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Effect of Transcutaneous Electrical Nerve Stimulation and Cupping Therapy in The Treatment of Tennis Elbow: A Randomized Controlled Trial

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ABSTRACT

Background: Tennis elbow (TE) is a common disorder of the upper extremities that occurs due to powerful grip and repetitive motions in the wrist joint during various activities. Although several management strategies have discussed some of the methods used to reduce pain and improve elbow and wrist movements, the use of new approaches remains a vigorous option to reach the maximum degree of improvement and complete recovery.

Aim: The current study aimed to investigate the effect of Transcutaneous electrical nerve stimulation (TENS) and cupping therapy in treating TE.

Methods: One hundred and twenty patients between the ages of 20 and 50 years of both sexes complained of tennis elbow. They were divided randomly into four groups. Group A (n=30) received conventional treatment, group B (n=30) received TENS in addition to conventional treatment, group C (n=30) received cupping therapy with conventional treatment, and group D (n=30) received TENS and cupping therapy plus conventional treatment. Visual analog scale (VAS) was used to assess pain intensity, a hand dynamometer was used to measure pain-free grip strength (PFGS), and a patient-rated tennis elbow evaluation (PRTEE) questionnaire was used to measure pain and disability of the forearm before and after four weeks.

Results: There was a significant decrease in VAS, PRTEE score, and an increase in PFGS favoring group D compared to the other groups post-treatment ($p < 0.001$).

Conclusion: The combination of TENS and cupping therapy results in better improvement in TE treatment than conventional therapy, TENS, and cupping therapy alone.

Keywords: Tennis elbow, Lateral epicondylitis, Conventional therapy, TENS, Cupping therapy.

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INTRODUCTION

Tennis elbow (TE) was first used to describe a painful condition at the elbow joint observed in tennis players. It is also known as lateral epicondylitis, which is caused by muscle fatigue and overuse of the common extensor origin (CEO) muscles [1-2]. The common causes of the TE were repetitive movements of the arm, including the use of plumbing tools and paint, driving heavy cars, and trauma to the epicondyle as direct blows and sudden forceful extension. Its prevalence ranges from 1% to 3% between the ages of 30 and 54. It can affect both arms, but the dominant arm is most common [3-4]. Although it affects equally females and males, it lasts longer and more severely in females than in males. Usually,the onset of TE is gradual due to repeated movements and strain injuries with increasing symptoms over time as the pain is described as severe and profound with a decrease in grip strengthand functional ability of the upper limb [5-6].

In some cases, the severity of symptoms in lateral epicondylitis improves without any interventions within 6 to 24 months. Still, the untreated TE may lead to chronic pain around the elbow and worsen the arm's functional activity [7].

Several methods are used to prevent, treat, and avoid the recurrence of TE, including instructions and rest, corticosteroid injections, braces or straps around muscle belly, physiotherapy, and surgery [8-9].

Physiotherapy includes several modalities such as resistive exercises, peripheral and neural mobilization, phonophoresis, cryotherapy, manual massage, and electrical stimulation. The benefits of these modalities were increasing blood supply to muscles, increasing regeneration of muscle fibers, regeneration, and decreasing pain, but for the short term. However, if rest and multimodal exercises were added, the benefits of these modalities show medium to long-term pain relief, which is considered an affordable treatment option [10-12].

Transcutaneous electrical nerve stimulation (TENS) is an important treatment method used in physiotherapy. The neurophysiological basis of relieving pain by TENS is directly derived from the gate control theory of pain. The brain pays attention to signals that pass in specific pathways without turning to the other, so no two signals pass in the same pathway. Thus, it distracts the brain from focusing on the pain signals, thus reducing the patient's sense of thispain [13-14]. In addition, the philosophy of TENS is based on another theory, which is that the slight tingling caused by stimulation increases the strength of the body's resistance to pain, thus increasing the secretion of endorphins in the body, and this helps reduce the patient's sense of pain [15-19].

Cupping therapy is an ancient alternative medicine, which dates to the ancient Egyptian, Chinese, and Middle Eastern civilizations. According to traditional Chinese medicine, it is believed that cupping therapy helps to remove blockages in the energy paths and eliminate imbalances in the body by stimulating the free flow of vital energy within its pathways [20]. Several trials have been conducted about the benefits of TENS and cupping therapy in different musculoskeletal disorders, but there are insufficient studies to prove their effectiveness in tennis elbow [21-22]. Therefore, this study aimed to investigate the effect of TENS and cupping therapy in TE treatment.

