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Open Access Original Article

Crescent Journal of Medical and Biological Sciences
Vol. 7, No. 3, July 2020, 362–367
eISSN 2148-9696

Effects of Forearm Myofascial Trigger Point Dry Needling on Pain and Function of Patients With Carpal Tunnel Syndrome

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Abstract

Objectives: To evaluate the effects of dry needling (DN) on pain and function in patients with concurrent carpal tunnel syndrome (CTS) and forearm muscles myofascial trigger point (MTrP).

Materials and Methods: This randomized controlled trial evaluated fifty affected hands with the clinical and electrodiagnostic diagnosis of mild and moderate CTS with the presence of MTrP in their forearm muscles. Patients were randomized to intervention and control groups. In the intervention group, one session forearm MTrP DN was performed in addition to wrist splint. Then, pain and function were assessed using the visual analogue scale (VAS) and Boston Carpal Tunnel Questionnaire (BCTQ) at the baseline, one week, and six weeks after the intervention in both groups. The outcomes in this study were pain reduction (VAS) and improvement in hand function (BCTQ).

Results: The co-occurrence of mild and moderate CTS with forearm muscle MTrP was observed in 61% of cases. In addition, improvement in pain severity, VAS, a mean difference of 1.44 (with a 95% CI of 0.96, 1.92, $P<0.001$), the BCTQ total score, and a mean difference of 0.21 (with a 95% CI of 0.10, 0.32, $P<0.001$) were observed in the DN group compared with the control group at one-week follow-up.

Conclusions: In general, forearm MTrP should be considered when examining patients with CTS since MTrP therapy in patients with CTS can enhance the effectiveness of physical therapy on symptom improvement in short terms.

Keywords: Carpal tunnel syndrome, Forearm muscles, Dry needling, Trigger point

Introduction

Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy. The common symptoms of CTS include numbness, paresthesia, weakness, and pain in the areas of the hand innervated by the median nerve. Conservative treatments can relieve complains of mild and moderate CTS, including medication, splinting, local injection, and manual therapies (1-3).

In addition, myofascial pain syndrome (MFPS) with trigger points in the muscle is a common musculoskeletal problem. Trigger points can cause motor, sensory, and even autonomic dysfunction, as well as referred pain (4-6). Dry needling (DN) uses very thin hollow-core needles that are subcutaneously inserted into trigger points. Several studies have investigated the effectiveness of this method on myofascial pain in different parts of the body (7-9).

There is no clear mechanism regarding the association between CTS and forearm myofascial pain. Few studies have reported the possible correlation of the occurrence of CTS in patients with MFPS (10,11). Forearm muscles including brachioradialis and extensor carpi radialis get overworked by excessive gripping motions thus the trigger points in these muscles are relatively common which can produce pain at the elbow and referred pain in the wrist, the base of the thumb, and the dorsum of the hand, and finally, exacerbate CTS symptoms (5).

Considering the high prevalence of CTS and MFPS, these two conditions may occur simultaneously and exacerbate clinical symptoms. The trigger point DN may offer a promising therapeutic option to alleviate symptoms in these patients although there is a lack of studies validating this treatment in CTS.

Accordingly, the aim of the present study was to determine the frequency of the co-occurrence of CTS with forearm myofascial trigger points (MTrPs) and the effects of one-session DN on symptoms in these patients. It was hypothesized that forearm MTrP DN in combination with other treatments would exhibit more CTS symptom reductions.

Materials and Methods

Design

This prospective randomized controlled study was conducted on eligible patients who visited the Physical Medicine and Rehabilitation Clinics at Tabriz University

Received 20 February 2019, **Accepted** 7 June 2019, **Available online** 1 July 2019

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of Medical Sciences during a 6-month period. Patients were provided with details about the study protocol and were asked to sign an informed consent form. Further, they were allowed to withdraw from the study at any stage.

Study Population

The patients diagnosed with mild and moderate CTS based on clinical and electrodiagnostic criteria (12) were examined by an expert physiatrist for the presence of trigger points in their forearm muscles by palpation. All muscles of the forearm were assessed for trigger points. The diagnosis of MTrPs was based on the detection of a hyperirritable spot or nodule in a taut band of the muscle (5).

