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Electroacupuncture for the treatment of supraspinatus calcific tendonitis

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ABSTRACT

Background: Conservative treatment of calcific tendonitis includes rest, medications, and physical therapy. Several physiotherapy interventions such as shockwave therapy are commonly used. The aim of this study was to investigate the efficacy of an electrotherapy method called electroacupuncture, in the treatment of calcific tendonitis.

Methods: 40 patients with calcific tendonitis were randomly divided to receive either a combination of medications and electroacupuncture, or just a course of medications. Evaluated outcomes included pain using the visual analog scale, shoulder range of motion with the use of goniometer, and quality of life along with functional status using the Instrumental Activities of Daily Living Scale (IAOLDS) and the Beck Depression Inventory (BDI). Radiological evaluation for the progression of the calcific deposits was also performed. All these evaluations were performed before and at the end of treatment. A final interview with the patients regarding any recurrent episodes was performed 18–24 months after the end of treatment.

Results: The intervention group showed greater improvement in pain intensity (2.8 points), range of motion (forward flexion, +30; abduction +29) when compared with the control group (for all, $P < .05$) while there was no statistically significant difference regarding the quality of life (IOLDS +0.2; BDI 0). Radiological evaluation demonstrated total or nearly total absorption of calcific deposits in 15 patients of the intervention group and in 8 patients of the control group.

Conclusion: The successful clinical results of electroacupuncture and the regression of calcific depositions after treatment showed that electroacupuncture may have a role as a treatment modality in calcific tendonitis.

1. Introduction

Calcific tendonitis is a common disorder of the shoulder characterized by significant pain and substantial restriction of both active and passive range of motion. The incidence of calcific deposits as a random radiological finding is 2.7%–22%, whereas only 34%–45% of them are symptomatic.[1,2] Uhthoff described 4 sequential phases of the disease: the formative phase during which fibrocartilage metaplasia occurs and hydroxyapatite crystals are formed, the resting phase, the resorptive phase involving a painful inflammatory reaction followed by progressive absorption of the calcific deposits, and the postcalcific phase which is characterized by reconstitution of the normal collagen architecture of the tendon.[2]

The usual conservative treatment of calcific tendonitis consists of rest, physical therapy and medications, while surgical treatment involves removal of the calcific deposits. The usual physiotherapy interventions include extracorporeal shockwave therapy (ESWT), transcutaneous electric nerve stimulation (TENS), ultrasound therapy and acetic acid iontophoresis. ESWT yield good to excellent results in these patients, while the role of the rest modalities is not clear.

Electrotherapy has a well established role in physical therapy. The umbrella term "electrotherapy" includes several different

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modalities such as transcutaneous electric nerve stimulation (TENS) and iontophoresis.[3] Electrotherapy uses two electrodes connected to an electric device that generates a low-level direct current with anti-inflammatory and analgesic properties. Acupuncture is also a widely accepted method having been used for various painful diseases, including shoulder disorders.[4–7] Its analgesic effect is believed to be achieved through release of endogenous opioids and by overriding pain signals.[8]

Subsequently a treatment modality combining the positive effects of electrotherapy and acupuncture would hypothetically enhance the successful results of each single method alone. The purpose of our study was to assess the efficacy of a particular intervention called electroacupuncture regarding pain relief, improvement of range of motion, improvement of quality of life and absorption of the calcific deposits in patients with calcific tendonitis.

2. Methods

2.1. Selection of participants

After institutional review board approval a prospective randomized clinical trial enrolling 40 patients with calcific tendonitis was conducted between June 2014 and June 2016 at the Pain Management Unit (PMU) of our hospital. An informed consent was obtained by all patients. Patients were excluded from the study if any other intervention or medical treatment had been used. The patients were randomly allocated into two groups: one group received a course of medications (analgesics and NSAID for a 3-week period) and electroacupuncture, while the other group (control group) received only a course of the same medications for the same period. The randomization technique involved sequentially numbered sealed envelopes. The envelopes were opened before the treatment. All patients in both groups performed an exercise program during their treatment. Participants were measured at baseline and after 3 weeks.