MATERIALS AND METHODS

Subjects

One hundred and twenty patients (67 females and 53 males) with unilateral TE were includedin the study from January 2020 to December 2020 and diagnosed by an orthopedist. Their ages ranged between 20 and 50 years old. They were divided randomly into four groups. Group A (n=30) received conventional therapy, group B (n=30) received TENS in addition to conventional therapy, group C (n=30) received cupping therapy with conventional therapy, and group D (n=30) received TENS and cupping therapy plus conventional therapy. All patients read and signed a consent form before participation in this trial. This study was approved by the Ethical Committee of the Faculty of Physical Therapy, October 6 University, Egypt, and registered in the Clinical Trials Government (NCT04867811). Patients with pain in the lateral epicondyle with aggravation of pain on pressure on the lateral epicondyle and during the resistance to wrist extension, the persistence of symptoms for more than three months, no physical therapy interventions during the last three months were included in the study while patients with bilateral TE, radio-ulnar joint synovitis, radial, and ulnar nerves entrapment, cervical radiculopathy, medial epicondylitis, paralysis,and previous injury or surgery in the region of CEO were excluded from this study.

Randomization method

The randomization method was performed by three nurses, where the first was responsible for writing the numbers from 1 to 120 and writing the treatment program in two small envelopes. The two envelopes were sealed and opaque of the same color and size. The second was responsible for putting the two envelopes in two bottles and selecting an envelope from each bottle by each participant, and the latter was responsible for placing the two chosen envelopes in addition to the patient's name in an

opaque sealed envelope. At the beginning of the treatment, each allocation envelope wasopened.

PROCEDURES

Assessment

1- Visual Analog Scale (VAS)

VAS is a 10 cm (100-mm) long line which ranged from "0 = no pain" to "10 = most pain" [23]. It is a valid, reliable, sensitive, and most robust statistically robust scale [24] with a very high test-retest reliability for acute pain [25]. All patients were asked to rate the pain intensity in the involved elbow on this line.

2- Pain-Free Grip Strength (PFGS)

A baseline hydraulic hand dynamometer (200 lb.90 kg Capacity, product 12-0241, model number W54652, white plains, New York, 10602) was used to evaluate the PFGS. It has validity and reliability for measuring the strength of the upper extremity [26-27]. The patient was in a proneposition with the tested elbow in a comfortable extension position with the forearm pronated [28-29]. All patients were instructed to press the dynamometer with maximum force and stop immediately when feeling pain. The average was calculated after three attempts, with a rest of 20 seconds between each attempt.

3- Patient-Rated Tennis Elbow Evaluation (PRTEE)

It is used to assess TE as it consists of two subscales: pain subscale includes five items ranging from 0=no pain to 10= the worst pain and functional subscale which include specific activities (6 items) and usual activities (4 items). All patients were asked to set their pain and functional disability levels from 0 to 10, then the total score (Sum of pain and function scores) was calculated on a scale of 100 [30-31]. It shows high test-retest reliability and validityin lateral epicondylitis [32].

Treatment Stretching exercise

Gentle passive stretching exercises were applied to wrist flexors and extensors while the patient was seated with the elbow extended to increase the stretching force. The stretch was applied for 30 seconds and repeat ten times in the session.

Strengthening exercises

1. Fingers extension with a rubber band:

The rubber band was placed around the five fingertips,in which the patient was asked to spread fingers 15 repetitions for three sets. For progression in the2nd, 3rd, and 4th week, another band was added, increasing two sets each week.

2. Ball squeeze

A rubber ball was placed in the palm, and the patient was asked to squeeze 15 repetitions for three sets with increasing two sets each week.

3. Wrist extension and flexion with free weight

For wrist extension, 0.5 kg was placed in the hand with the palm pronated and the forearm supported on the knee. The patient was asked to raise the wrist slowly and down slowly. For wrist flexion, 0.5 kg was placed in the hand with the palm supinated and the forearm supported on the knee. The patient was asked to raise the wrist slowly and then down slowly.The exercise was repeated for ten repetitions with adding 0.5 kg in each session.