An electromyographer performed neurophysiologic evaluation using an electromyography device. The following inclusion criteria were used for CTS (12):

Criteria of Mild CTS: Median sensory nerve action potential (SNAP) distal latency >3.0 milliseconds with or without SNAP amplitude below the lower limit of normal (the stimulation of median nerve 14 cm proximal to the active electrode, record from third digit);

Criteria of Moderate CTS: Prolonged median sensory latency as above and the prolongation of compound motor action potential distal latency >4.2 milliseconds (the stimulation of median nerve 8 cm proximal to the active electrode, record from abductor pollicis brevis.

The frequency of the co-occurrence of CTS and forearm muscle trigger points was recorded as the percentage of the total number of the examined hands. A total number of 50 affected hands from 50 patients was included in a trial with a parallel-group design if they were simultaneously suffering from mild to moderate idiopathic CTS (based on clinical and electrodiagnostic criteria) and trigger points in the forearm muscles.

On the other hand, the exclusion criteria included a history of carpal tunnel surgery, previous local injection for CTS, concurrent elbow pain on the affected side, cervical radiculopathy, and the acute presentation of symptoms. Furthermore, the other criteria were a history of concomitant diseases (i.e., rheumatoid arthritis, the osteoarthritis of the first metacarpophalangeal and carpometacarpal joints, diabetes, and hypothyroidism), severe CTS, a history of wrist trauma and fracture, polyneuropathy, and the presence of MTrPs proximal to the elbow.

Sample Size and Assignment

The mean values and standard deviations of the visual analogue scale (VAS) variable were obtained from the study by Hadianfard et al (13) in order to determine the sample size. The minimum size of each group was calculated as 20 considering the 95% confidence interval, the power of 80%, the two-tailed test, and using the formula for determining the sample size regarding comparing the two means in the pre- and post-design. With an estimated 20% drop, the sample size increased to 25 cases in each group.

A method of random allocation (based on a list of random numbers produced using a Rand function) was used to randomly allocate patients to intervention (DN and splinting) and control (splinting) groups each containing 25 cases. An independent research assistant drew an enveloped number for each patient.

Interventions

In both groups, nighttime wrist splint in neutral position was administered during the study (for six weeks). In addition, the intervention group received one-session deep DN on forearm muscle trigger points (based on the Travell technique) by an expert physiatrist. With the patient in the supine position, the forearm pronated and slightly flexed at the elbow, deep DN was done by holding the trigger point in a pincer grasp (between the thumb and the fingers) using a needle with a length of 38 mm and a diameter of 0.45 mm. After insertion into the trigger point, the needle was partially withdrawn and then reinserted, then needle movements were repeated until the twitch response was disappeared and the appropriate response was achieved accordingly (5). During the course of treatment, both groups were advised to avoid intensive hand activities.

Data Collection and Assessments of Outcomes

Data were collected using physical examination, the Boston Carpal Tunnel Questionnaire (BCTQ), electrodiagnostic study, and the VAS.

Assessments including symptom severity and hand function were performed at the baseline, one week, and six weeks after the intervention in both groups, and inter- and intra-group changes were evaluated to determine the effects of interventions (i.e., DN with splinting vs. splinting alone).

A primary efficacy endpoint analysis was applied to prevent possible biases using the intention-to-treat principle. The VAS for pain and changes in the BCTQ score were the primary and secondary outcome measures, respectively. The applied VAS was a 10-cm-long horizontal line that was anchored at two endpoints indicating no pain and the most severe experienced pain. The scores were assessed in centimeters (14). BCTQ, which is a patient-oriented questionnaire, was administered to assess symptom severity by the symptom severity scale (SSS) using 11 questions, as well as the functional status by the functional status scale (FSS) using eight questions often found in CTS. For each symptom, patients received a score between one (no symptom) and five (severe symptom). The overall SSS and FSS scores were calculated as the mean of the scores (15). Finally, a researcher blind to treatment allocation assessed the outcomes.

Statistical Analysis

The Statistical Package for the Social Sciences software for

Windows, version 16 (SPSS Inc., Chicago, IL) was used for statistical analyses following the per-protocol principle. All continuous and categorical variables are presented as the mean and standard errors (SEs), as well as frequencies and percentages, respectively. Given that the skewness and kurtosis of all study variables were between -2 and +2, the distribution of the data was assumed to be normal (16). The Levene test was carried out to assess the homogeneity of the variance between the two groups. Moreover, the baseline characteristics were compared using independent samples *t* tests and the chi-square test for continuous and categorical variables, respectively. Additionally, the differences between the two independent groups were compared using the Mann-Whitney U test when the dependent variable was ordinal or continuous, but not distributed normally.

