Microcurrent Electrical Nerve Stimulation in Tennis Elbow

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ABSTRACTS

Tennis elbow is an overload injury of the extensor tendons of the forearm. This study was designed to determine the effect of the microcurrent electrical nerve stimulation (MENS) on reducing pain and disability and increasing hand grip strength in patients with tennis elbow. Sixty patients completed the program and were randomly assigned into two groups. Group 1 (experimental, n=30) received MENS and therapeutic exercises. Group 2 (control, n=30) received sham MENS and therapeutic exercises. Both groups received two visits a week for six weeks. The following parameters were evaluated: pain with the numerical rating scale, disability using the disabilities of the arm, shoulder & hand and hand grip strength using a hand dynamometer before and after intervention. There was a decline in pain, disability and a rise in hand grip strength in both groups compared with baseline (P<0.005 on the paired t-test). The first group showed statistically significant differences in the reduction of pain and disability and increase of hand grip strength compared with the second group (P<0.05 on the independent t-test). MENS may play a role in treating tennis elbow by reducing pain, disability and increasing hand grip strength.

Key words: *Tennis elbow, microcurrent, eccentric training, exercise.*

INTRODUCTION

Tennis elbow refers to persistent pain at the common wrist-extensor origin[1]. It is one of the most frequent causes of elbow pain in adults. The dominant arm is commonly affected and the disorder appears to be of longer duration and severity in females[2]. Tennis elbow symptoms may persist for over 1 year in up to 20% of people[2].

Tennis elbow usually affects the extensor carpi radialis brevis with less frequent involvement of the extensor carpi radilais longus and the anterior portion of the extensor digitorum communis[3]. Pain and decreased function are the main complaints of patients with tennis elbow. Although the signs and symptoms of tennis elbow are clear and its diagnosis is simple, there is no consensus on the optimum treatment, but numerous treatment options have been proposed to treat tennis elbow.

Treatment options include acupuncture, non-steroidal anti-inflammatory drugs, corticosteroid injections, splinting, exercises, shock wave therapy, laser, ultrasound, transcutaneous electrical nerve stimulation (TENS), pulsed electromagnetic field treatment, manipulation, and manual therapy[4,5]. There is insufficient evidence that any of these interventions are effective, either in the long or short term. More research is needed to discover the most effective treatment in patients with tennis elbow.

Microcurrent electrical nerve stimulation (MENS) represents a unique approach to manage tennis elbow. MENS is an inexpensive, safe, non-pharmacological form of analgesia[6,7]. It is a subsesnory modality that provides current intensities between 1 and 999 μA analgesia[6,7]. It functions on the Arndt Schulz Law[6,7]. This law states that that healthy tissue is the result of direct flow of electrical current throughout the body. The normal flow of the electric current may get interrupted when a particular site of the body is injured. Microcurrent therapy over the injured site may readjust this flow by providing current flow to tissues at physiologic amperage reducing electrical resistance and letting bioelectricity to flow through and reestablish homesotstais[6].

Previous in-vitro studies have demonstrated that applying microcurrent promotes amio acid transport and protein production in fibroblasts and tenocytes. In-vivo studies, using animal models, have demonstrated that tendon and ligament tissue responds well to this application[8].

Although microcurrent equipment has been approved by the Food and Drug Administration in the United States in the category of TENS, they are not similar and cannot be compared to TENS in their effects[9]. Most TENS units deliver currents around the 60 mA range[9]. A typical microcurrent pulse is about 0.5 seconds, which is 2500 times longer than the pulse in a typical TENS unit and with microcurrent the patient cannot feel the current[6].

MENS has been used to promote wound healing, reduce muscle pain, joint pain, delayed onset muscle soreness, and neuropathic pain[10,11,12,13,14]. Some researchers showed that it may also relieve myocontracture and can enhance conventional rehabilitation programs for children with cerebral palsy and congenital muscular torticollis[15,16].