4. Wrist supination and pronation with grasping a hammer

While seated, the patient was asked to grasp a hammer with the forearm supported on the knee and rotate the hand to palm up and down ten repetitions for three sets with increasing two sets in eachweek.

5. Wrist roller

The patient was seated with the elbows flexed slightly. The forearms pronated where they were asked to hold each end of a short rod and turn with an alternating wrist, causing the cord 3 feet tied in the middle of the rod with a weight of 0.5 kg) to wind around the rod and elevatethe weight, then the weight was lowered with a reverse motion. The exercise was repeated ten times with a rest of 30 seconds and progressed with increasing 0.5 kg in each session.

Friction massage

The friction massage consisted of deep, circular motions over the maximum tenderness areas around the CEO by using the fingertips for 5 minutes with the elbow flexed about 30 degrees.

TENS

Medserve. (Ltd, Prostim / ET3000, S/N:0314, England) was used for stimulation. The patient was seated in a chair with the arm flexed about 30 degrees to relax CEO muscles on the plinth. The electrodes (6x8 cm) used for stimulation were made of carbon rubber with a spongy pad. One electrode was placed on the CEO, and the other was placed over extensor carpi radialis longus and brevis muscles in the middle of the forearm for 30 minutes fig. (1). Two wide straps fixed the two electrodes to produce good electricalconductivity. TENS was adjusted according to these parameters; pulse rate: 100 Hz, pulse width: 40 us, time stimulate: 30 seconds, sweep: 50 Hz, sweep time: 5 seconds, ramp up: 10 seconds, ramp down 10 seconds, time rest: (off) and polarity: positive. The intensity was increased gradually until a tingling sensation was felt and muscle twitching appeared.

Cupping therapy

The patient was seated in a chair with the elbow flexed on the plinth to relax the forearm muscles. The area around the elbow joint was cleaned with alcohol to remove any foreign bodies from the treated area. Five suction cups were used; two medium cups (NO:3, diameter: 5.8 cm and NO:4, diameter: 5 cm) were placed on the LI10 and LI11 points (large intestine points) at the beginning of the study, and three other cups (NO:3, diameter: 5.8 cm) were placed after two weeks on the posterior and lateral aspects of the arm above the elbow joint. A hand suction pump was used for 10 minutes, then the cups were removed, and a lancet pen was used to prick the skin at different sites around the cupped area. Then, the cups were placed again on the pricked area to create a vacuum under the cup. The cups stayed for about 10 minutes, or until the blood stopped clotting, then the cups were removed, and the blood was safely discarded, and the area was then cleaned by alcohol. Sterile cups were used for each patient during the treatment, with safe and final disposal at the end of the session to prevent infection fig. (2,3).

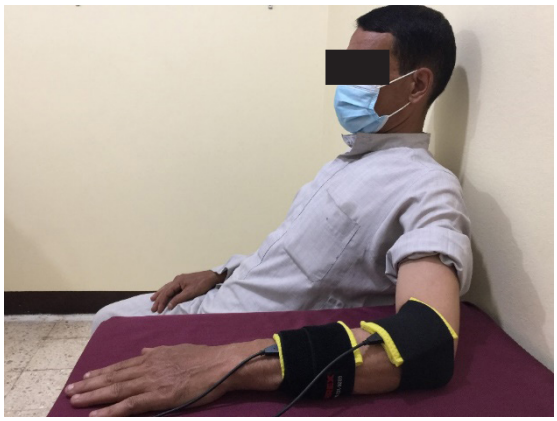

Figure 1. TENS application

Figure 2. Cupping therapy on the LI10 and LI11 points at the start of the treatment

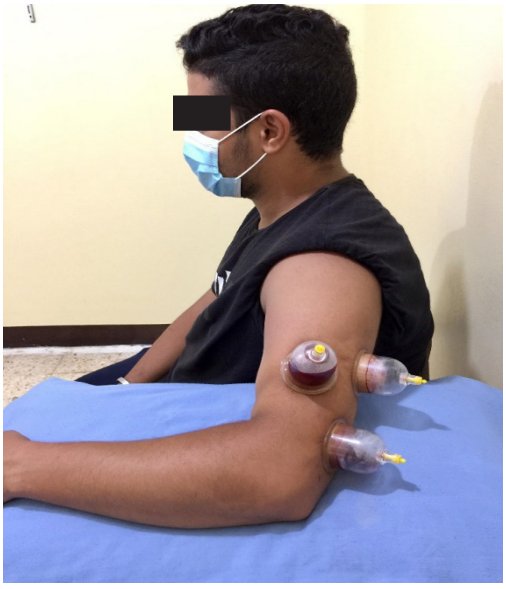

Figure 3. Cupping therapy after 2 weeks.

