J Acupunct Meridian Stud 2018;11(2):47—53

Available online at www.sciencedirect.com

Journal of Acupuncture and Meridian Studies

journal homepage: www.jams-kpi.com

Research Article

Electroacupuncture for the Treatment of Calcific Tendonitis. A Pilot Study

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Available online 3 January 2018

Received: Mar 15, 2017
Revised: Dec 20, 2017
Accepted: Dec 27, 2017

KEYWORDS
calcific tendonitis;
electroacupuncture;
electrotherapy;
medical treatment

Abstract
Current treatment for calcific tendonitis consists of arm rest, antiinflammatory medications, and corticosteroid injections. If unsuccessful, a lot of clinicians suggest several physiotherapy modalities, such as shockwave therapy and electrotherapy. The purpose of our study was to assess the efficacy of electroacupuncture, as a substitute for failed medical treatment in calcific tendonitis.

In a pilot study, we prospectively followed 10 patients treated with electroacupuncture for calcific tendonitis who failed to respond to medical treatment. Its efficacy was assessed by evaluating the level of pain, the Beck Depression Inventory, the range of active elbow mobility, and by repeated radiological evaluation of the course of calcific deposits. All clinical and radiological observations were recorded before and within 6 months after the onset of treatment.

After electroacupuncture treatment (2 Hz, 180 mA for 30—60 seconds at GB21, GB34, LI4, LI 14, LI15, TW5, TW14, Chien Chien SI9, SI12, S37, S38), the visual analog score decreased notably, and the range of motion returned to normal. Radiological evaluation

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pISSN 2005-2901 eISSN 2093-8152
https://doi.org/10.1016/j.jams.2017.12.004

demonstrated almost complete absorption of calcific deposits within 6 months, after treatment.

We conclude that electroacupuncture relieved skeletal pain, improved the quality of patient's life, and contributed to total regression of the calcific depositions in followed patients. So, electroacupuncture may be a valuable treatment option for calcific tendonitis, when medical treatment fails to relieve symptoms.

Introduction

Calcific tendonitis is a common disorder of the shoulder, resulting in significant pain and substantial decrease of the range of motion. It mainly affects women aged 30—50 years [1—5]. The exact cause of the disease and the pathogenetic mechanism remain unclear and controversial. Calcific deposits on the rotator cuff are found in 2.7—22% of patients presenting for routine radiological examination, but only 34—45% of them are clinically symptomatic [6,7].

Uhthoff and Loehr described four subsequent phases of the disease. The first is the formative phase during which yet unknown triggers (hypoxia is a possible trigger) induce a fibrocartilage metaplasia, usually in some part of the supraspinatus tendon. The metaplastic tissues deposit hydroxyapatite crystals which form deposits that progressively increase in size. The next phase is the resting phase. In this stage, the deposits enter a stable period in terms of size but, if large enough, they may produce mechanical symptoms. These two phases may last from 1 to 6 years. The third phase is called resorptive, during which the calcific deposits are progressively being absorbed despite a still unfolding painful inflammatory reaction, thus making this phase the most painful. Last comes the postcalcific phase where the metaplastic fibroblasts reconstitute the normal collagen architecture of the tendon and lasts between 12 and 16 months [7,8].

Treatment of calcific tendonitis include a variety of methods, ranging from conservative methods to operative removal of the calcific deposits [3,7,9]. Simple conservative treatment regimens consist of antiinflammatory and analgesic medications, corticosteroid injections and arm rest, while surgical removal is carried out by either open or arthroscopic procedures. Other treatment options include a minimal invasive technique with needle destruction of the deposits and several alternative physiotherapeutic methods like extracorporeal shockwave therapy, transcutaneous electronic nerve stimulation and ultrasound and acetic acid iontophoresis, with extracorporeal shockwave therapy conferring the most satisfactory results [10—13].

