the six views and categorized deposit sizes as < 15 mm, and ≥ 15 mm. Follow-up radiographs were also taken immediately after the operations and postoperatively at weeks two and six and months three, six, and 12 post-surgery.

The French Arthroscopic Society radiographic classification was used to assess and classify calcific deposits preoperatively: type A (homogeneous calcification with well-defined limits), type B (heterogeneous and fragmented calcification with well-defined limits), type C (heterogeneous calcification with poorly defined limits and sometimes with a punctate appearance), and type D (dystrophic calcifications at the tendon insertion) [14].

2.4. Assessment of clinical outcomes

All patients were evaluated during a minimum 12-month follow-up period. An independent research coordinator evaluated clinical outcomes. The visual analog scale (VAS) pain score; University of California, Los Angeles (UCLA) score; and American Shoulder and Elbow Surgeons (ASES) scores were collected and assessed. Assessment was performed preoperatively; at three, six, and 12 months after surgery; and at the final follow-up examination. To better understand prognostic factors affecting the clinical outcome of calcific tendinitis of the shoulder, we considered the following parameters: age, gender, location of calcific tendinitis, duration of symptoms, size, preoperative stiffness, additional subacromial decompression, rotator cuff repair, FAS classification, and degree of removal.

2.5. Statistical analysis

All statistical analyses were performed using SPSS software (version 14.0, SPSS Inc., Chicago, IL). To compare differences between preoperative and postoperative clinical parameters, we performed the paired t-test, and Willcoxon signed rank test. The paired t-test and repeated-measures analysis of variance (ANOVA) were used to evaluate the changes in outcome measurements. The Spearman's correlation method, Kruskal-Wallis test, and Wilcoxon signed rank test were used to determine the correlation between various factors and the final clinical outcomes. After an initial screening for associations with potential variables, a multivariate analysis with a linear regression model was conducted by including the significant variables in the univariate analysis. A p value less than 0.05 was considered statistically significant [15].

3. Results

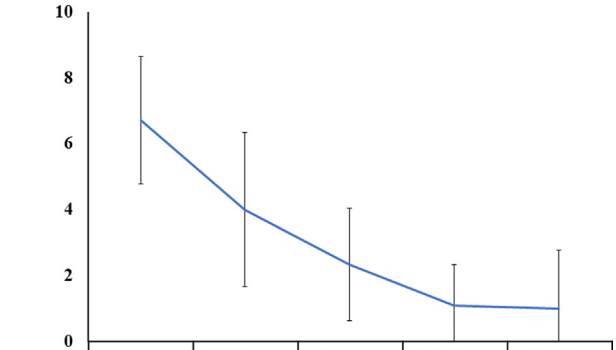
3.1. Patients' characteristics

Our final study population consisted of 35 patients. The mean age of patients was 55.1 years (range, 42–69). The mean duration of symptoms at the first visit was 38.5 months (range, 3-96) and the mean follow-up period was 50.6 months (range, 15-104). A summary of the demographic and clinical characteristics of patients is shown in Table 1. Seven (20%) patients had preoperative stiffness on the involved shoulder. Repair using a suture anchor was performed in 9 (25.7%), side-to-side repair in 3 (8.6%), and calcific deposit debridement only in 27 (65.7%). Regarding the additional subacromial decompression performed in 27(76.5%) patients (Table 1).

Table 1
Demographic Data.

Parameter	Data
Age, year	55.1 ± 6.9
Sex, male/female, *n*	3/32
Involved tendon, *n*	
Supraspinatus	19
Infraspinatus	9
Subscapularis	7
Duration of symptoms, month	38.5 ± 27.5
Size, mm	17.4 ± 9.6
Preoperative stiffness, yes/no, *n*	7/28
Subacromial decompression, yes/no, *n*	27/8
Rotator cuff repair, single-row/side-to-side/no, *n*	9/3/23
Preoperative FAS classification, A/B/C/D	9/15/11/0
Degree of removal, compete/partial	9/26

FAS; French Arthroscopic Society.



