Effects of Steroid Iontophoresis and Electrotherapy on Bicipital Tendonitis

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ABSTRACT. Objective: The aim of this study was to compare the effects of steroid iontophoresis [SI] and electrotherapy [ET] on bicipital tendonitis.

Methods: Forty-seven patients with bicipital tendonitis, diagnosed by ultrasonography, were all treated with hot packs [15 minutes], ultrasound [1.5 w/cm^2, five minutes], and a standard exercise program. They were also divided randomly into two experimental groups. One group received SI [0.5 percent hydrocortisone acetate given with the negative electrode, 3-4 mA galvanic current, 15 minutes]. The second group was treated with ET [interferential current, 0-100 Hz, 15 minutes]. All patients were evaluated at pre-treatment, post-treatment, and one month later with the following assessment tools: pain [pain at rest, with normal activities, and with strenuous activities] with a numeric scale [0 to10], range of motion [ROM] with goniometry and with the ROM items of Constant's Shoulder Scale, patient satisfaction with a numeric scale [0 to 10], and disability by using the function section of the Pennsylvania Shoulder Scale.

Results: All of the assessment parameters revealed statistically significant improvement at post-treatment and one month later [$P < 0.05$] in the SI group. The ET group experienced less dramatic improvement in the immediate post-treatment [$P < 0.05$] assessment and the durability of benefit was less than with SI.

Conclusions: Application of SI to the conventional physical therapy for patients with biceps tendonitis seems to provide a better and more prolonged clinical and functional improvement.
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KEYWORDS. Bicipital tendonitis, iontophoresis, electrotherapy, shoulder pain, physical therapy

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INTRODUCTION

Shoulder pain is a common complaint, especially with aging, that may cause an important functional disability. The shoulder joint is supported with a complex soft tissue structure, and it is not always easy to clarify the origin of the pain. Although the pain is believed to originate from the soft tissue, other possible causes of shoulder pain such as stroke, polyneuropathy, multiple sclerosis, rheumatic diseases [e.g., rheumatoid arthritis, ankylosing spondylitis], malignancies, and radiating or referring pain should not be neglected (1).

Due to its complex anatomy and the difficulty of direct examination, the role of the biceps tendon as a source of shoulder pain has received much attention in orthopedic literature (2). The long head of the biceps arises from the supraglenoid tuberosity at the upper margin of the glenoid cavity, and is continuous with the glenoidal labrum. This tendon, enclosed in a special sheath of the synovial membrane of the shoulder-joint, arches over the head of the humerus. It emerges from the capsule through an opening close to the humeral attachment of the ligament and descends in the intertubercular groove. This structure can be affected by any event that affects the shoulder joint, including inflammatory processes, overuse, and traumas (2).

There are many imaging methods including X-rays, arthroscopy, arthrography, magnetic resonance imaging, and ultrasonography [US] that can be used in shoulder pathologies. Although each method has its own advantages and disadvantages, there is a common consensus that US can be used as a first line imaging method in shoulder pathologies (3).

There is no consensus in the literature about the treatment of prolonged soft tissue shoulder pathologies, including biceps tendon lesions that may result in range of motion [ROM] restrictions and functional disability.

The aim of this study was to compare the effects of steroid iontophoresis [SI] and electrotherapy [ET] on shoulder pain due to pathologies with biceps tendon lesions in which the diagnosis was confirmed with US examination.

MATERIALS AND METHODS

Patients with nonspecific shoulder pain lasting for more than four weeks were prospectively evaluated to determine those who had bicipital tendon pathology. The study was carried out at the outpatient service between the time period of January 2004 and December 2004. Thus, the study population consisted of eligible patients who applied for treatment of shoulder pathology in that time period. After a detailed physical examination, plain shoulder films, routine laboratory tests including complete blood count, sedimentation rate, C-reactive protein, brief routine biochemistry, and, if necessary, rheumatoid factor were ordered for all patients. A soft tissue shoulder US examination was performed on all patients by a medical doctor who was experienced in soft tissue US examination.