Acupuncture was proposed in 1979 from World Health Organization as a clinically useful treatment for various skeletal pain syndromes like the "frozen shoulder syndrome" [13] because electroacupuncture, as an adjunct to exercise, was shown to significantly improve its functional state [14].

The aim of this pilot study was to prospectively evaluate the impact of electroacupuncture on pain intensity, changes in functional status, and radiological imaging in a small study cohort of patients with calcific tendonitis of the shoulder.

Material and methods

We conducted a prospective pilot study on 10 consecutive patients with calcific tendonitis who were referred by orthopedic surgeons to the pain management unit of our hospital. After institutional ethics committee approval, the study enrolled formally consenting patients between June 2012 and June 2014.

None of the enrolled patients had responded to conservative treatment courses with oral antiinflammatory drugs, minor opioids, and arm rest that lasted from 1 to 12 months before our intervention.

All patients received electroacupuncture trials with alternating current (2 Hz, 180 mA) at acupuncture points (0.25 $\times$ 25 mm needles without tonification or dispersion): GB21, GB34, LI4, LI 14, LI15, TW5, TW14, Chien Chien SI9, SI12, S37, S38 that lasted 60 seconds on each point and was repeated every 4 days (Scheme 1) [15,16]. During the electroacupuncture treatment, the patients were seated with their arm resting on a table.

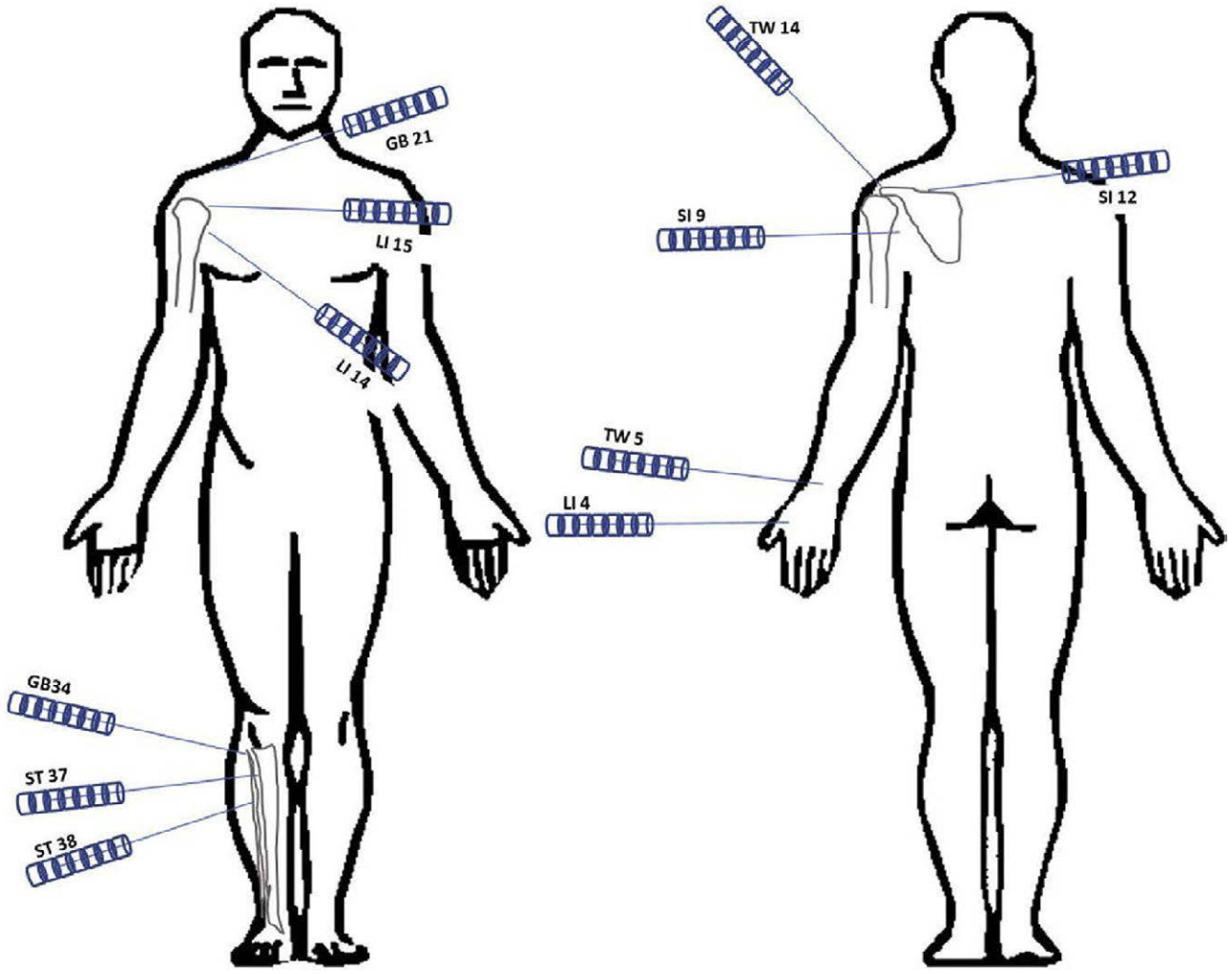
All patients were evaluated before, at six months, and 1 year after treatment. The evaluation included assessment of pain level using the visual analog scale (VAS), measurements of active range of motion (in degrees) and assessment of the Beck Depression Inventory (BDI) on each presentation at the pain management unit [17]. We suggested active exercise with pendular movements of the arm to all patients and ordered radiological evaluation with standard shoulder X-ray imaging 2—6 months after acupuncture treatment to evaluate the progression of the calcific deposits.

