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Comparision of Ultrasound Therapy of Various Durations in the Treatment of Subacromial Impingement Syndrome

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Abstract. [Purpose] A prospective, randomized, single-blind study was performed in order to compare the efficacy of ultrasound treatments of various durations for patients with subacromial impingement syndrome. [Subjects and Methods] One hundred patients who had been diagnosed with subacromial impingement syndrome by clinical examination and magnetic resonance imaging were included in this study. Patients were randomly divided into two groups of fifty patients per group. The first group received 15 sessions of therapeutic ultrasound (4 minutes), superficial heat and transcutaneous electrical stimulation therapy combined with exercise. The second group received the same treatment except that each of the 15 ultrasound sessions were eight minutes in length. The patients were evaluated before and after the treatment. A visual analog scale (VAS) was used to assess pain, the University of California at Los Angeles (UCLA) and Constant Scale were used to assess shoulder function and the Beck Depression Inventory (BDI) was used to quantify depressive symptoms. [Results] There were no statistically significant differences between the groups in age, time since the onset of pain, sex, education and depression levels prior to the treatment. The post-treatment evaluation of patients VAS, UCLA, Constant, and BDI scores showed statistically significant within group improvements. When the two groups were compared, we found no statistically significant differences in the Constant activities of daily living, Constant external rotation, Constant force and BDI scores. However, the second group scored better than the first group in all the remaining parameters. [Conclusion] Ultrasound therapy was found to have beneficial effects on pain and functional status in the treatment of subacromial impingement syndrome. Eight minutes of ultrasound treatment was shown to be more effective than 4 minutes of ultrasound treatment.

Key words: Shoulder, Subacromial impingement syndrome, Ultrasound

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INTRODUCTION

Subacromial impingement syndrome (SIS) is characterized by severe pain spreading from the shoulder throughout the biceps and deltoid. The pain increases at night and with abduction and internal rotation[1)]. SIS is one of the most frequent causes of shoulder pain and occurs when the muscles comprising the rotator cuff are compressed in the subacromial space and the coracoacromial arch[2)]. Multiple predisposing factors play a role in the development of SIS. The most common risk factors are weak rotator cuff muscles, abnormal scapular muscle structure, abnormal structure of the acromion, repetitive trauma, articular capsule abnormalities and overhead arm activity for long periods[3)].

The primary goals of treatment are to improve function and reduce pain. The first steps in treatment are rest, ice packs and nonsteroidal anti-inflammatory drugs. If healing is not achieved, physical therapy and rehabilitation are administered[4, 5)]. Physical therapy programs include mobilization and manipulation techniques, magnetic field therapy, ultrasound, transcutaneous electrical nerve stimulation and infrared therapy[6, 7)]. Ultrasound is a frequently used method in physical therapy. Ultrasound increases tissue temperature, blood flow and tissue collagen elasticity and is also effective at relieving muscle spasms[8)].

While there are many studies in the literature on the use of various physical therapy methods alone, in combination, compared to each other or to a placebo for the conservative treatment of subacromial impingement syndrome, there are no studies comparing various durations of ultrasound therapy.

The aim of this study was to evaluate various durations of ultrasound therapy in the conservative treatment of subacromial impingement syndrome.

SUBJECTS AND METHODS

One hundred patients admitted to the outpatient clinic of the Istanbul Physical Therapy and Rehabilitation Education and Research Hospital with shoulder pain between January 2012 and December 2012 who were clinically and radiologically diagnosed with subacromial impingement syndrome were included in this study. A detailed history was obtained

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from all patients and a thorough physical examination was performed in order to develop a differential diagnosis and final diagnosis. Clinical diagnostic tests, including the Neer, Hawkins, painful arc, drop arm, Yergeson, Jobe and supraspinatus tests, were conducted. MRI images of the patients were examined and the findings were recorded. Patients above forty years of age who had symptoms for six months or longer and had findings compatible with nerve compression on physical examination and whose passive range of motion was less than 30% compared to the unaffected side were included in this study. Patients with systemic inflammatory rheumatic diseases, decompensated heart failure, neurologic deficits who had undergone shoulder and neck surgery, who had received physical therapy and steroid injections for their shoulder pain, who had findings consistent with calcific tendinitis and bursitis on conventional XR images, who had complete lacerations on their MRI images this or who had adhesive capsulitis and shoulder instability were excluded from the study.

The 100 patients included in this study were divided into 2 groups each consisting of 50 patients using consecutive sequential randomization. The first group received fifteen ultrasound treatment sessions for the affected shoulder (1.5 W/cm^2, 4 minutes), as well as TENS (30 minutes), infrared therapy (20 minutes) and physical therapy exercises. The second group received the same treatment, except that each of the 15 ultrasound sessions were eight minutes in length instead of 4 minutes.