Similarly, the linear mixed-effect model was used to evaluate the effects of DN on symptom severity and functional status scores, in which the group (treatment or control) and period (baseline, 1- and 6-week follow-up, and baseline) were assumed to be the between-subject factor and within-subject factor, respectively. Eventually, GraphPad Prism software (No. 6) was utilized to draw the graphs, and *P* values < 0.05 on the two-tailed test were considered statistically significant.

Results

During 6 months, 224 cases with mild and moderate idiopathic CTS were evaluated in this study. The trigger points in the extensor carpi radialis and brachioradialis muscles were found in 61.6% of cases (138 out of 224 hands).

Fifty cases with primary mild and moderate CTS and forearm MTrPs were included in two groups each including 25 cases. The demographic characteristics, symptoms, and function at the baseline are summarized in Table 1. Based on the data, both groups were found to be similar with respect to age, sex, clinical symptoms, and functional findings.

The chi-square test showed no significant difference between the two groups in terms of the severity of CTS. Table 2 presents measured parameters at baseline, taken at the end of weeks 1 and 6 for each study group, where a trend toward improvement was found in both groups ($P<0.05$).

On the other hand, when examining the effects of DN after 1 week, the DN group demonstrated more pain reduction compared with the control group ($P<0.001$, Table 3). Further, the DN group exhibited greater improvement in the BCTQ-SSS ($P<0.001$) and BCTQ-FSS parameters ($P<0.001$) compared with the control group. In addition, trends toward greater improvements in pain severity, BCTQ-SSS, and BCTQ-FSS parameters were observed in the DN group compared with the control group at the 6 weeks follow-up although the differences in these improvements were not found to be statistically significant

Table 1. Demographic and Clinical Findings of Participants at the Baseline (n = 25 per group)

Variables	Dry Needling	Control	*P*
Age (y)	47.40 ± 8.51	48.60 ±12.05	0.686[a]
Female/male (n)	18 (72.0 %)	19 (76.0 %)	0.999[b]
Severity			
Mild (n)	8 (32.0 %)	12 (48.0 %)	0.248[b]
Moderate (n)	17 (68.0 %)	13 (52.0 %)	
VAS	6.68 ± 1.84	6.32 ± 2.17	0.615[c]
BCTQ symptom	2.67 ± 0.55	2.56 ± 0.64	0.961[a]
BCTQ function	2.05 ± 0.52	2.16 ± 0.72	0.979[a]
BCTQ total	2.37 ± 0.51	2.36 ± 0.66	0.994[a]

Note. Values are presented as the number of patients per group and the percent or mean ± standard deviation. In addition, parameters measured for the hand, except for age and gender, are for the individual. VAS: Visual analogue scale; BCTQ: Boston carpal tunnel questionnaire.
[a]Independent samples *t* test; [b] Chi-square test; ‡Mann-Whitney U test.

Table 2. The Symptoms Severity and Functional Evaluations of Patients in Each Group at Baseline and After Treatment

Variables	Dry Needling Group (n = 25)		Control Group (n = 25)	
	Mean ± SD	*P**	Mean ± SD	*P**
VAS				
At baseline	6.68 ± 1.84	< 0.001	6.32 ± 2.17	< 0.001
At week 1	4.00 ± 1.47	< 0.001	5.08 ± 2.02	< 0.001
At week 6	3.16 ± 1.31		3.44 ± 1.76	
BCTQ symptom				
At baseline	2.67 ± 0.55	< 0.001	2.56 ± 0.64	< 0.001
At week 1	2.20 ± 0.51	< 0.001	2.30 ± 0.60	< 0.001
At week 6	2.04 ± 0.49		2.18 ± 0.50	
BCTQ function				
At baseline	2.05 ± 0.52		2.16 ± 0.72	
At week 1	1.63 ± 0.47	< 0.001	1.94 ± 0.69	< 0.001
At week 6	1.43 ± 0.42	< 0.001	1.66 ± 0.60	< 0.00
BCTQ total				
At baseline	2.37 ± 0.51	< 0.001	2.36 ± 0.66	< 0.001
At week 1	1.91 ± 0.48	< 0.001	2.12 ± 0.60	< 0.001
At week 6	1.74 ± 0.44		1.92 ± 0.51	

Note. SD: Standard deviation; VAS: Visual analogue scale; BCTQ: Boston carpal tunnel questionnaire. * The results from the mixed ANOVA model for testing the differences from the baseline.