Statistical analysis consisted of paired Student t test for nominal variables, and the level of statistical significance was set at p value < 0.05. Values are expressed as mean $\pm$ standard deviation.

Results

Ten patients (eight males and two females), aged 36—65 years (46 $\pm$ 12) with 12 calcific tendonitis episodes were treated. Eight ($n = 8$) of them were affecting the right shoulder and four ($n = 4$) the left. The duration of each episode under medical treatment was variable, ranging from 1 to 11 months (6.4 $\pm$ 3.3).

Before acupuncture treatment, the pain was rated by the patients in the range of 6—10 (8.2 $\pm$ 1.4) of the VAS and as they stated was intolerable during the night, preventing them from sleep. BDI values were between 7 and 16 (10.2 $\pm$ 2.6, normal range: 0—9) and six patients ($n = 6$) reported values from 10 to 16 (Table 1).



Scheme 1 Acupuncture points used in our patients.

Table 1 Patients biometric characteristics, duration of pain prior to treatment (Tx), depression, and pain scores changes before and 2 to 6 months after treatment.

Patient	Gender	Age	Duration of pain (months)	BDI before Tx	BDI after Tx	VAS before Tx	VAS after Tx
1[a]	F	36	6	9	2	10	0
1[b]	F	36	1	7	5	8	3
2	F	45	11	16	9	10	0
3	M	56	6	12	7	10	1
4	M	60	8	12	4	7	2
5	F	38	6	9	2	8	0
6	F	36	3	9	8	8	0
7	F	65	7	10	8	10	0
8	F	55	9	8	8	8	1
9	F	30	12	7	2	6	0
10[a]	F	40	5	12	11	7	0
10[b]	F	40	3	12	11	7	0
	10 F, 2 M	46.1 ± 11.99	6.42 ± 3.26	10.25 ± 2.63	6.34 ± 3.51	8.24 ± 1.42	0.58 ± 0.99
Significance of change				$p < 0.005$		$p < 0.001$	

[a] Patient's right shoulder.
[b] Patient's left shoulder.
BDI = Beck Depression Inventory; VAS = visual analog scale.

All patients had either severely deteriorated abduction or frontal elevation or internal rotation angles. The evaluated patients received 1—16 electroacupuncture trials (6.7 ± 4, median: six per episode) (Table 2).