Continuous ultrasound was applied using circular motions for 15 sessions (with a frequency of 5 times per week). A Chattanooga brand ultrasound machine with a transducer head size of 5 cm^2 was used. The initial exercise program consisted of Codman's pendulum exercises, passive range of motion exercises and stretching exercises. Posterior capsular stretching exercises and wall walking exercises were also performed. The exercises were taught to the patients at the beginning of the physical therapy program. After the patients achieved full or nearly full range of motion, shoulder-strengthening exercises were performed. Patients were instructed to not to use their affected arm for daily activities, in particular overhead activities, in order to properly rehabilitate their shoulders. After the patients' shoulders were properly strengthened, they were allowed to abduct their shoulder greater than 90 degrees and use their arm for daily activities. The exercises were performed under observation in the outpatient clinic, twice a week, and the patients were instructed to carry out the exercise program at home twice a day with 20 repetitions per exercise.

The patients were evaluated before treatment and 15 days after the end of treatment. Pain was evaluated using a VAS (visual analog scale), functional activity was evaluated using the UCLA (University of California at Los Angeles) shoulder rating scale and the Constant shoulder score, and depression was evaluated using the BDI (Beck Depression Inventory).

Pain score: Pain was categorized as occurring while resting, moving or sleeping. Pain was evaluated using a visual analog scale (VAS). A 10 cm line was drawn, divided into ten equal segments, and numbered from 0 to 10 (0=no pain, 5=moderate pain, 10=worst pain). The patients were asked to mark the most appropriate value describing their pain on the scale.

UCLA score: Pain, function, patient satisfaction, strength of forward flexion and active forward flexion were evaluated and the following point system was utilized: 34–35 points were classed as excellent, 29–33 points as good and less than 29 points as poor[9].

Constant shoulder score: Pain, activity level, active ROM and strength parameters were evaluated and the total possible score was 100 points: 90–100 points were classed as excellent, 80–89 points as good, 70–79 points as moderate and <70 points as poor[10].

The Beck Depression Inventory (BDI) was conducted for each patient to screen for depression and evaluate the severity of the depressive symptoms[11]. In addition to definitive statistics, the independent t-test was used to compare inter-group values and the paired t-test was used to compare values within a group. A p-value of ≤ 0.05 was considered statistically significant.

This study was conducted in compliance with the Declaration of Helsinki, approval for the conduct of the experiment was received from the local ethics committee, and all patients included in this study signed an informed consent form. The writers have no conflict of interest to declare.

RESULTS

The average age of the 100 patients included in this study was 54.99±8.10 years (42–68). The average age of the 50 patients in the first group was 55.4±7.63 years (42–68). The average age of the 50 patients in the second group was 54.7±8.67 years (43–68). There was no significant difference between the two groups with regards to age ($p>0.05$). Sixty-one of the patients were female (61%) and 39 of the patients were male (39%). Thirty-two percent (16) of the first group were male and 46% (23) of the second group were male. There was no statistically significant difference between the two groups with regards to the male to female ratio ($p>0.05$).

Eighteen (36%) of the 50 cases in the first group were housewives, 14 were (28%) retirees, 6 (12%) were government employees, and 12 were (24%) employed in the private sector. Twenty (40%) of the 50 cases in the second group were housewives, 15 (30%) were retirees, 5 (10%) were government employees and 10 (20%) were employed in the private sector. There was no significant difference between the groups with regards to profession ($p>0.05$) (Table 1).

There were no statistically significant differences between the groups before treatment in their VAS ($p=0.895$), UCLA ($p=0.900$), total Constant ($p=0.633$) and BDI ($p=0.289$) scores.

On the 15th day after treatment, there were a statistically significant decreases in the VAS scores of both groups ($p<0.001$). The Constant and UCLA scores that evaluate functionality were significantly higher in both groups ($p<0.001$) (Table 2). The BDI scores of both groups were significantly lower ($p<0.001$).

There was a significant improvement in all scales in

Table 1. Demographic features

	GROUP 1 (n=50)	GROUP 2 (n=50)
Sex		
Female	34	27
Male	16	23
Avarage age (year)	55.4±7.63	54.7±8.67
Time since the onset of pain (month)	8.34±4.86	6.66±4.91
Occupation		
Housewives	18	20
Government employees	6	5
Private sector	12	10
Retirees	14	15

(N=100) Values are mean ± SD

Table 2. UCLA, constant and BDI scores before and after treatment

	GROUP-1		GROUP-2	
	Before treatment	After treatment	Before treatment	After treatment
Constant pain	5.00±3.50	6.50±2.31*	4.14±1.84	1.80±1.07*
Constant daily living	11.68±3.79	13.12±3.21*	7.54±1.66	3.38±1.46*
Constant flexion	7.12±1.99	7.32±2.00*	3.54±3.78	8.22±2.37*
Constant abduction	5.24±2.17	6.60±1.62*	5.68±2.37	7.52±1.54*
Constant external rotation	5.32±3.76	6.2±3.39*	5.88±4.23	7.24±2.58*
Constant internal rotation	4.68±2.74	5.72±2.27*	5.92±3.50	7.04±2.53*
Constant strength	7.00±11.33	15.50±12.26*	6.54±10.31	16.38±11.36*
Constant total	44.92±14.66	59.38±15.32*	42.96±24.97	66.80±19.43*
UCLA	18.52±6.08	22.70±6.09*	18.70±8.04	29.50±14.85*
BDI	14.80±9.38	12.5±7.76*	18.24±20.76	11.30±8.84*