2.2. Interventions

During the electroacupuncture sessions, the patients were seated with their arm resting on a table. An electrotherapy device was used (Model: Electro Acupuncture Machine AWQ-105 Pro). First the skin of the shoulder was sterilized with an alcohol solution and then a sterile stainless steel acupuncture needle (single packaged one-time needle 25 mm long and 0,25 mm diameter) was inserted 15–20 mm intramuscularly into 2 specific acupoints. The first site was the trigger point, which was the site of the greatest tenderness and pain (different for each patient) while the second site was a traditional acupoint located at the depression of the superior deltoid muscle lateral to the acromion (Fig. 1).[4] The two needles were then connected to the electrodes of the electrotherapy device. A low voltage current of 180 mA at a frequency 5 Hz was administered through the electrodes. Each pulse was lasting 100 μs, eliciting light muscular twitching. The total duration of each session was 30 min. The recommended treatment protocol included two electroacupuncture sessions a week for a total of 3 weeks.

The exercise protocol included passive forward flexion (with the help of an overhead pulley system), internal and external rotation (with the aid of a stick) as well as pendulum exercises 5 times a day for 3 weeks.

2.3. Outcome measures

The intervention was performed by the last author and assessment was performed by the second author who was blinded to the group allocation. Primary outcomes included pain and shoulder active range of motion. Secondary outcomes included functional status, quality of life, recurrence of the disease and radiological progression of the calcific deposits. Assessment of intensity of pain was done using the visual analog scale (VAS) ranging from 0 (no pain) to 10 (worst pain). VAS is a valid measure of pain intensity. A 12-inch gioniometer was used to measure active range of motion. Assessment of functional status and quality of life was performed using the Instrumental Activities of Daily Living Scale (IAOLDS) and the Beck Depression Inventory (BDI). The Instrumental Activities of Daily Living Scale is a reliable and useful standardized scale to evaluate functional disability and self-efficacy. Beck Depression Inventory is one of the commonest scales for the assessment of the severity of mood disorders. These two scales were selected due to the fact that patients often mentioned that their pain is so intense that it intervenes with their daily activities, and subsequently has a great psychological impact to their lives. A radiological anteroposterior view of the shoulder was obtained before and after treatment in order to evaluate the progression of calcific deposits. Calcific tendonitis was classified according to Gartner classification, while the size and number of calcific deposits were also recorded. According to Gartner classification type I are well circumscribed and dense calcific deposits, type II calcifications either have a sharp border and an inhomogeneous structure or a cloudy border and a homogeneous structure, while type III calcifications are translucent with a cloudy appearance and without clear circumscription.[9] All patients were finally interviewed 18–24 months after treatment and asked for any recurrent episodes of calcific tendonitis.

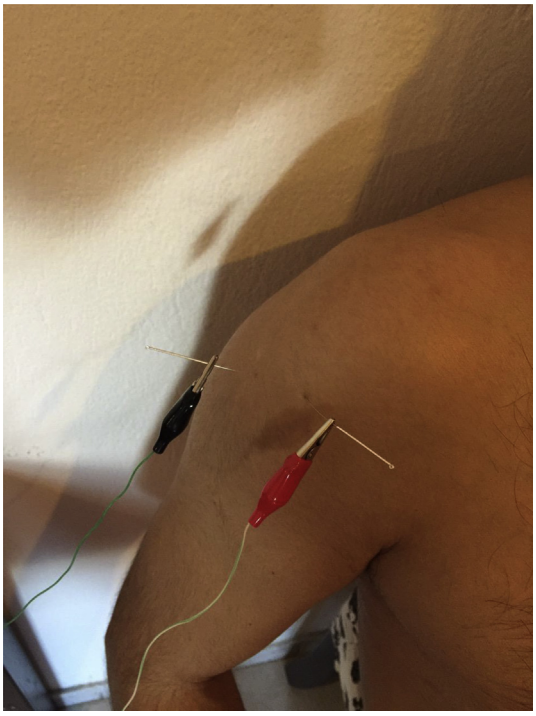

Fig. 1. Position of the needles on the shoulder. The two needles connected to the electrodes are placed on two points of the shoulder area: one at the site of the greatest tenderness and the other at one traditional acupoint.