After the first electroacupuncture trial, seven out of 10 patients (7/10) were feeling significantly less pain and managed to have a peaceful night sleep (Table 1).

In detail, one 36-year-old female patient (Patient 1), suffering from painful calcific tendonitis of the right shoulder for approximately 6 months before presentation, experienced complete resolution of pain and restoration of normal arm movement angles after the first acupuncture trial and did not receive further interventions. Two months later, radiologic evaluation revealed complete resolution of the calcific deposit (Fig. 1). Unfortunately, the same patient returned to our unit almost a year later suffering from calcific tendonitis of her left shoulder. Even though she had no deterioration of arm movements, she finally required 16 electroacupuncture trials to eliminate her pain.

Among two patients who required three electroacupuncture trials each (Patient 2 and Patient 3), one presented spectacular improvement in pain and arm frontal elevation after treatment at the acupuncture point LI15 (Patient 3).

One patient (Patient 9) experienced reoccurrence of pain 4 months after successful initial treatment and received additive treatment with four electroacupuncture trials.

The last patient of this study (Patient 10) presented consecutive episodes of tendonitis in both arms with persistent pain which required multiple electroacupuncture interventions. After 20 trials in total, she eventually returned to normal life with no residual pain.

At 6 months, posttreatment, all patients had significant improvement in pain (VAS = 0—3, mean = 0.6 ± 1) and restoration of abduction (mean = 178.3 ± 3.8°, range: 170°—180°), frontal elevation (mean = 178.3 ± 3.9°, range: 170°—180°), and internal rotation of the affected arm (Table 2).

Four patients received trigger point deactivation with local anesthetic injections in the biceps and deltoid muscles and the scapula area (patients 5, 6, 7, and 9).

Only half of our patients (5/10) consented to repeated radiological examination 2—6 months posttreatment, and in these patients, we could diagnose almost complete resolution of calcific deposits (Figs. 1—5). The remaining five patients denied radiological reevaluation claiming certainty for complete cure of their problem.

At one year, after treatment, all patients reported no pain symptoms, normal functionality of their shoulder joint, and attested normal social and professional life (when applicable).

Discussion

Calcific tendonitis of the shoulder rotator cuff is a pathologic process that quite often evolves quietly, without producing noticeable symptoms. In 10% of patients it is a bilateral disorder. When it becomes symptomatic, often only in the resorptive phase of the disease, it radiates to the deltoid insertion and, less frequently, to the neck. It is commonly aggravated by elevation of the arm above shoulder level or by lying on the shoulder. Usually it affects the patients' social and professional life as it lasts from 3 weeks to 6 months [1—5]. Generally, the duration of the pain syndrome tends to be shorter when the onset of pain is abrupt and of high intensity [8].

Current treatment consists of either conservative medical treatment assisted by physiotherapy or interventional approaches [1—5,7,9—12].

Table 2 Number of electroacupuncture trials, abduction, frontal elevation, and internal rotation of the arm (in degrees) before and 2 to 6 months after treatment (Tx).

Patient	Trials	Abduction before Tx	Abduction after Tx	Frontal elevation before Tx	Frontal elevation after Tx	Internal rotation before Tx	Internal rotation after Tx
1[a]	1	110	180	80	180	Thigh	T7
1[b]	16	170	180	170	180	L3	T7
2	3	120	180	80	180	Buttock	T7
3	3	160	180	80	180	T12	T7
4	6	140	180	70	180	T12	T7
5	6	170	180	80	180	Thigh	T7
6	6	120	180	100	180	Buttock	T12
7	6	100	180	70	180	Buttock	T7
8	6	120	180	80	180	Buttock	T7
9	7	135	180	100	180	Buttock	T7
10[a]	12	40	170	30	170	Thigh	T12
10[b]	8	40	170	30	170	Thigh	T12
Mean ± SD	6.7 ± 4.0	116.25 ± 40.7	178.3 ± 3.8	80.83 ± 35.79	178.3 ± 3.89	What the patient could reach with the dorsal surface of the corresponding hand	
Significance of change		$p < 0.001$		$p < 0.001$			

[a] Patient's right shoulder.
[b] Patient's left shoulder.
SD = standard deviation.