There have been no studies investigating the effects of MENS in the management of tennis elbow. Therefore, the purpose of this study was to investigate the clinical results of MENS in reducing pain, disability and increasing hand grip strength in patients with tennis elbow.

MATERIALS AND METHODS

Design

The study was a randomized controlled study with patients randomly assigned to one of two intervention groups: (A) group 1 received MENS and therapeutic exercises and (B) group 2 received sham MENS and therapeutic exercises. The duration of the interventions was six weeks.

Patients

Eighty two patients aged 22-55 years (average age 38.7±5.1; 52 women, 30 men) who attended to the outpatient clinic were recruited into this study (from January 2010 to May 2010). Patients had a medical diagnosis of tennis elbow by a physician. Patients had suffered pain for less than a year.

Patients were eligible to participate in the study if they had pain on the facet of the lateral epicondyle when palpated and if they experienced less pain during resistance of supination with the elbow in 90° of flexion rather than in full extension[17]. Patients also had to complain of pain in at least two of the following tests (Tomsen test, Resisted middle fnger test, Mill's test and Handgrip dynamometer test) [18].

Exclusion criteria for the study were bilateral tennis elbow, pregnancy, an implanted pacemaker, systemic metabolic diseases, elbow surgery, radial nerve entrapment, chronic inflammatory and neoplastic disease, dysfunction in the shoulder, neck and/or thoracic region, and treatment with corticosteroid or local anesthetic injection in the previous three months.

Instrumentation

A- Measuring tools

Numercal pain rating scale was used to measure pain lasting at least 24 hours19. The disabilities of the arm, shoulder and hand (DASH) questionnaire was used to measure disability. It is a valid and reliable self report questionnaire (30 items) where 1 point was given for no complaint or performance of the specific activity without difficulty and 5 points for disability or performance with complaints. The total score ranged between 30 (best) and 150 (worst) 20. Hand held dynamometer (Jamar, J.A. Preston Co., MI) was also used as a valid and reliable tool to measure hand grip strength 21. The assessor used the mean of three measurements.

B- Treatment instrument

Amrex® Spectrum Micro 1000 Microcurrent (Amrex® Electrotherapy Inc, Carson, CA) was used to provide MENS. The machine was adjusted to provide 50 microampere and 30 Hz for pain management as stated by Manley 1994[22].

Procedure

Prior to collecting data, patients were informed of the risks of the study and signed an informed consent to participate in the study. Patients who met the inclusion criteria were randomly assigned to one of two groups. Blank folders were numbered from 1 to 100 and given hidden codes for the group assignment, determined by a random-number generator. When a participant was eligible and gave consent to participate, the investigator drew the next folder from the file, which determined the assigned group. Then, each patient was tested using the numerical rating scale, the DASH, and the hand dynamometer. A physical therapist, blinded to group allocation, conducted the testing procedures. The investigator assessed patients in both groups at both the initial and final sessions.

After initial testing, patients began the treatment on the same day. Another physical therapist performed all interventions with patients in both groups. All patients received two sessions per week for six weeks.

Group 1 received MENS for 30 minutes. Two therapy pads were placed over the common extensor tendon and just proximal to the olecranon. The skin areas where electrodes were to be placed were shaved if hairy and cleaned with an alcohol wipe to aid adherence of the electrodes. The lateral elbow was palpated to identify the epicondyle, and a short line was drawn from it, extending distally to indicate the position of the common extensor tendon. This was used during the practice session as a guide for placement of one electrode so as to cover the area over the tendon. The therapist placed the other electrode proximal to the olecranon. The electrodes were standard 5x5cm reusable adherent flexible conducting pads.

Patients in Group 1 received verbal and written instructions, rationale, and a demonstration from the treating therapist on performing the exercises. Patients received progressive eccentric exercise of the wrist extensors and static stretching exercises of the extensor carpi radialis brevis. Eccentric exercises of the wrist extensors were performed with the elbow extended on the bed, the forearm in pronation, the wrist in an extended position, and the hand hanging over the edge of the bed. From this position, patients flexed their wrist slowly while counting to 30, then returned to the starting position with the help of the other hand. Patients were told to never exercise to the point of pain. When patients were able to perform the eccentric exercises without pain, the load was increased using free weights. Static stretching exercises of the extensor carpi radialis brevis were also performed. The therapist placed the elbow of the patient in full extension, the forearm in full pronation, and the wrist in flexion and ulnar deviation according to the patient's tolerance. This position was held for 30–45 seconds each time and then released.