DATA ANALYSIS

Descriptive analysis and ANOVA tests were used to compare the patient's characteristics between groups using the Shapiro-Wilk test to check the normal distribution of the data. The Levine test was also used to test the homogeneity between groups. As for the comparison within and between the effects of the groups and subsequent multiple comparisons, mixed MANOVA and Bonferroni were used, respectively. The Statistical Package for Social Studies (SPSS) was used for statistical analyses (IBM SPSS, Chicago, IL, USA).

RESULTS

- *Physical characteristics*

Table (1) demonstrates the general characteristics of the four groups. There was no significant difference between groups in age, weight, height, BMI, and affected side distribution ($p > 0.05$).

Table 1. Physical characteristics.

Mean ± SD		Group A	Group B	Group C	Group D	
		Mean ± SD	Mean ± SD	Mean ± SD	p-value	
Age (years)		38.23 ± 6.07	38.73 ± 6.57	38.6 ± 7.34	38.43 ± 6.47	0.41
Weight (kg)		83.53 ± 1.65	83.26 ± 1.48	83.76 ± 1.65	83.13 ± 1.71	0.22
Height (cm)		167.83 ± 1.53	168.06 ± 1.41	168.33 ±1.47	168.5 ± 1.28	0.15
BMI (kg/m²)		29.66 ± 0.87	29.48 ± 0.75	29.57 ± 0.88	29.28 ± 0.6	0.81
Affected side	Dominant	18	20	17	20	0.81
	Non-dominant	12	10	13	10	

SD, standard deviation; p-value, level of significance ($p< 0.05$)

Effect of treatment on VAS, PFGS, PRTEE score (pain and Functional disability):

There was a significant interaction of treatment and time ($F = 46.41$, $p = 0.001$). There was a significant main effect of time ($F = 3919.58$, $p = 0.001$). There was a significant main effect oftreatment ($F = 26.39$, $p = 0.001$).

- *Within-group comparison*

There was a significant reduction in VAS, PRTEE score (pain and functional disability)post-treatment compared with that pretreatment in groups A, B, C, and D ($p < 0.001$). The percentage of decrease in VAS, pain, and functional disability for group A was 35.06, 19.69%,and 35.61, respectively, and the percentage for group B was 67.25, 46.06, and 66.1 respectively, while in group C it was 50.75, 32.7, and 53.07, respectively. Group D showed the highest improvement in VAS, pain, and functional disability with 80.38, 60.78%, and 79.78, respectively.

There was a significant increase in PFGS post-treatment compared with that pretreatment in groups A, B, C, and D ($p < 0.001$). The percent increase in PFGS of groups A, B, C, and D was 45.27, 80.13, 60.47, 93.43, respectively (table 2, figures 4-7).

- *Between groups comparison*

There was a significant reduction in VAS, PRTEE score (pain and functional disability) of group D compared to groups A, B, and C post-treatment ($p < 0.001$) and a significant decrease in VAS, pain, and functional disability of group B compared to groups A and C ($p <0.001$). In addition, there was a significant reduction in group C's VAS, pain, and functional disability compared to group A and post-treatment ($p < 0.001$).

There was a significant increase in pain-free grip strength

of group D compared with groups A, B, and C post-treatment ($p < 0.001$) and a significant increase in PFGS of group B compared to groups A and C post-treatment ($p < 0.001$). In addition, there was a significant increase in PFGS of group C compared to group A and post-treatment ($p < 0.001$). (table 2, figures 4-7).

Table 2. Mean VAS, PFGS, PRTEE score (pain and functional disability), pre and post-therapisttreatment of groups A, B, C, and D.