The patients with advanced degenerative shoulder pathology in X-rays and who were known to have cervical disc pathology, systemic rheumatism, malignancy, stroke, polyneuropathy, carpal tunnel syndrome, mental problems, deformities of the joints in the affected upper limb, and/or trauma history in previous four weeks were excluded. Patients with a biceps tendon pathology, which was either isolated or accompanying to other shoulder pathologies, were included in the study.

The study was approved by our Institutional Local Ethics Committee and informed consent obtained from each patient.

Patients were divided randomly into two groups. Randomization was conducted by an envelope method. After the patient was chosen for the study, his or her treatment was determined with the sealed envelope. The envelopes were opened sequentially by a physiotherapist after the patient's name and other details were written on the envelope. All patients were assessed before and after the treatment. Subjects were reassessed after one month. A physiatrist who was blinded to the treatment method performed all assessments.

Treatment Methods

Hot pack [15 minutes], US [1.5 watts per square centimeter, continuous mode, five minutes], and a standard exercise program includ-

ing pendulum, strengthening, and ROM exercises in pain range were given to all patients every weekday. Additionally, SI [0.5 percent hydrocortisone acetate with the negative electrode placed anterior side of the shoulder, 3-4 mA galvanic current, 15 minutes] was applied in the first group, and ET [interferential current, 0-100 Hz, 15 minutes] was applied in the second group for 15 sessions. Results and complications were recorded.

Assessment Scales

Constant's Shoulder Scale [CSS] and the Pennsylvania Shoulder Scale [PSS] are being used widespread in the follow-up of non-specific shoulder pathologies. The CSS is a 100-point scoring system in which 35 points are derived from the patient's report of pain and function. The remaining 65 points are allocated for objective assessment of ROM and strength (4). The PSS consists of two 100-point scoring systems and has been developed to cover the deficiencies of available shoulder scoring systems (4). The self-assessment 100-point scoring system is based on scoring of the patient's report of pain, satisfaction, and function. The 100-point impairment score consists of objective measures of ROM and strength (4).

Outcome Assessments

Pain

Pain with arm at rest by the side, pain with normal activities, and pain with strenuous activities, which were also parts of the PSS, were assessed with a 10-point numeric rating scale with end points of "no pain" [0] and "worst possible pain" [10]. Rest pain was assessed before and after treatment and at follow-up; pain with normal and strenuous activities was assessed only before treatment and at follow-up. Besides getting a score for each item, a total pain score was obtained as in the PSS by subtracting the sum of three pain item scores from 30.

Range of Motion

Flexion, abduction, and external rotation of the painful shoulder were measured both with goniometry and as in the CSS. Goniometric measurements were done using a universal standard goniometer, which was reliable [intraclass correlation coefficient = 0.85-0.99] for the measurement of shoulder ROM (5,6). Internal rotation was not measured with goniometry. It was scored as in the CSS. Range of motion measures were obtained before and after the treatment and one month later.

Satisfaction

The patient's satisfaction with the function of the shoulder was assessed with a numeric rating scale with end points of "not satisfied" and "very satisfied." Scoring was based on the number circled by the patient.

Disability

Disability was assessed by using the function part of the PSS. It is based on a 20-item questionnaire with a four-category Likert scale for responses with a maximum 60 points. Scoring of this section was as follows: three points were awarded if the patient "can perform the activity without difficulty," two points for "some difficulty," one point for "much difficulty," and zero for "cannot do at all."

Ultrasonography

Soft tissue shoulder US [General Electric, Pro200, 5.5-11 MHz and 7.5 MHz linear probe] examination was performed to all patients by a medical doctor who was experienced in soft tissue US before treatment and at follow-up. An increase in the thickness of biceps tendon or presence of fluid within the biceps tendon sheath was evaluated as tendonitis.

Statistical Analysis

Statistical analysis was performed by the Statistical Package for Social Sciences program version 11.0 for Windows. Demographics were compared by using the student t- test. The results were compared by using the multivariate analysis of variance, post hoc comparisons were made by using the Mann-Whitney for differences between the groups, and the t-test was used for comparisons of the

data within the groups. $P < 0.05$ was considered to be significant.