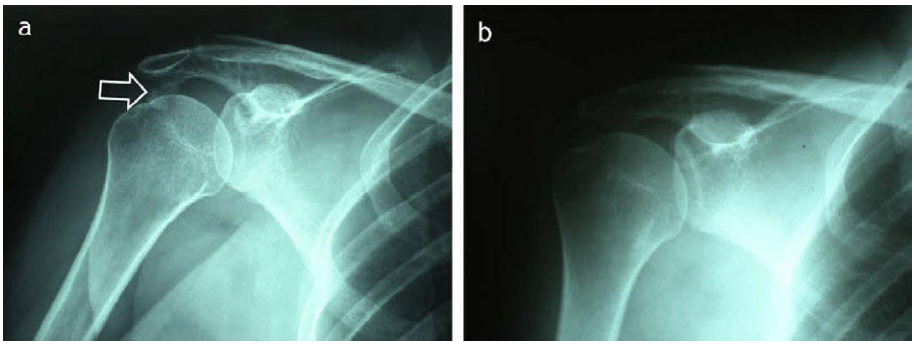


Figure 1 Patient 1. (A) Calcific tendonitis of the right shoulder, before treatment. (B) Two months, posttreatment.

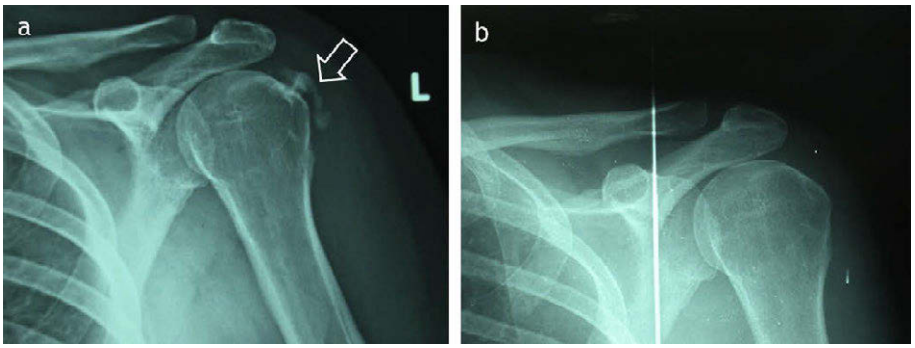


Figure 2 Patient 2. (A) Calcific tendonitis of the left shoulder, before treatment. (B) Two months, posttreatment.

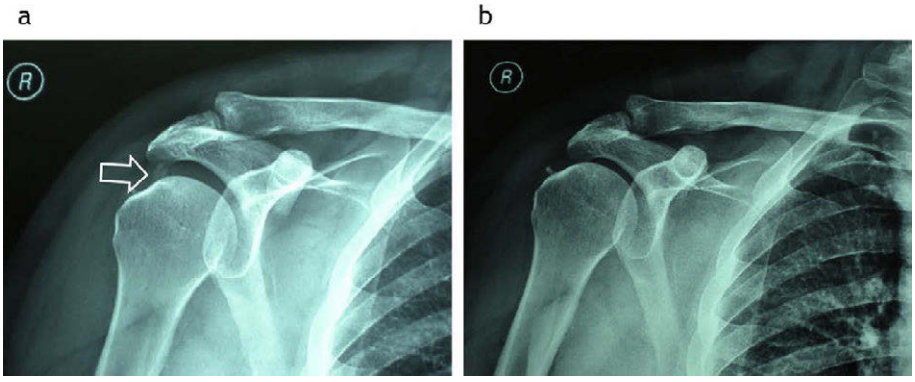


Figure 3 Patient 3. (A) Calcific tendonitis of the right shoulder, before treatment. (B) Two months, posttreatment.