	Preop	PO 3 mo	PO 6 mo	PO 12 mo	Final FU
VAS	6.7 ± 1.9	4.0 ± 2.3	2.3 ± 1.7	1.1 ± 1.3	1.0 ± 1.8
p-value		< 0.0001	< 0.0001	< 0.0001	< 0.0001

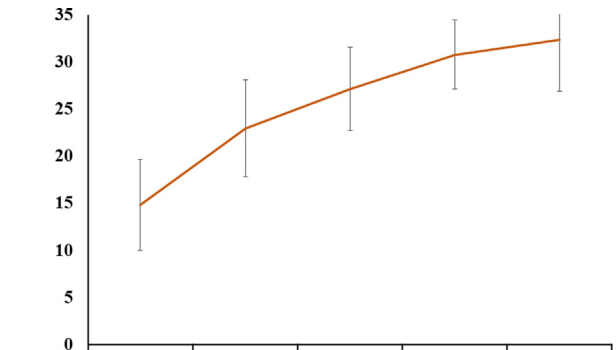
Fig. 1. Serial changes in VAS pain score. (FU, follow-up; mo, months; PO, postoperative; Preop, preoperative, VAS, visual analog scale).

3.2. Radiographic results

Preoperatively, the average size of deposits was 17.4 ± 9.6 mm^2. Seventeen (48.6%) calcific deposits were smaller than 15 mm, and 18 (51.4%) were greater than 15 mm. Nineteen (54.3%) calcific deposits were located within the supraspinatus tendons, 7 (20.0%) were subscapularis tendons, and 9 (25.7%) were infraspinatus tendons. According to FAS radiographic classification, 9 were type A, 15 were type B, and 11 were type C. Based on postoperative radiographs, 9 patients had complete removal of all calcium deposits, and 26 had partial removal. Twenty-four (92.3%) patients with remnant calcifications experienced complete disappearance of these lesions at 12-month follow-up, including 11 (42.3%) that had disappeared by three months and seven (26.9%) that had disappeared by six months, and six (23.1%) that had disappeared by 12 months. Two (7.7%) patients had remnant calcifications 12 months after surgery. In these two patients, deposits had completely disappeared at 26 and 29 months after surgery, respectively. The average time to complete resorption of calcification from treatment was 7.5 ± 7.2 months.

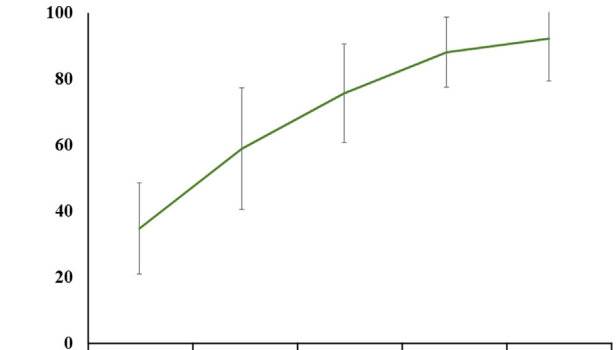
3.3. Clinical results

The mean VAS pain score, UCLA score, and ASES score improved from 6.7 ± 1.9, 14.8 ± 4.8, and 34.8 ± 13.8, before surgery to 1.0 ± 1.8, 32.4 ± 5.5, and 92.3 ± 13.0, respectively, at final follow-up ($p < 0.001, < 0.001, < 0.001$) (Figs. 1–3). Regarding serial changes over the entire year using repeated-measures ANOVA, we observed significant improvement in VAS pain score, UCLA score, and ASES score from three months after surgery. VAS pain score decreased



	Preop	PO 3 mo	PO 6 mo	PO 12 mo	Final FU
UCLA	14.8 ± 4.8	23.0 ± 5.2	27.1 ± 4.4	30.8 ± 3.7	32.4 ± 5.5
p-value		< 0.0001	< 0.0001	< 0.0001	< 0.0001

Fig. 2. Serial changes in UCLA score. (FU, follow-up; mo, months; PO, postoperative; Preop, preoperative, UCLA, University of California, Los Angeles).



	Preop	PO 3 mo	PO 6 mo	PO 12 mo	Final FU
ASES	34.8 ± 13.8	58.9 ± 18.4	75.8 ± 15.0	88.1 ± 10.5	92.3 ± 13.0
p-value		< 0.0001	< 0.0001	< 0.0001	< 0.0001

Fig. 3. Serial changes in ASES score. (FU, follow-up; mo, months; PO, postoperative; Preop, preoperative, ASES, American Shoulder and Elbow Surgeon).

to less than three points at six months after surgery, UCLA and ASES scores also increased more than 75 percent at six months after surgery.