RESULTS

A total of 96 patients with nonspecific shoulder pain lasting for more than four weeks were prospectively evaluated to determine who had bicipital tendon pathology. Forty-seven patients [28 females, 19 males] with the mean age of 56.2 ± 9.96 years were included in the study. In the ET group, there were 12 females and nine males with the mean age of 53.4 ± 10.8 years. A minor trauma of six patients [28.8 percent] and overuse by four patients [19 percent] were declared as a causative event. Duration of the symptoms was one to three months in five patients [23.8 percent], three to six months in six patients [28.6 percent], and more than six months in 10 patients [47.6 percent]. Thirteen patients [61.9 percent] had dominant shoulder involvement [Table 1].

In the SI group, there were 16 females and 10 males with the mean age of 58.5 ± 8.8 years. History of minor trauma was present in six [23.1 percent] and overuse in three [11.5 percent] of the patients. Duration of the symptoms was one to three months in six patients [23.1 percent], three to six months in eight patients [30.8 percent], and more than six months in 12 patients [46.2 percent]. Sixteen patients [61.5 percent] had dominant shoulder involvement [Table 1].

No complications occurred in the ET group. However, we observed a superficial burn complication in two patients in the SI group at the beginning of the therapy which subsided spontaneously after ceasing the therapy for a few days.

No patient was lost to follow-up in either group. There were no significant differences between the groups in terms of demographic variables [age, sex, causative event, dominant side involvement, and duration of the symptoms], pain [at rest, with normal, and strenuous activities], satisfaction, ROM [flexion, abduction, internal and external rotations, and CSS total ROM score], and disability scores at baseline [$P > 0.05$]. The relations of the demographic data with shoulder symptoms were not found statistically significant [$P > 0.05$].

In the SI group, the improvements in all follow-up parameters were statistically significant after the treatment and at the final assessment [$P < 0.05$; Table 2]. Although the ET group showed statistically significant improvements in all follow-up parameters at post-treatment, the improvements in pain at rest, abduction, internal and external rotations, and total CSS ROM score were not statistically significant one month later [Table 3]. However, differences in improvements of pain at rest, abduction, external rotation, and total CSS ROM score obtained before the treatment and one month later were not found statistically significant between the groups [$P = 0.14$, $P = 0.38$, $P = 0.9$, and $P = 0.25$, respectively]. Difference in improvements of internal rotation measures

TABLE 1. Demographic Data and Baseline Characteristics of the Patients

	ET Group N[%]	SI Group N[%]	P
Age [mean ± SD]	53.43 ± 10.84	58.46 ± 8.77	0.167
Female/Male	12 [57.1]/9 [42.9]	16 [61.5]/10 [38.5]	0.763
Dominant side involvement	13 [61.9]	16 [61.5]	0.853
Causative event			0.671
Overuse	4 [19.0]	3 [11.5]	
Minor trauma	6 [28.8]	6 [23.1]	
Symptom duration			0.963
1-3 months	5 [23.8]	6 [23.1]	
3-6 months	6 [28.6]	8 [30.8]	
> 6 months	10 [47.6]	12 [46.2]	

ET = electrotherapy, N = number, % = percent, SI = steroid iontophoresis, SD = standard deviation

TABLE 2. Differences in Follow-Up Parameters in the Steroid Iontophoresis Group

	Before Treatment	After Treatment		Final Assessment	
	Mean ± SD	Mean ± SD	P*	Mean ± SD	P*
Rest pain	3.5 ± 1.9	2.1 ± 1.2	0.001	2.3 ± 1.2	0.031
Pain with normal activity	5.6 ± 1.5	-	-	3.2 ± 1.2	0.013
Pain with strenuous activities	7.8 ± 1.2	-	-	6.4 ± 1.3	0.022
Satisfaction	3.7 ± 1.5	-	-	4.8 ± 1.4	0.021
Flexion	128 ± 32	135 ± 30	0.003	138 ± 28	0.017
Abduction	120 ± 37	128 ± 36	0.013	125 ± 35	0.045
External rotation	75 ± 14	77 ± 17	0.003	76 ± 10	0.025
Constant internal rotation	4.7 ± 2.7	5.8 ± 2.4	0.002	5.4 ± 2.5	0.020
Constant total ROM	25.7 ± 2.9	28.5 ± 7.9	0.008	27.8 ± 7.4	0.011
Pennsylvania total pain	13.2 ± 4.2	-	-	17.3 ± 1	0.009
Pennsylvania function	24.6 ± 7.7	-	-	27.5 ± 7.7	0.019