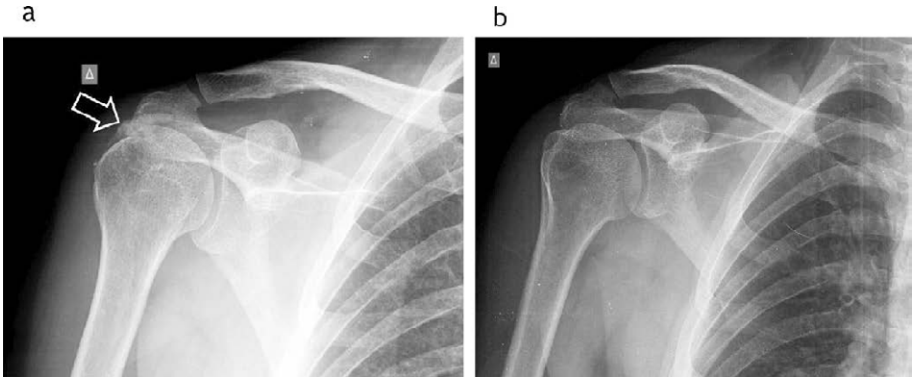


Figure 4 Patient 4. (A) Calcific tendonitis of the right shoulder, before treatment. (B) Six months, posttreatment.

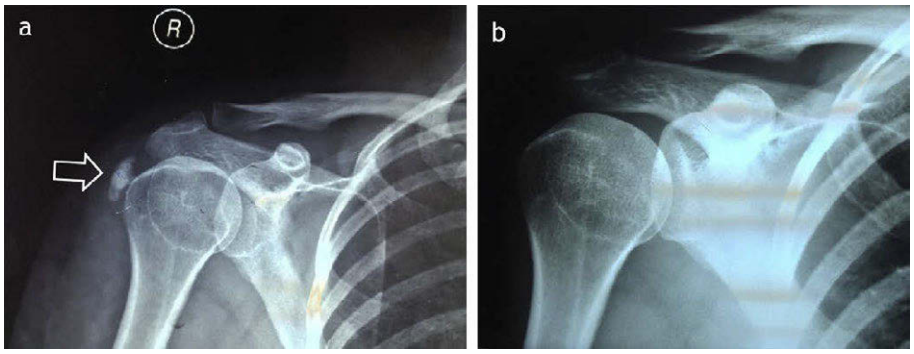


Figure 5 Patient 5. (A) Calcific tendonitis of the right shoulder, before treatment. (B) Six months, posttreatment.

Electroacupuncture has wide patient's acceptance in musculoskeletal pain compared with other nonsurgical modalities and practically carries minimal, if any, intervention associated risk.

In this pilot study, we treated 12 calcific tendonitis episodes in 10 patients. This intervention was inspired by the study from Cheing et al [14] but was accomplished by triggering multiple acupoints (local and distal). In this prospective randomized study, 70 patients with a "frozen shoulder" were treated with either electroacupuncture or transcutaneous electronic nerve stimulation in combination with active movement therapy and these on interventional treatments were proven equally effective. Compared to ours, this study applied electroacupuncture at only three (one trigger point, LI 15, ST 38) acupoints with alternating frequency of 2—100 Hz at a pulse duration of 100—400 μs for 20 minutes.

The enrollment criterion of 1—12 months under medical pain treatment was selected to evaluate if electroacupuncture could accelerate recovery from the painful syndrome.

The electroacupuncture protocol used in this study has been repetitively used in our pain unit for several years [15,16]. We used regional and remote puncture points that we have tried in patients with frozen shoulder in the past. Lathia et al described the effective use of acupuncture in 31 patients with chronic shoulder pain syndromes by applying either standard (local points GB 21, LI 14, LI 15, TW 14, and SI 9 and distal points LI 4, LI 11, ST 38, and GB 34) or individualized puncture site schemes (different combinations of local and distal acupoints) [13].