	Pretreatment mean ± SD	Post- treat-ment mean ± SD	MD (95% CI)	% of change	P-value
VAS					
Group A	6.56 ± 0.77	4.26 ± 0.94	2.3 (2.06: 2.53)	35.06	0.001
Group B	6.9 ± 0.88	2.26 ± 0.58	4.64 (4.38: 4.88)	67.25	0.001
Group C	6.7 ± 0.79	3.3 ± 0.75	3.4 (3.16: 3.63)	50.75	0.001
Group D	6.93 ± 0.74	1.36 ± 0.49	5.57 (5.33: 5.79)	80.38	0.001
	P = 0.24	***P = 0.001***			
PFGS (Kg)					
Group A	14.8 ± 2	21.5 ± 2.67	-6.7 (-7.29: -6.1)	45.27	0.001
Group B	15.1 ± 1.64	27.2 ± 1.8	-12.1 (-12.69: -11.5)	80.13	0.001
Group C	15.33 ± 1.62	24.6 ± 1.24	-9.27 (-9.86: -8.66)	60.47	0.001
Group D	15.06 ± 1.92	29.13 ± 1.79	-14.07 (-14.66: -13.46)	93.43	0.001
	P = 0.72	***P = 0.001***			
Pain					
Group A	31.33 ± 1.32	25.16 ± 1.34	6.17 (5.56: 6.76)	19.69	0.001
Group B	31.63 ± 1.54	17.06 ± 0.98	14.57 (13.96: 15.16)	46.06	0.001
Group C	30.76 ± 1.77	20.7 ± 1.55	10.06 (9.46: 10.67)	32.70	0.001
Group D	31.26 ± 1.17	12.26 ± 1.59	19 (18.39: 19.6)	60.78	0.001
	P = 0.15	***P = 0.001***			
Func-tional disability					
Group A	15.53 ± 1.52	10 ± 1.61	5.53 (5: 6.07)	35.61	0.001
Group B	15.93 ± 1.61	5.4 ± 1.03	10.53 10: 11.07)	66.10	0.001
Group C	15.13 ± 1.54	7.1 ± 1.06	8.03 (7.49: 8.57)	53.07	0.001
Group D	15.33 ± 1.39	3.1 ± 0.75	12.23 (11.69: 12.77)	79.78	0.001
	P = 0.21	***P = 0.001***			

SD, Standard deviation; MD, Mean difference; CI, Confidence interval; p-value, Level of significance ($p < 0.05$)

Table 3. Comparison of VAS, PFGS, PRTEE score (pain and functional disability) post-treatment between groups A, B, C, and D.

	VAS		*PFGS*		Pain		Functional disability	
	MD (95% CI)	P value	MD (95% CI)	P value	MD (95% CI)	P value	MD (95% CI)	P value
Group A vs group B	2 (1.5:2.49)	0.001	-5.7 (-7.05: -4.34)	0.001	8.1 (7.13: 9.06)	0.001	4.6 (3.79: 5.4)	0.001
Group A vs group C	0.96 (0.47: 1.46)	0.001	-3.1 (-4.45: -1.74)	0.001	4.46 (3.5: 5.43)	0.001	2.9 (2.09: 3.7)	0.001
Group A vs group D	2.9 (2.4: 3.39)	0.001	-7.63 (-8.98: -6.28)	0.001	12.9 (11.93: 13.86)	0.001	6.9 (6.09: 7.7)	0.001
Group B vs group C	-1.04 (-1.52: -0.53)	0.001	2.6 (1.24: 3.95)	0.001	-3.64 (-4.59: -2.67)	0.001	-1.7 (-2.5: -0.89)	0.001
Group B vs group D	0.9 (0.4: 1.39)	0.001	-1.93 (-3.28: -0.58)	0.001	4.8 (3.83: 5.76)	0.001	2.3 (1.49: 3.1)	0.001
Group C vs group D	1.94 (1.43: 2.42)	0.001	-4.53 (-5.88: -3.18)	0.001	8.44 (7.47: 9.39)	0.001	4 (3.19: 4.8)	0.001

Mean difference; CI, Confidence interval; p-value, level of significance ($p < 0.05$)