SD = standard deviation, ROM = range of motion

* According to the baseline values

TABLE 3. Differences in Follow-Up Parameters in the Electrotherapy Group

	Before Treatment	After Treatment		Final Assessment	
	Mean ± SD	Mean ± SD	P*	Mean ± SD	P*
Rest pain	3.1 ± 1.8	2.3 ± 1.1	0.015	2.8 ± 1.3	0.13
Pain with normal activity	5.7 ± 1.6	-	-	5.2 ± 1.1	0.041
Pain with strenuous activities	8.1 ± 1.1	-	-	7.5 ± 0.8	0.048
Satisfaction	3.9 ± 1.1	-	-	4.2 ± 0.9	0.046
Flexion	135 ± 35	143 ± 36	0.04	142 ± 37	0.045
Abduction	116 ± 43	128 ± 45	0.021	127 ± 42	0.052
External rotation	76 ± 10	79 ± 09	0.035	78 ± 08	0.055
Constant internal rotation	4.9 ± 3	5.2 ± 2.9	0.046	4.8 ± 3.1	0.10
Constant total ROM	25.1 ± 9.3	27.1 ± 8.6	0.039	26.4 ± 8.9	0.064
Pennsylvania total pain	13.2 ± 4.1	-	-	14.6 ± 2.6	0.027
Pennsylvania function	24 ± 6.2	-	-	27.4 ± 8.1	0.042

SD = standard deviation. ROM = range of motion

* According to the baseline values

obtained before the treatment and one month later was statistically significant between the groups [P=0.03]. The US findings obtained before treatment and one month later are summarized in Table 4.

DISCUSSION

Technical improvements coupled with advances in the understanding of anatomic and pathologic characteristics of the articular sup-

TABLE 4. The Ultrasonographic Findings Obtained Before Treatment and at Follow-Up

	Steroid Iontophoresis Group		Electrotherapy Group	
	Pretreatment N[%]	Follow-up N[%]	Pretreatment N[%]	Follow-up N[%]
Bicipital effusion	20 [76.9]	18 [69.2]	15 [71.4]	16 [76.2]
Bicipital tendonitis	8 [30.8]	8 [30.8]	8 [38.1]	7 [33.2]
Rotator cuff tendonitis	8 [30.8]	8 [30.8]	5 [23.8]	6 [28.5]
Rotator cuff calcification	0 [0]	0 [0]	2 [9.5]	2 [9.5]
Supraspinatus full-thickness tear	0 [0]	0 [0]	1 [4.8]	1 [4.8]
Supraspinatus partial tear	20 [76.9]	21 [80.8]	13 [61.9]	13 [61.9]
Subacromial bursitis	15 [57.7]	13 [50.0]	11 [52.3]	11 [52.3]
Impingement	16 [61.5]	17 [65.3]	19 [90.4]	18 [85.7]
Degenerative changes in acromioclavicular joint	3 [11.5]	3 [11.5]	3 [14.3]	3 [14.3]

N = number, % = percent

port tissue have resulted in more accurate diagnosis in the shoulder pain. The role of the long head of the biceps tendon as a source of shoulder pain has been controversial in literature. Various authors (7) have suggested its contribution to the impingement syndrome, though few consider it a common primary focus. Although the significance of biceps lesions in prolonged shoulder pain has been emphasized by various authors, there is no a consensus regarding the treatment of this subacute or chronic condition in literature. Sethi et al. (7) strongly recommended that the long head of biceps tendon be included in the overall algorithm of treatment for the impingement syndrome. In the biceps tendon pathologies, initial treatment consists of rest, discontinuing those activities that exacerbate the symptoms, and administration of nonsteroid anti-inflammatory drugs. If the patient does not respond to the conservative care, a cortisone and local anesthetic mixture administration can be applied along the course of the tendon. Taskaynatan et al. (8) performed steroid injections at the anterior route beside the lateral route to target biceps pathologies commonly encountered in non-specific shoulder pain and announced a noteworthy success.