3.4. Univariate & multivariate analysis to detect the factors affecting clinical outcomes

In the univariate analysis, SAD was negatively correlated with the VAS pain score ($p = 0.041$). And rotator cuff repair was negatively correlated with the UCLA score ($p = 0.028$). There was no correlation between clinical outcomes and various parameters including age, gender, size, symptom duration, preoperative stiffness, the degree of calcium removal, location of the calcific deposit, and FAS classification ($p > 0.05$) (Table 2).

The multivariable linear regression analysis revealed that rotator cuff repair was only independently associated with worse ULCA score during follow-up period ($p = 0.009$)(Table 3).

3.5. Complications and additional treatment

Overall, there were no serious adverse events or complications (e.g., subcutaneous hematoma, infection, or hyperesthesia). Also, secondary operations were not required in any patient. However, four (11.4%) patients without any motion limitation before surgery developed stiffness. All patients who had stiffness were treated with non-operative treatment.

Table 2
Correlations between clinical outcomes and variable parameters.

Variable Parameter	VAS pain score	UCLA score	ASES score
Age	.329	.179	.304
Gender	.344	.644	.461
Size	.579	.863	.620
Symptom duration	.118	.460	.271
Preoperative stiffness	.732	.479	.920
Rotator cuff repair	.208	.028[a]	.132
Subacromial decompression	.041[a]	.050	.096
Degree of removal	.271	.565	.403
Location of calcific deposit	.451	.543	.226
Classification of calcific deposit	.873	.374	.853

[a] Statistically significant; VAS, visual analog scale; UCLA, university of California, Los Angles; ASES, American shoulder and elbow surgeons.

Table 3
Multivariable Linear Regression Analysis with Clinical Outcomes at Final Follow-up as the Dependent Variable.

Variable Parameter	Hazard Ratio [95% CI]	*P* value
VAS pain score		
Symptom duration	−0.014 [−0.037-0.009]	0.217
Subacromial decompression	−0.886 [−2.324-0.552]	0.218
Rotator cuff repair	0.942 [−0.313-2.197]	0.136
Degree of removal	−0.139 [−1.552-1.273]	0.842
UCLA score		
Symptom duration	0.037 [−0.03-0.105]	0.271
Subacromial decompression	1.308 [−2.906-5.522]	0.531
Rotator cuff repair	−5.053 [−8.731-1.375]	0.009*
Degree of removal	−2.657 [−6.798-1.483]	0.2
ASES score		
Symptom duration	0.113 [−0.052-0.279]	0.172
Subacromial decompression	5.711 [−4.613-16.036]	0.268
Rotator cuff repair	−9.011 [−18.023-0.001]	0.05
Degree of removal	−0.04 [−10.184-10.105]	0.994

VAS, visual analog scale; UCLA, university of California, Los Angles; ASES, American shoulder and elbow surgeons; CI: confidence interval.
* Statistically significant.

4. Discussion

This study documents two major findings:

- patients undergoing arthroscopic treatment of a calcific deposit in the shoulder had satisfactory clinical and radiological outcomes at the final follow-up; functional scores (e.g., UCLA, ASES) improved slowly, and reached more than 75 percent at six months after surgery;
- rotator cuff repair and subacromial decompression were poor prognostic factors of clinical outcomes after arthroscopic treatment.

Very few studies have evaluated the serial results of postoperative recovery after surgical treatment for calcific tendinitis [10–12,16]. Our study revealed that patients significantly improved in all clinical score from 3 months after surgery. However, recovery of shoulder function and pain relief lasted for six months. These findings suggest that sufficient functional recovery did not occur at an early stage. Seil et al. similarly noted that postoperative pain decreased relatively slowly despite excellent final results and 100% of active patients returning to work between three and six months after surgery. Only 15% of the patients experienced a sudden and nearly complete reduction of pain within the first three months. In the remaining patients, slow, but continuous, pain relief occurred over 12 months [10]. Lee et al. studied the functional recovery of the shoulder after arthroscopic treatment for chronic calcific tendinitis. They found that ASES scores and Constant scores significantly improved from the 3-month follow-up through to the final follow-up in all patients, yet the improvement was slow, taking six months before the average score reached 80 points [16]. Maier et al. noted that arthroscopic calcific deposits yielded favorable outcomes and effected fast remission of pain. However, recovery of subjective shoulder function required almost three months on average [11]. Marder et al. investigated clinical results of surgical treatment for calcific tendinitis at regular intervals during the first 26 weeks post-surgery and reported that the debridement group reached 75% of clinical scores at 12 weeks, while the debridement and concomitant subacromial decompression group took 26 weeks to achieve similar results [12].