2.4. Statistical analyses

Statistical power analysis was used to determine the optimum

sample size. The minimum necessary sample size was determined to be 18 subjects for each group. Sample size calculations were performed a priori using an alpha level of 0.05, and the ideal power was considered to be 80%. Statistical analysis was performed using the SPSS software, version 16.0 for Windows. Paired t-test was performed to evaluate differences in scores in the same group, while unpaired t-test was performed to examine differences between the two groups. The level for statistical significance was set at 0.05.

3. Results

3.1. Participants characteristics and baseline radiographs

A total of 44 patients with calcific tendonitis were screened. Four of them were excluded. A total of 20 patients with calcific tendonitis treated with electroacupuncture and medications and the rest 20 patients received only medications. There were 12 women and 8 men with a mean age of 46 years in the electroacupuncture group, while there were 11 women and 9 men with a mean age of 45 years in the control group. Both groups were homogenous with regard to age, gender and affected extremity (Table 1). Thirteen patients of the treatment group and 11 patients of the control group had a single calcific deposit, 7 patients of the treatment group and 8 patients of the control group had 2 calcific deposits, while one patient of the control group had 3 calcifications. The mean calcification size was 13.4 mm in the treatment group and 14.1 mm in the control group (Table 2).

3.2. Adherence to the treatment

The mean number of electroacupuncture sessions was 5. One patient experienced significant improvement of his symptoms shortly after the first session and decided to discontinue therapy, while 3 others discontinued therapy for the same reason after 3 sessions. Radiological assessment could not be performed in 3 patients of the electroacupuncture group and in 2 patients of the control group either because they denied or because they were not able to come to the hospital.

3.3. Primary analysis

At baseline all patients in both groups were suffering from significant pain with the VAS score ranging from 7 to 10 (mean 8.1 in control group and 7.8 in electroacupuncture group). Patients also had substantial restriction of both active and passive range of motion and a painful arc of motion. Forward elevation was up to 140° (mean 110° in control group and 108° in electroacupuncture group) and abduction was up to 100° (mean 68° in control group and 74° in electrotherapy group). After treatment the mean VAS score was 4.6 in the control group and 1.5 in the electrotherapy group. Within group analysis showed a significant ($p < .05$) decrease in pain and increased range of motion before and after treatment in both groups (Table 3). Ten patients in the electroacupuncture group mentioned that they could sleep without discomfort shortly after their first session. Between the two groups analysis also showed statistically significant ($p < .05$) decrease in pain and increase of range of motion in favor of the treatment group (Table 4). Patients were also divided into two groups based on the number of calcifications (1 or >1 calcifications) in order to assess whether results are affected by the number of classifications. Electroacupuncture showed to be significantly superior to simple course of medications regarding pain and range of motions in both groups, thus the positive effect of electroacupuncture is independent of the number of calcifications.

Table 1
Baseline characteristics of the 40 patients.

Characteristic	Electrotherapy group	Control group
Patients	20	20
Mean age	46	45
Male/Female	8/12	9/11
Affected shoulder (right/left)	13/4	12/8

Table 2
Baseline radiological findings.