Although physical modalities are used widely in the treatment of rotator cuff disease, the results about their efficacies were inconsistent in literature. The short-term efficacy of therapeutic US has been demonstrated only in calcifying tendonitis. Its efficacy in other shoulder disorders has not been shown (9,10). Van der Heijden et al. (11) suggested that neither bipolar interferential electrotherapy nor pulsed ultrasound were effective in soft tissue shoulder pain. In the present study, superficial [hot pack] and deep heating [US] modalities were used for the purpose of increasing blood flow, decreasing pain, increasing tendon extensibility, and decreasing joint stiffness. Despite the insufficient evidence about the effectiveness of heat therapy and ET in shoulder pain in literature, exercise therapy has been usually found effective.

Some randomized controlled studies (12-14) have shown the efficacy of topical steroids, nonsteroidal anti-inflammatory drugs, and acetic acid iontophoresis in which the movement of the molecules through the skin can be influenced by electrical current in different musculoskeletal disorders. However, those studies were not specifically on rotator cuff disease or biceps tendon pathology. Some authors could not show any effect of iontophoresis on steroid migration through in vivo and in vitro studies, whereas others did (15,16). The suggested way of migration has been intercellular pathways of polar regions in the lipid lamellae where voltage dependent pore formation occurs in the stratum corneum (17).

In the present study, a significant improvement in all follow-up parameters was obtained after the treatment in ET group. However, the improvements in pain in rest and night pain, abduction, internal and external rotations, and total ROM were lost with a small difference at the final assessment. On the other hand, improvement in pain of strenuous activities was still continuing at the follow-up. A possible cause of this improvement in pain of strenuous activities may be a result of patients' abilities to use their extremities with less pain and with a wider range than the pretreatment period. Thereby, patients could adapt their lives according to their present pathology and avoid activities that caused or increased pain. In fact, in light of current knowledge, it does not seem that interferential currents regress or reverse the inflammation. Rather, it seems to facilitate the rehabilitation program by acting on pain. In contrast, the effects of steroids on inflammation have been well-described in literature (18).

In English literature, we could not find a paper studying the effect of SI on bicipital tendonitis, though its effect on tendonitis in different body parts and inconsistent results have been reported (19,20). In the present study, hydrocortisone acetate was used. Even though there was no knowledge about iontophoretic migration of this agent, our results showed that iontophoresis with hydrocortisone acetate was effective on bicipital tendonitis. The long head of the biceps tendon is enclosed in a special sheath of the synovial membrane of the shoulder joint, which covers the tendon in a part while it descends in the intertubercular groove. Incidence of inflammation in this region is high either as a primary or as a part of other shoulder pathologies (2). Therefore, SI was applied through negative electrode at anterior side and as much as superior of the shoulder in purpose of being more effective on bicipital lesions. Despite the fact that the agent was not produced for such a purpose, it was found effective. Maybe better results could be obtained with an agent produced specifically for iontophoresis. Many physicians keep away from this method because of lack of scientific data, difficulties in application, and possible complications like burn. It is clear that steroids could be effective in the situation it reaches to the inflammatory region. Currently, hydrocortisone is commonly used in clinical practice to threat a variety of musculoskeletal conditions. Because delivery of this agent via intra-articular injection or oral route may result in undesirable side effects, iontophoresis, which is a safer method, may be a choice of treatment. We observed a superficial burn complication in only two patients at the beginning of the therapy which subsided spontaneously after ceasing the therapy for a few days. Afterwards, we could continue the therapy without any problem.

At the follow-up using US examination, we could not obtain a significant difference in lesion numbers between the groups [Table 4]. However, we observed that bicipital effusion size was regressed more in the SI group than in the ET group. Although diameter of the effusion along the biceps tendon was measured with US, a statistical analysis was not done because of difficulties in standardization of measurements.

In the present study, although not statistically significant in all follow-up parameters, overall improvements in pain, ROM, and, as a result, in function were likely better in SI group. Our results showed that treatment modalities targeting the biceps tendon pathologies, which are either isolated or accompanying to other shoulder pathologies, may increase the improvement. We suggest that since the method of steroid delivery may be important, iontophoresis, a noninvasive technique, may be considered where steroid is supposedly necessary. Further studies with different agents are needed to confirm our results.

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