Clearly defined prognostic factors in the surgical treatment of calcific tendinitis of the shoulder have not been described in the literature. Although rotator cuff repair was a poor prognostic factor in this study, it is still a matter for debate whether the lesions left after calcium removal should be repaired. Some investigators do not routinely perform the repair of the residual tendon, as they believe that the tendon naturally self-heals [17]. On the other hand, Seil et al. and Balke et al. evaluated patients in whom calcium deposit was removed without repair of tendon defects, and 31% and 23% of patients showed a rotator cuff defect at follow-up on an ultrasound, respectively [1,10]. It is important to note that all patients with large partial tears or complete tears after calcium removal were treated with rotator cuff tendon repair. Ranalletta et al. reported that arthroscopic removal and rotator cuff repair without acromioplasty could lead to favorable outcomes in patients with symptomatic calcifying tendonitis of the supraspinatus tendon [18]. Yoo et al. evaluated the clinical results of complete removal of calcific deposits with or without repair of the rotator cuff tendon in 35 consecutive patients. They observed no differences in terms of clinical scores and time to pain relief [19].

Our study revealed that SAD was a negative prognostic factor. However, the role of SAD in the management of calcific tendinitis remains controversial [20,21]. Seil et al. noted that subacromial decompression did not lead to any differences in clinical scores [10]. A prospective randomized controlled trial by Clement et al. reported that short-term functional outcomes are not influenced by the surgery being performed in combination with subacromial decompression [22]. Maier et al. analyzed factors with potential influence on postoperative recovery and outcomes and noted that minimal restriction of range of motion occurred in patients with hook-shaped acromions and long-standing preoperative symptoms [11]. Clavert et al. found that functional results were lower after removing a FAS type C calcification than type A or B and recommeneded that acromioplasty improved the results when the calcification was associated with an aggressive acromion, type C calcification, or a partial cuff tear [23].

There is no consensus in the current literature regarding the extent of the resection of the deposits to be conducted. In our study, all remnant calcifications were completely resorbed without any recurrence at the final follow-up, and remnant calcific deposit did not influence clinical outcomes. According to radiologic analyses, complete removal of a deposit does not seem to be necessary. Lee et al. noted that clinical outcomes were independent of the degree of calcium removal and remnant calcific deposits had been completely resorbed in all patients at final follow-up. They reported an average time from treatment to complete resorption of calcification of 5.2 months [16]. Rizzello et al. evaluated 12 partial-removal patients who had arthroscopic management for calcific tendinitis. On radiographic examination performed two months after surgery, no calcification increased in size, and no translucent deposit changed to a dense deposit [24]. Maier et al. also found that all remnant calcifications showed complete or virtually complete resolution at the final follow-up [11]. Hashiguchi et al. reported that a comparison of radiographs taken one week postoperatively with those taken at the final follow-up examination showed no evidence of recurrence of enlargement of the calcific deposit [25].

Our study has several limitations. First, this is a retrospective study, and we have no control group treated with alternate approaches. Second, our sample size is relatively small to analyze prognostic factors affecting the clinical outcomes of calcific tendinitis of the shoulder. Therefore, our results may not be generalizable, and further investigations should be performed to understand the potential connections better. Third, a relatively short minimum duration of follow-up was another weakness in our study. In terms of strengths, this study analyzed the serial radiological and clinical outcomes of surgical treatment for calcific tendinitis. We believe that our results will help better explain serial radiological and clinical outcomes and prognostic factors after arthroscopic treatment for calcific tendinitis of the shoulder.

5. Conclusion

Our study demonstrated that overall satisfactory radiological and clinical outcomes might be achieved by arthroscopic treatment in calcific tendinitis of the shoulder. However, recovery of shoulder function and pain relief required up to six months. Therefore, it is necessary to inform patients that pain and discomfort around the shoulder may persist up to six months following treatment. Rotator cuff repair and subacromial decompression were poor prognostic factors of clinical outcomes after treatment.

Disclosure of interest

The authors declare that they have no competing interest.

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None.

Authors' contributions

CH Cho: design, supervision, clinical examination.
KC Bae: design, supervision, re-editing.
BS Kim: data analysis, patients examination.
HJ Kim: data analysis, stastastical analysis.
DH Kim: writing, re-editing, data analysis.

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