Values are mean ± SD, *p<0.05 from pretreatment
UCLA: University of California at Los Angeles; BDI: Beck Depression Inventory

both groups after treatment. When the two groups were compared, there was no statistically significant difference in their Constant daily living (p=0.135), Constant external rotation (p=0.087), Constant strength (p=0.710) and BDI (p=0.443) scores, but the second group had significantly better values than the first group in all the remaining parameters after treatment (Table 3).

Table 3. Comparison of the groups after the treatment

	GROUP 1	GROUP-2
VAS*	5.2±1.26	3.38±1.46
Constant pain*	6.50±2.31	8.22±2.37
Constant daily living	13.12±3.21	14.24±4.16
Contant flexion*	7.32±2.00	8.80±3.37
Constant abduction*	6.60±1.62	7.52±1.54
Constant external rotation	6.2±3.39	7.24±2.58
Constant internal rotation*	5.72±2.27	7.04±2.53
Constant force	15.50±12.26	16.38±11.36
Constant total*	59.38±15.32	66.80±19.43
UCLA*	22.70±6.09	29.50±14.85
BDI	12.5±7.768	11.30±8.84

Values are mean ± SD, *p<0.05 from post treatment between two groups
VAS: Visual Analog Scale; UCLA: University of California at Los Angeles; BDI: Beck Depression Inventory

DISCUSSION

Subacromial impingement syndrome is one of the most common causes of shoulder pain and a general consensus on the method of treatment within the realm of physical therapy has not yet been reached[12]. Rest, cold compress, exercise, NSAIDs and ultrasound are among the most common treatment protocols for SIS[13].

The efficacy of different durations of ultrasound therapy for the treatment of patients diagnosed with SIS was compared in this study. There was a significant decrease in the VAS, Constant and UCLA scores of the group that received ultrasound treatment for 8 minutes compared to the group that received ultrasound for 4 minutes. The effectiveness of ultrasound in the treatment of SIS has been shown in various studies[1, 7, 14–17], but there are also studies indicating that it is not effective[18, 19].

Different durations of ultrasound have been used in vari-

ous studies[1, 7, 14–17] but, to our knowledge, there is no study in the literature that has directly compared treatment different durations.The result of this study indicate that ultrasound therapy is beneficial in the treatment of SIS.

In a study by Robertson et al. conventional ultrasound and placebo ultrasound were compared, and it was shown that conventional ultrasound was more effective than placebo with regards to range of motion and pain[7]. A study by Levendoğlu et al. compared the effectiveness of physical therapy versus steroid injections in patients with SIS[14]. In their study, 8 minutes of ultrasound was administered and a meaningful increase in range of motion and VAS was recorded after treatment.

In the studies on ultrasound therapy for SIS, there are differences in parameters like the duration and intensity of ultrasound therapy. Ebenbichler et al. administered 2.5 W/cm^2 (0.89 mh 1:4 intermittent ultrasound) ultrasound 5 times a day for 3 weeks and then 3 times a week for 3 weeks to patients with calcific tendonitis in the supraspinatus tendon. They reported and the calcium deposits disappeared or disintegrated in 19% of patients[15]. Santamato et al. compared laser therapy and ultrasound therapy in their study. The ultrasound group received 1 mHz 2 W/cm^2 ultrasound for 10 minutes and there was a significant improvement in their VAS scores[1]. Johanson et al. compared the effectiveness of acupuncture and ultrasound therapy in patients with SIS. The ultrasound group received 1 mHz 2 W/cm^2 ultrasound for 10 minutes in 10 sessions, and this amount of therapeutic ultrasound was reported to be effective[16].

The incidences of chronic pain and depression is increased in patients with SIS. Çelik et al. compared the effect of two different exercise programs on pain. TENS for 20 minutes, 1 W/cm^2 intermittent ultrasound for 4 minutes and an exercise program were administered to both groups and the Constant pain score and VAS score were significantly decreased in both groups at the end of the second and the 16th weeks. Similarly, the Beck Depression Inventory was used in their study and a meaningful improvement was observed in both groups at the end of the 16th week[17].

The limitations of our study include a lack of control and placebo groups and that the long-term effects of the treatment were not evaluated.

In conclusion, ultrasound therapy was effective at decreasing pain and improving functionality. We showed that 8 minutes of ultrasound administration was more effective than 4 minutes at relieving pain and improving functionality. However, studies with a larger number of patients and ultrasound treatments of various durations and intensities are needed to determine the appropriate intensity and duration of ultrasound therapy.

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