(All *P* values>0.05, Table 3). Finally, no adverse reactions or serious complications were observed in either group. These results are illustrated in Figures 1 and 2.

Discussion

This study investigated the effects of forearm muscles trigger point DN to alleviate symptoms in patients with concurrent CTS. Mild and moderate CTS were concomitant with the trigger points in extensor carpi

Table 3. The Effect of Dry Needling at 1 Week and 6 Weeks, the Mean Changes of Symptoms Severity and Functional Evaluations

Variables		Dry Needling Group (n = 25), Mean ± SD	Control Group (n = 25), Mean ± SD	Mean Differences (95% CI)	Dry Needling vs. Control, *P* *
1 week	**VAS**				
	Point changes	2.68 ± 0.94	1.24 ± 0.72	1.44 (0.96, 1.92)	< 0.001
	Percentage changes	41.13 ± 13.84	20.40 ± 10.91		
	BCTQ total				
	Point changes	0.45 ± 0.21	0.24 ± 0.14	0.21 (0.10, 0.32)	< 0.001
	Percentage changes	19.31 ± 8.04	10.40 ± 5.24		
6 weeks	**VAS**				
	Point changes	3.52 ± 1.29	2.88 ± 1.17	0.35 (0.06-, 1.34)	0.073
	Percentage changes	53.33 ± 12.59	46.69 ± 16.04		
	BCTQ total				
	Point changes	0.63 ± 0.29	0.54 ± 0.23	0.09 (-0.06, 0.24)	0.227
	Percentage changes	26.51 ± 6.77	22.51 ± 9.80		

Note. SD: Standard deviation; CI: Confidence interval; VAS: Visual analogue scale; BCTQ: Boston carpal tunnel questionnaire. *The results from mixed ANOVA Model.

radialis and brachioradialis muscles in 61% of patients. Based on the findings, DN decreased patients' symptoms at the short-term assessment.

Acupuncture is a treatment method based on influencing the body by inserting the needles in the acupoints although this method has little effects on CTS symptoms in the short term (17). Based on similar theories about acupuncture, trigger point DN has been proposed as a treatment technique for myofascial pain. Some previous studies have evaluated the effects of this method on myofascial pain in various body parts (18,19).

Trigger points can be also present in patients with CTS. Another potential link would be the presence of the sensitization mechanism in both CTS and myofascial pain. Few studies have reported the possible concomitance of CTS with trigger points in shoulder muscles. Furthermore, almost one-third of patients with possible CTS had trigger points. This rate was higher in the group that presented normal NCS results compared to the group that received a definitive CTS diagnosis. In fact, a patient representing potential symptoms of CTS should be assessed for trigger points as a possible cause of their pain (10,11). There are limited studies that evaluated the concomitance of CTS and trigger points in forearm muscles. Pain and physical dysfunction in patients with CTS may be exacerbated due to coexistent forearm muscles myofascial pain. However, no previous evidence is available in this field.

Hains et al reported the therapeutic effects of trigger point myofascial therapy using ischemic compression for relieving CTS symptoms (20).

The therapeutic effects of DN and local injection can be detected immediately and can persist for six weeks after 3 sessions of DN therapy in chronic myofascial pain (21,22). There is some evidence for the short-term therapeutic effect of DN in the management of myofascial pain (23). Similarly, based on VAS and BCTQ scores in the present study, trigger point DN can relieve complains of patients with CTS. Similar to the present study, Bubnov and Kalika reported the therapeutic effects of DN on the pain of patients with CTS. They used ultrasound for the identification of MTrPs in the forearm and hand muscles and evaluated patients immediately and 24 hours after the intervention (24).