Patients in Group 2 received verbal and written instructions, rationale, and a demonstration from the treating physical therapist on performing the exercises. Group 2 received the same intervention as above except that the power output of the sham MENS device was set to zero during the treatment. All patients in both groups were instructed to use their arm during the treatment, but to avoid activities that irritated the elbow such as shaking hands, grasping, lifting, knitting, handwriting, driving a car, and using a screwdriver. They were also advised to practice home exercises in the days in which they do not come to the clinic. Patient compliance was monitored using a treatment diary.

Data Analysis

SPSS statistical software was used for the statistical analysis (SPSS Inc., Chicago, IL, USA). Descriptive statistics of the baseline characteristics were compared between study groups. Tests for the assumptions of normality and homogeneity of variance were done. Differences between the groups were determined using the independent t- test. The difference within groups between baseline and end of treatment was tested with a paired t-test. A 5% level of probability was adopted as the level for statistical significance.

RESULTS

Eighty-two patients eligible for inclusion visited the clinic within the study period. Ten patients were unwilling to participate in the study, and 12 patients did not meet the inclusion criteria described above. The other 60 patients were randomly assigned to one of the two groups: (1) MENS and therapeutic exercises [n=30; 11 men, 19 women; mean (standard deviation) age 40.12 (5.45) y]; (2) sham MENS and therapeutic exercises [n=30; 9 men, 21 women; mean (standard deviation) age 43.62 (7.68) y]. Patient flow through the study is shown in the CONSORT flow chart shown in fig. 1.

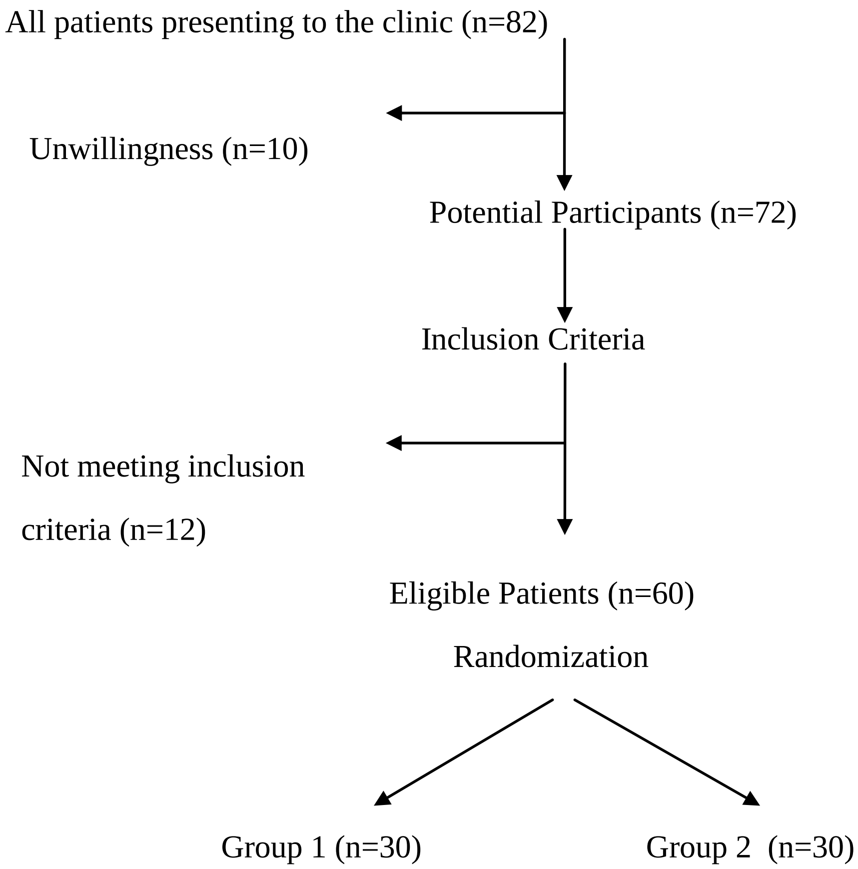

Fig. (1): Flow chart detailing the study.