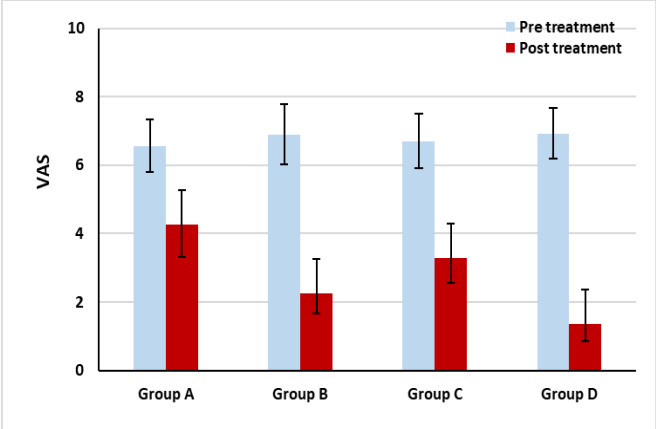

Figure 4. Mean VAS pre and post-treatment of groups A, B, C, and D

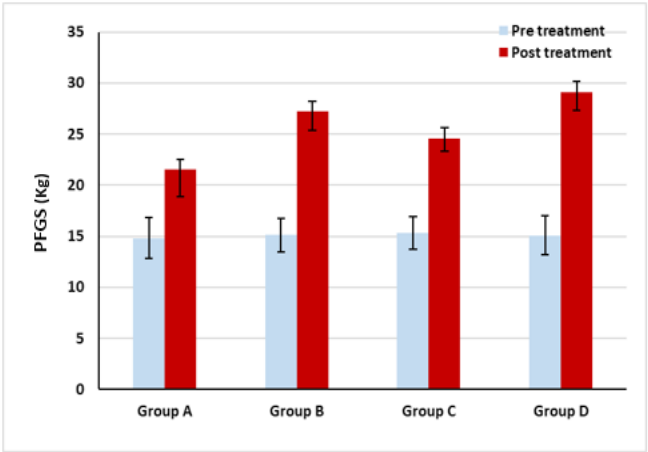

Figure 5. Mean PFGS pre and post-treatment of groups A, B, C, and D

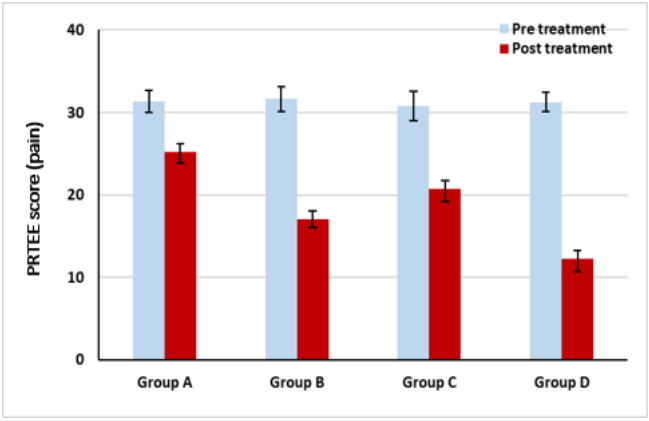

Figure 6. Mean PRTEE score (pain) pre and post-treatment of groups A, B, C, and D

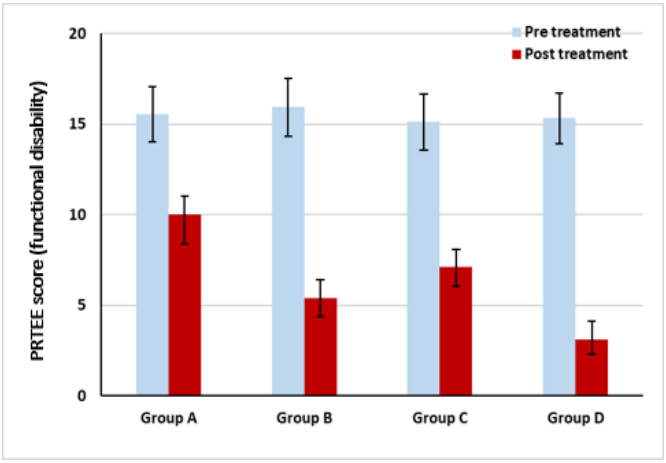

Figure 7. Mean PRTEE score (functional disability) pre and post-treatment of groups A, B, C, and D

DISCUSSION

TE is a musculoskeletal disorder affecting the soft tissues around the CEO that is characterized by microtears, degeneration of collagen, and angioblastic proliferation of the soft tissue in this area which, in turn, affect [33] the muscle fiber type composition and lead to muscle-tendon stiffness and blood stagnation, which makes the pain persistent with weak grip strength during gripping activities [34-37]. Therefore, this study aimed to investigate the effect of TENS and cupping therapy inTE treatment.