	Electrotherapy group	Control group
Number of calcific deposits		
1	13	11
2	7	8
3	0	1
Classification		
I	10	9
II	8	9
II	2	2
Mean size of calcific deposits, mm	13.4	14.1

3.4. Secondary analysis

The mean pretreatment value of Beck Depression Inventory was 11 in the control group and 10 in the electroacupuncture group while the mean pretreatment value of the Instrumental Activities of Daily Living Scale (IAOLDS) was 5.2 in the control group and 5,6 in the electrotherapy group. After treatment the mean value of Beck Depression Inventory was 8 in the control group and 6.4 in the electrotherapy group and the mean value of the Instrumental Activities of Daily Living Scale (IAOLDS) was 6.8 in the control group and 7.4 in the electroacupuncture group (Table 3). Between two groups analysis showed that there was no statistically significant difference regarding the quality of life indices (Table 4). An anteroposterior radiological view of the affected shoulder was obtained in 17 patients in the electroacupuncture group and in 18 patients in the control group after treatment. Radiological evaluation demonstrated total resorption of calcific deposits in 15 patients who received electroacupuncture while this was evident in 8 patients of the control group (Fig. 2). The mean size of calcific deposits decreased by 13 mm in the treatment group and by 9.2 mm in the control group ($p < .05$). During the final interview of all patients up to 2 years after treatment, 2 patients of the electroacupuncture group and 6 patients of the control group mentioned that they had 2 recurrent episodes, while 1 patient of the electroacupuncture group and 2 patients of the control group reported 1 recurrent episode. All recurrent episodes were confirmed by radiological evaluation and reported to be less severe than the first one (mean VAS score 6 in control group and 4.3 in electroacupuncture group), lasting for a mean period of 2 weeks, while all episodes but one subsided with a brief period of NSAID and rest. Only one patient of the control group reported that symptoms during the 2nd recurrence were intractable and surgical treatment was decided following failure of conservative treatment with medications.

4. Discussion

The basic concept of our approach was to combine the analgesic effects of acupuncture and electrotherapy with the absorptive action of the electric current. Patients showed a gradual pain relief and significant improvement of range of motion. Almost all patients mentioned that they could sleep without pain shortly after their

Table 3
Change in the mean scores and range of motion at baseline and after 3 weeks in control and electroacupuncture groups.

Variable	Control group		Electrotherapy group	
	Before treatment	After treatment	Before treatment	After treatment
VAS	8,1	4,6	7,8	1,5
IOLDS	5,2	6,8	5,6	7,4
BDI	11	8	10	6,4
Forward elevation	110	150	108	178
Abduction	68	140	74	165

Table 4
Mean differences in pain, quality of life and range of motion before and after treatment in the two groups.

Variable	Electrotherapy group	Control group	P- value
VAS	6,3	3,5	<0.05
IOLDS	1,8	1,6	>0.05
BDI	3	3	>0.05
Forward elevation	70	40	<0.05
Abduction	91	72	<0.05

first session, while the quality of life of all patients except from one substantially improved after the treatment. This patient was suffering from end stage renal insufficiency and probably this comorbidity affected his outcomes. Another significant outcome of the study is that only few patients had recurrent episodes of calcific tendonitis in the following years.

Non operative treatment of calcific tendonitis includes medications, barbotage (with or without subacromial corticosteroid injection) and various physiotherapy modalities. Needling of calcifications with lavage and subsequent corticosteroid injection is commonly performed resulting in high rates or clinical improvement, while total resorption of calcification can be achieved in up to 56.5% of cases with this method.[10] The percentage of total resorption with electroacupuncture in our study was higher (88%), but safe conclusions regarding superiority of one modality over the other cannot be made without direct comparative studies. The most thoroughly investigated and widely used physiotherapy method for the treatment of calcific tendonitis is ESWT. This method has an apparent mechanism of action, resulting in fragmentation of the calcific deposits. Several studies have reported excellent outcomes with ESWT and a recent systematic review confirmed its safety and effectiveness.[11,12]