The mean age of the patients was about 41 years, and the mean duration of tennis elbow pain was five months. Tennis elbow was in the dominant arm in 90% of patients. There were no significant differences in mean age (P= 0.004, independent t test) or the mean duration of symptoms (P= 0.001, independent t test) between the groups.

The Shapiro Wilk test was employed to assess for normality (normal distribution), and the Levene's test was used to assess the homogeneity of variances between comparison groups. These tests were necessary to establish whether parametric statistics could be employed. The scores of the dependent variables were found to be normally distributed for all data collected. Homogeneity of variances was found to be satisfied.

Baseline mean (standard deviation) of pain scores on the numerical rating scale was 7.63 (1.4) for the entire sample (n=60). There were no significant differences between the groups for baseline pain (P=0.098 on independent t-test, Table 1). At week 6, there was a decline in the numerical rating scale scores compared with the baseline (P=0.0005 on paired t-test). There were significant differences in the magnitude of reduction between the groups at week 6 (P=0.0005 on independent t-test, Table 2).

Baseline mean (standard deviation) of disability scores measured by the DASH was 60.16 (15.12) for the entire sample (n=60). There were no significant differences between the groups for baseline disability (P=0.271 on independent t-test, Table 1). At week 6, there was a decrease in disability in both groups compared with baseline (P=0.005 on paired t-test). There were significant differences in the magnitude of improvement between the groups at week 6 (P=0.005 on independent t-test, table 2).

Baseline mean (standard deviation) of hand grip strength values measured by the hand dynamometer was 22.3 lb (7.79) for the entire sample (n=60). There were no significant differences between the groups for baseline hand grip strength (P=0.844 on independent t-test, Table 1). At week 6, there was a rise in hand grip strength in both groups compared with baseline (P=0.0005 on paired t-test). There were significant differences in the magnitude of improvement between the groups at week 6 (P=0.006 on independent t-test, Table 2). It can be noted that group 1 had lower mean pain and disability scores and higher mean of hand grip strength scores.

Table (1): Pain intensity, disability and grip strength at baseline for both groups.

Dependent Variables	Group	Mean±Standard deviation	t	P
Pain	1	7.93±1.31	1.68	0.098
	2	6.73±1.42		
Disability	1	62.33	1.112	0.271
	2	58		
Grip Strength	1	22.5±8.37	0.197	0.844
	2	21.1±7.3		

Table (2): Pain intensity, disability and grip strength at 6 weeks for both groups.

Dependent Variables	Group	Mean±Standard deviation	t	P
Pain	1	2.76±1.16	-6.64	0.0005
	2	5.16±1.59		
Disability	1	41.66±13.17	-2.93	0.005
	2	51±13.67		
Grip Strength	1	30.16±9.16	2.85	0.006
	2	24.16±6.98		

DISCUSSION

The results of this current study are novel, as to date there have been no data investigating the effectiveness of MENS for the decrease of pain and disability and increase of hand grip strength in patient with tennis elbow. This study showed that patients in group 1 (experimental) had more significant decrease in pain and disability scores and increase in hand grip strength than patients in group 2.

Exercise reduces the pain and improves function, reversing the pathology of tennis elbow as supported by experimental studies on animals[23,24]. Exercise therapy would be a suitable co-intervention since there is evidence that controlled mechanical stress can enhance the remodeling process[25].