This study showed a significant reduction in VAS, PRTEE score (painand functional disability), and improvement in PFGS among the four groups in favor of group D, who received both TENS and cupping therapy in addition to conventional therapy for four weeks.

The mean ages of the patients in the current study ranged between 38.2 and 38.7 years. This was discussed in Roto and Kivi, 1984 [38] study, which demonstrated the effect of ages on the physiological properties of tissues and concluded that over 30 years of age, several clinical changes occur like the decline in the amount of water content, glycoproteins, proteoglycans, collagen turnover, and elastic components. All these changes affect tissue function due to a decrease in blood flow and tenoblastic activity. Also, Kannus and Józsa, 1991 [39] stated that with increasing age, the energy in the metabolic pathways changes from aerobic to anaerobic, tissues are more vulnerable to stress. This may explain why all 50-year-old patients in the four groups (7 patients in group A and C, eight patients in group B, and nine patientsin group D) record a pain score of 7-8 on VAS and 18 points on the PRTEE scale (functional disability).

Regarding the effect of conventional therapy on the treatment of TE, Pienimaki et al. 1996 [40] found that stretching exercises has a positive effect on pain but not maximal grip strength in patientswith TE after eight weeks, and it was concluded that progressive exercise therapy was more effective than ultrasound in the treatment of TE. In another study, the exercise group represented less pain and functional impairment after three years of follow-up [41]. Bisset et al. 2006 [42] reported that the physical exercise group significantly improved pain and functional disability than the corticosteroids injection group after 12 months of follow-up. Although the initial results in the injection group were more favorable, the recurrence rate was higher in thisgroup than in the exercise group.

Martinez-Silvestrini et al. 2005 [43] stated no statistical difference in pain intensity, functional disability, and ROM between stretching group, eccentric exercise plus stretching group, and concentric exercise plus stretching group after a short period. In another study, Svenlov and Adolfsons, 2001 [44] found that eccentric exercise has a significant improvement in pain scores and grip strength with complete symptom resolution in 86% of this group compared to the stretching group after three months of rehabilitation. Another study that compared strengthening exercises with a standard rehabilitation program showed that pain and grip deficit decreased at the end of the program [45]. Although massage is an essential element in the rehabilitation plan, few studies have demonstrated the effect of deep friction massage, which Cyriax, 1996 [46] initially advocated. Verhar et al. 1996 [47] found no statistical difference between friction massage and corticosteroids injection in the treatment of TE after 12 months follow-up. Struijs et al. 2005 [48] stated that strengthening exercises with friction massage was more effective in reducing pain and disability than using brace only in patients TE in the short term and that the combination between strengthening exercises with friction and brace was more effective than brace only after six weeks of follow-up.

Chesterton et al. 2014 [49] stated that TENS might prove to be an appropriate method for treating TE. It may help reduce pain in the condition's early stages without noticeable side effects or long-term recurrence. In their study, TENS was applied for 45 minutes daily with an adhesive electrode at a frequency of 110 Hz at a pulse duration of 200 μs, and the intensity wasstrong but with a tolerable sensation. Ching-Sung et al. 2005 [50] assumed that stimulation of TENS at 100 Hz and 200 μs in chronic lateral epicondylitis decrease VAS score and functional disability. The improvement of pain and function disability may be attributed to pain gate stimulation that involves activation of the A beta (Aβ) sensory fibers at a frequency of 100 to 130 Hz and which reduces the transmission of

the noxious stimulus from the unmyelinated 'c' fibers to the higher centers of the brain by secretion of GABA (gamaaminobeutiric acid) substance in the spinal cord at the posterior horn cell [51]. Also, TENS can stimulate wound healing and accelerate tendon repair, which may be due to the release of the calcitonin gene. In addition, this potent vasodilator would increase blood circulation in the lesion area, thus accelerating tissue repair [52].