While the analgesic effect of electrotherapy is widely accepted, the underlying mechanism of absorption of calcific deposits in cases of calcific tendonitits is still unclear.[13] The rationale for this may lies on the fact that galvanic current leads to decreased pH around the anode.[14] It is known that calcific deposits are insoluble in water but become soluble in acidic pH, thus the decreased pH levels due to electrotherapy may set up a favorable environment for their regression and absorption.[15,16] Regarding acupuncture, needling is believed to activate small myelinated type II and III afferent nerve fibers resulting in release of endorphins and induction of its analgesic effect. Conventional acupuncture for the treatment of chronic shoulder pain have been shown to yield successful results.[17,18]

While various electrotherapy modalities such as TENS and iontophoresis have been used for the treatment of calcific tendonitis, few studies have been conducted for evaluation of electroacupuncture in shoulder disorders.[8,19–21] Perron et al. used acetic acid iontophoresis followed by continuous ultrasound in 11 patients with calcific tendonitis. The size of calcium deposits was reduced by a mean value of 20%, but there was no statistically significant difference between the experimental and control group. According to the authors, the resorption of these deposits was attributed to the natural process of the disease.[22] In our study we observed total or nearly total absorption of the calcific deposits in a higher number of patients in the electroacupuncture group compared to control group. Since resolution of calcifications usually takes longer (1–6 years) and there was significant difference regarding the total resorption rates between the treatment and control group, the regression of the calcific deposits in our study which was observed at the time of the radiological examination cannot be attributed to the natural process of the disease.[23] Pan et al. compared ESWT with TENS for the treatment of calcific tendonitis in 60 patients. Shockwave therapy showed to be superior to TENS regarding pain relief, functional scores and reduction of the size of calcium deposits.[24] We observed total regression of calcific deposits in 88% of patients who underwent radiological evaluation while in other studies using ESWT and iontophoresis total resorption was observed only in 40%–50% of patients.[15,25]

There are certain limitations of our study that must be

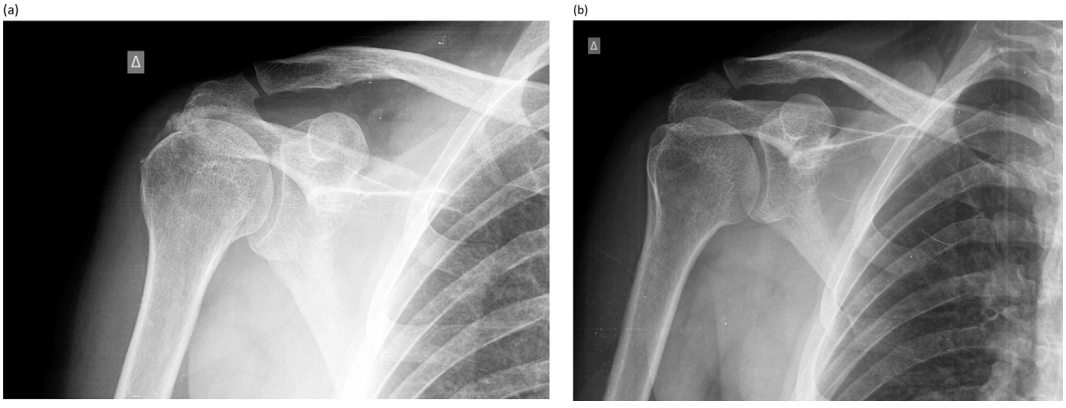

Fig. 2. Anteroposterior radiograph of a shoulder showing a calcific deposit before electroacupuncture treatment (a) which disappeared after treatment (b).

addressed. One of them is the relatively small number of participants, so further studies with larger sample size are needed for safe conclusions. Another limitation of the study is that it is not double blinded and patients were aware of their treatment, which may have affected the clinical results of electroacupuncture.

5. Conclusions

Our results showed that electroacupuncture is an effective alternative method for the treatment of calcific tendonitis with excellent outcomes regarding pain relief and improvement of shoulder range of motion Electroacupuncture may have an intermediate role in patients in whom several other conservative methods have failed and still surgical removal of calcific deposits has not been decided.

Declaration of interests

None.

Acknowledgments

None.

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