There are two types of exercise programs: home exercise programs and exercise programs carried out in a clinical setting. A home exercise program is commonly advocated for patients with tendinopathies as it is easy and does not require a visit to the clinic. However, research shows that patients fail to comply with the home exercise programs[26]. Therefore, patients received the exercises in a clinical outpatient clinic under the supervision of a physical therapist in this study. Patients received eccentric exercises and the load was increased according to the patients' symptoms to get optimum results. Eccentric exercises were performed at low speeds to facilitate tissue healing[27].

Although a supervised exercise program is an effective treatment approach, a supplement to the exercise program should be found to reduce the treatment period[27]. One such modality is MENS which is an alternative method of pain control, which has received little attention. There has been no research about its use in tennis elbow. However, it has been used in some orthopedic conditions.

MENS was used to treat Achilles tendinopathy in a study that employed 48 subjects with tendinopathy of at least three months duration. Subjects were randomly assigned to receive either MENS or conservative treatment. Treatment lasted for 30 minutes daily over 14 days, followed by eccentric exercises. Numerical measures of patient-rated pain and stiffness and clinician-rated clinical status were recorded at baseline and at 3, 6 and 12 months after treatment. Diagnostic ultrasound was also used to assess the subjects. Improvements were most marked in the first three months after treatment. The study was limited by non-standardization of the conventional treatment and invalidated scoring system used with the outcome measures[28].

Microcurrent therapy has been also used with patients with postoperative total knee replacement[29,30]. Some authors found that adding microcurrent skin patches plus tramadol for pain relief is better than tramadol alone for 24 patients with postoperative total knee replacement[29]. Patients of the microcurrent group showed a consistently lower pain scores, measured by the visual analogue scale, which led to lower need for tramadol as compared to the control group[29]. Other authors showed that combining microcurrent with physical therapy treatment is more effective than physical therapy with sham device in 78 patients after total knee replacement[30]. The authors showed a median increase of 31% in the Oswestry total score from 53% before start of treatment to 91% three months afterwards; the control sample showed an increase of 18% in median from 56 % to 78%; The difference between groups was statistically significant in the three-months increase ($P<0.001$)[30].

This study included a sham device and therefore, the improvements in the dependent variables cannot be attributed to the placebo effect. A sham intervention has increased the validity of the study. The present study findings suggest that a combination of MENS and exercise is an adequate treatment for patients with tennis elbow. However, this study does have some shortcomings. First, the sample size was small and therefore the study was susceptible to lack of internal validity. Second, there was lack of blinding of the treating therapist. However, blinding of the treating therapist would not be possible. Third, structural changes in the tendon related to treatment interventions were not studied. Finally, there was a lack of long term follow up to determine whether the improvement in the dependent variables that was observed in this 6 weeks follow-up is sustained long-term. It is recommended that future studies should include a sham unit that is disabled by the manufacturer so that no electrical stimulation passes through it to avoid errors. Research is also needed to determine the optimum parameters of MENS for pain relief. It can be concluded that MENS may reduce pain and disability and increase hand grip strength in patients with Tennis elbow.

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الملخص العربي

التنبيه الكهربائي البسيط في حالات التهاب أوتار مفصل الكوع

أجريت هذه التجربة لبيان أثر استخدام التنبيه الكهربائي البسيط لتخفيف الألم والاعاقة ورفع قوة قبضة اليد لمرضى التهاب أوتار مفصل الكوع . اشترك في هذه التجربة 60 مريضاً ، تم تقسيمهم إلى مجموعتين متساويتين بطريقة عشوائية ، تلقت المجموعة الأولى التنبيه الكهربائي البسيط ، وتلقت المجموعة الثانية تمرينات علاجية . تم عمل القياسات اللازمة قبل التجربة وبعدها من قياس الألم ومدى الاعاقة وقوة قبضة اليد . وقد أسفرت النتائج عن قدرة التنبيه الكهربائي البسيط على تخفيف الألم والاعاقة ورفع قوة قبضة اليد لمرضى التهاب أوتار مفصل الكوع .

الكلمات الدالة : التنبيه الكهربائي البسيط – ألتهاب أوتار مفصل الكوع – قوة قبضة اليد .