Halle et al. 1986 [53] concluded that all the protocols used in their study (ultrasound with a home program, ultrasound and hydrocortisone with a home program, TENS plus a home program, and injection with the home program and steroid) showed a decrease in pain score and disability; however, there was no significant difference between the treatments in their effectiveness post-treatment. Therefore, they recommended that all treatment modalities be available to treat TE but based on clinical considerations.

In this study, wet cupping was used twice during the study period. Two middle cups were placed at the beginning of the study on points LI10 and LI11. The cups were suctioned for 10 minutes before pricking the skin. This matches with Stephens et al. 2020 [54] study, which concluded that the 10-minute cupping therapy effectively reduces pain and increases total hemoglobin level immediately in cases of nonspecific neck pain in one session. Also, Cramer et al. 2011[55] stated that applying cupping therapy for 10 minutes reduced pain and improved function after 14 days in patients with neck pain. Lauche et al. 2011 [56] found that the degree of pain and functional deficit improved after suctioning the area for 10 minutes every four days. Chen, 2009 [57] mentioned that wet cupping therapy improved shoulder joint mobility and reduced pain intensity in patients with scapulohumeral periarthritis after 60 days. Also, Michalsen et al. 2009 [58]reported that pain and functional impairment improved in carpal tunnel syndrome patients after treatment with wet cupping therapy for one session. Ouyang et al. 2001 [59] stated that the degree of pain changed after wet cupping therapy after a 10-minute treatment around the shoulder joint in patients with shoulder pain after 4 weeks of application. Rachana and Krupa, 2020 [60] concluded that there was a significant reduction in pain level following the application of dynamic cupping in cases of mechanical neck pain. Pei-chang et al. 2014 [61] reported that 10 minutes after the removal of the cups, the skin temperature was elevated in the suctioned area compared to the control area. Kadhim, 2012 [62] showed that there was a feeling of warmth immediately after cupping therapy on the surface of the skin. Similarly, Wei et al. 2013 [63] showed that blood circulation increased immediately to the surface of the skin following the removal of the cups in healthy participants at acupuncture points. The improvement in pain and function following the cupping therapy may be due to vasodilatation and stimulation of blood circulation that increases metabolism and accelerates the removal of waste and toxins from the body, improving physical function [64] and affects blood pressure [62].

Also, due to the negative pressure that is applied by the cups to the surface of the skin, this results in bruising around the suction area, which attracts macrophages that act on the phagocytosis of the red blood cells and activate them to produce heme oxygenase-1 for the heme metabolism it contains. Heme Oxygenase-1 breaks down heme into carbon monoxide, biliverdin/bilirubin, and iron, which in turn aids in antioxidant, inflammatory, and antiproliferative activities [65-66].

Two weeks after the start of the study, three cups were used. Two on the posterior aspect of the arm just above the elbow joint and the other on the lateral aspect of the arm. The explanation for this was that white blood cells become active after treatment with wet cupping, and this stimulates phagocytosis that engulfs any foreign bodies and removes toxins, which in turn, helps relieve pain and regenerate tissues, as in Romy et al. 2013 study [67] who found that the pain-reducing effect remained evident for one week after cupping therapy in patients with chronic neck pain. Also, Tae-Hun et al. 2012 [68] found that six sessions of wet cupping therapy can reduce pain and increase range of motion compared to a heating pad in patients with neck pain. This has been shown in previous studies that suggested the use of wet or dry cupping more than one session to help maintain white blood cell stimulation and detoxification [69-71].

Limitation of the study

There are some limitations in this study; first, the small sample size. Second, the short-term effect of the study on tennis patients and the inability to compel some cases to rest during the study period may have an impact on the completion of the tissue healing. Third, the study was conducted in the winter and summer, as it is likely to influence sensory nerve (Ferretti, 1992) stimulation by TENS, which may affect the study results.

Recommendations

Future studies should investigate the long-term effect of TENS and cupping therapy on a large sample size in patients with TE to generalize their effects. Also, the sham TENS group should be compared to the active TENS to clarify the physiological effects between the two groups. In addition, the experiment should be conducted either in summer or winter or in a comparison study between them to examine whether there are differences in sensory nerve stimulation.

CONCLUSION

The combination of TENS and cupping therapy is more beneficial in reducing pain and functional impairment with increasing handgrip strength in patients with TE than conventional therapy, TENS stimulation, and cupping therapy separately.

Conflict of interest

No conflict of interest.

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