Our results imply that calcific tendonitis can even affect the psychological status of the suffering patient, fortunately in a reversible manner. Most our pilot study patients (6/10) reported a depression state as it was judged by their BDI scores of 10—16, that correspond to depression of medium severity. This psychic adverse effect is presumably produced by chronic pain and the resultant insomnia and poor quality of life. All but one patient (10, who also suffered from Parkinson disease) reverted to healthier psychic status after electroacupuncture treatment.

The effectiveness of just a few trials of electroacupuncture in our patients could be explained by the already established antiinflammatory effects of nonsteroid antiinflammatory medications that they were receiving. Additionally, we were surprised that the same electroacupuncture treatment had obviously different effectiveness in the same patient when facing the same symptoms on the other shoulder. Patient 1 required only one electroacupuncture trial to treat her long standing pain (>6 months) of the right shoulder and 16 trials for the left one that was in pain for just 1 month. Recent data suggest that electroacupuncture significantly induces c-fos in the dorsal vagal complex area during experimental inflammation and may exert antiinflammatory effects via activation of purinergic and glutaminergic receptors in the dorsal motor nucleus of the vagus nerve and modulation of the nucleus tractus solitarius and dorsal motor nucleus of the vagus nerve neurons [18]. So, we believe that it should be investigated in the future if the phase of the disease and the intensity of inflammation modify the suppressive effect of electroacupuncture that this study implies.

Merolla et al report five distinct adverse events related to calcific tendonitis: pain, adhesive capsulitis, rotator cuff tears or rupture, greater tuberosity osteolysis, and ossifying tendinitis [19]. The absence of pain in many cases of calcific tendonitis deserves attention [6]. In the acute state of calcific tendonitis, pain tends to be severe, usually affecting the greater shoulder area with excessive tenderness, radiates to the root of the neck, produces muscle spasm, and prevents free arm movements [20]. When in the chronic subacute state, the movement of the shoulder is permitted despite the persistence of severe pain [21].

Neer described four possible origins of calcific tendonitis pain [22]. Chemical irritation of the surrounding tissues from calcium, pain resulting from the distending pressure on the tissues where deposits evolve, the thickening of the articular capsule and subacromial impingement between the acromion, and the calcium deposit in the rotator cuff when lifting the arm overhead. Additionally, voluntary immobilization of the glenohumeral joint to avoid pain leads to stiffness and sclerosis of the joint. So, it seems reasonable to hypothesize that the pain ameliorating effect of acupuncture could provide impressive restoration of shoulder mobility.

The role of emerging trigger points during a calcific tendonitis episode should be investigated. Clinicians quite often find multiple trigger points in patients with frozen shoulder. Four of our patients also had several trigger points in the shoulder muscles that had to be deactivated to relieve patients from pain [23].

The finding of almost complete abolishment of calcific deposits within 2—6 months, post-intervention in five of our patients also deserves further research. We can only assume it to result from the antiinflammatory effect of

electroacupuncture combined with the established effect of nonsteroidal antiinflammatory medications that permitted an accelerated restoration of normal arm mobility. The possible effect of electric current in the resolution of hydroxyapatite deposits remains unclear and should probably be investigated accordingly.

Our study has certain limitations. We chose not to follow muscle strength as a dependent variable, because the quite complex interaction of the involved muscles could obscure the results. Thus, we based our estimations on the angles of certain single direction movements of the shoulder that describe the current functionality of the shoulder joint. Additionally, 50% of our patients denied repetitive radiologic imaging and prevented a meaningful calculation of the percentage of patients who restored normal radiological images posttreatment.

Conclusion

Electroacupuncture seems to offer a valuable contribution to the treatment of calcific tendonitis. The exact pathophysiologic modifications that produce this result are still obscure but presumably deserve appropriate investigation that could further elucidate its mode of action.

Conflicts of interest

None of the authors have any financial interests related to the material in the manuscript.

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