In the present study, DN did not result in significant effects after 6 weeks probably because DN was done once

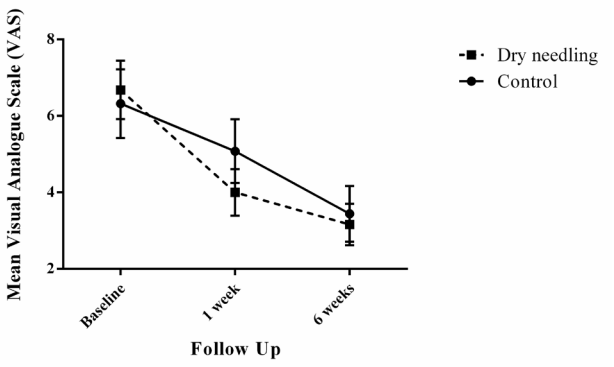

Figure 1. Means and 95% Confidence Interval for Visual Analogue Scale in Study Groups at Baseline, Week 1, and Week 6.

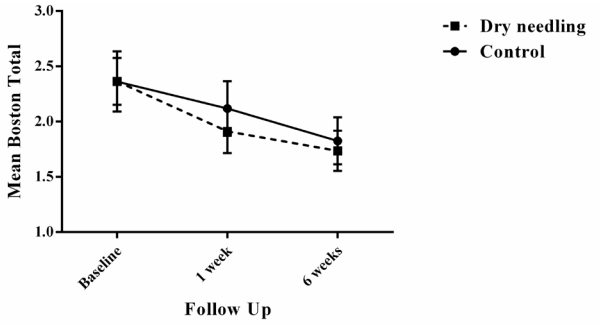

Figure 2. Means and 95% Confidence Interval for Boston Carpal Tunnel Questionnaire Total in Study Groups at Baseline, Week 1, and Week 6.

in this study. Further muscle-stretching techniques were not performed, which are typically used to prolong the therapeutic effects of DN.

In a clinical trial study, Edwards et al investigated the therapeutic effects of superficial DN plus active stretching in improving myofascial pain. They randomly allocated the patients to three groups and found that superficial DN plus active stretching was significantly more effective in deactivating the trigger points compared to using active stretching alone. This combination therapy also resulted in significant reductions in the symptoms and subjective pain in patients in the test group when compared with those in the control group that received no treatment (25).

Moreover, Mejuto-Vázquez et al evaluated the effect of DN on neck pain and the range of motion in patients with acute mechanical neck pain and active upper trapezius trigger points. The patients were allocated to the intervention (with DN) or control groups and were followed up one week after the intervention. The results showed a significant reduction in neck pain while a significant increase in the range of motion in the intervention group compared with the control group. Although slight, these changes indicated the positive clinical effects of DN (26). Likewise, in the present study, trigger point DN significantly decreased pain while improving the patient's function.

In another study conducted by Lo et al, 55% of the patients with CTS had myofascial pain as well (27) although the results related to patients with normal NCS were included in their study, which might explain this inconsistency with the results of the present study.

The present study had some limitations. In this small sample size study, control subjects without CTS were not included for the possible presence of forearm muscles trigger points. In addition, shoulder and arm muscles were not examined for the presence of the trigger points. We could not evaluate the sole effect of DN because all patients received routine CTS therapy. Thus, carrying a multicenter study with larger sample sizes and the evaluation of other upper limb muscles would be helpful.

Considering that MFPS is a common problem in the general population, especially in patients with upper limb pain (28), the MTrPs should be considered when examining patients for CTS. Whether the concomitance of MTrPs in patients with CTS occurs as a secondary phenomenon or a separate pathology, the potential causal nature of the relationship between these two conditions requires further study.

Although there is no clear mechanism with regard to the association between CTS and forearm myofascial pain, this study suggests that forearm myofascial therapy using DN could reduce CTS symptoms. Accordingly, regarding the high concomitance rate of mild to moderate CTS and trigger points in the extensor carpi radial and brachioradialis muscles, as well as the effects of DN on symptoms in these patients, forearm MTrPs should be considered when examining patients with CTS symptoms.

Although slight, MTrP therapy in patients with CTS can enhance the effectiveness of physical therapy on symptom improvement in the short term. Thus, therapeutic interventions to treat forearm muscle trigger points should be carried out whenever necessary.

Conflict of Interests

The authors declare no conflict of interests.

Ethical Issues

The present study was approved by the Ethics Committee of the Tabriz University of Medical Sciences and was registered in the Iranian Clinical Trial Registry with the identification number of IRCT 201602051292N4.

Financial Support

This research was supported by the Physical Medicine and Rehabilitation Research Center in Tabriz University of Medical Science.

Acknowledgments

The authors are especially grateful to the patients for their participation and cooperation in this research. The authors take responsibility for the integrity and accuracy of the data.

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