J Acupunct Meridian Stud 2015;8(5):229—235

Available online at www.sciencedirect.com

Journal of Acupuncture and Meridian Studies

journal homepage: www.jams-kpi.com

RESEARCH ARTICLE

Efficacies of Acupuncture and Anti-inflammatory Treatment for Carpal Tunnel Syndrome

Mohammadjavad Hadianfard, Esmaeel Bazrafshan, Hadi Momeninejad*, Navid Jahani

Department of Physical Medicine and Rehabilitation, Shiraz University of Medical Sciences, Shiraz, Iran

Available online 29 November 2014

Received: Jun 27, 2014
Revised: Nov 10, 2014
Accepted: Nov 24, 2014

KEYWORDS
acupuncture;
anti-inflammatory treatment;
carpal tunnel syndrome;
ibuprofen

Abstract
This study compared the efficacies of acupuncture and anti-inflammatory treatment in patients with carpal tunnel syndrome (CTS). Fifty patients with mild to moderate CTS were randomly divided into two groups. Both groups received night wrist splints as the standard conservative treatment for 1 month. The acupuncture group also received eight sessions of acupuncture therapy (twice a week for 4 weeks). The control group received 400 mg of ibuprofen three times a day for 10 days. The visual analog scale (VAS) score, the score on the Boston Carpal Tunnel Questionnaire for Functional Status and Symptom Severity (BCTQ FUNCT and SYMPT), and the electrodiagnostic findings were evaluated at baseline and 1 month after treatment. At the final follow up, significant improvements were found in both groups ($p < 0.05$). Statistically significant improvements were observed in the VAS score, the score on the global BCTQ FUNCT and SYMPT, and the electrodiagnostic findings, but not in the distal motor latency (DML), in the acupuncture group ($p < 0.05$). Our findings indicate that acupuncture affected the score on the global BCTQ FUNCT and SYMPT, the VAS score, and the electrodiagnostic findings, except the DML, more than ibuprofen did and that acupuncture might be an effective treatment for CTS.

* Corresponding author. Department of Physical Medicine and Rehabilitation, Shiraz University of Medical Sciences, Shiraz, Iran.
E-mail: momeninejad@sums.ac.ir (H. Momeninejad).

pISSN 2005-2901 eISSN 2093-8152
http://dx.doi.org/10.1016/j.jams.2014.11.005

1. Introduction

Carpal tunnel syndrome (CTS) is the most common peripheral nerve entrapment that compresses the median nerve within the carpal tunnel in the wrist. The classic symptoms of CTS are numbness, paresthesia, tingling in the radial three and half fingers, and awakening at night with numbness or pain in the fingers. In rare cases, patients also report cold hands, dry skin, or changes in sweating hands that seem to be related to the involvement of autonomic fibers. In the later stages of CTS, numbness may stabilize and motor impairment becomes more apparent and the patient complains of weakness and may report dropping objects.

Different clinical tests such as Tinel sign, Phalen test, and carpal tunnel compression are helpful in diagnosing this syndrome. To confirm the diagnosis, electrodiagnostic study is used. The electrodiagnostic study is the most sensitive method of diagnosis and grading of the severity of this syndrome and the evaluation of other problems. Imaging studies are rarely used in cases that do not respond to conservative treatment or have normal findings in nerve conduction studies.

Starting treatment in the early stages of CTS before the damage progresses is very important. First-line therapy is a conservative treatment for patients who do not have any evidence of denervation in electromyography, cannot undergo surgery, or have nonconstant symptoms of mild to moderate CTS [1]. According to the Work-Related Carpal Tunnel Syndrome Diagnosis and Treatment Guideline, conservative treatments include wrist splinting, local steroid injection, and forearm/wrist stretching home exercise regimens. Surgery is recommended if conservative management does not lead to sustainable functional improvement within 6—8 weeks [2].

Recently, acupuncture has received special attention for the management of pain. The efficacy of acupuncture for the treatment of CTS has been investigated in some studies [3—5].

A recent randomized controlled trial study compared the efficacy of acupuncture with night splinting for the treatment of CTS and showed that electroacupuncture was as effective as night splinting in the management of symptoms in patients with mild to moderate CTS [6]. Another recent randomized trial study with long-term follow up (13 months) compared the efficiency of acupuncture with oral steroids for the treatment of CTS. Although both groups showed more than 48.5% improvement in global symptom scale at Months 7 and 13, the patients who received acupuncture had significantly better improvement in distal motor latency (DML), distal sensory latency (DSL), and global symptom scale compared with those in the steroid group. The results of this study showed greater efficacy in the acupuncture group in both symptom scores and nerve conduction parameters [7].

By contrast, some studies did not approve the benefit of acupuncture in relieving symptoms when compared with the placebo or control group. For example, in a systematic review of randomized controlled trials in Korea in 2010, the effectiveness of acupuncture was assessed in the management of CTS and found that the existing evidence is not convincing enough to suggest that acupuncture is an effective treatment for CTS [8]. In another study, Weinstein et al [9] assessed the effect of manual acupuncture versus sham acupuncture and found no statistical difference between the two groups.

Although the National Institutes of Health confirmed that acupuncture may be useful as an adjunct treatment or an acceptable alternative or be included in a comprehensive management program for patients with CTS [10], there is still controversy surrounding the benefits of acupuncture [11,12]. The aim of this study was to investigate the efficacy of short-term acupuncture and compression with anti-inflammatory treatment approaches in mild to moderate CTS.

2. Materials and methods

This study was a randomized trial study undertaken in physical medicine and rehabilitation outpatient clinics in various hospitals in Shiraz, Iran. The Ethics Committee of Shiraz University of Medical Sciences approved the study prior to commencement. Diagnosis of patients was made based on the history and physical examination results in accordance with standard electrophysiological criteria. According to similar studies and considering the $\alpha = 0.05$ and $\beta = 0.2$ with power $= 80\%$, the sample size was calculated using the software *Power SCC* and included 25 patients (hands) in each group. This study was performed on 50 patients (25 patients in 2 groups; age range, 18—75 years) with electrophysiologically confirmed mild to moderate CTS.

In this study, mild CTS was attributed to patients with prolonged DSL ($\geq$ 3.6 milliseconds). Moderate CTS was attributed to patients with prolonged DML ($\geq$ 4.2 months). Exclusion criteria were as follows:

- *Severe CTS*: Thenar muscle atrophy or the presence of denervation potentials on needle electromyography in the abductor pollicis brevis or absence of sensory nerve action potential.
- Clinical and electrophysiological findings of associated conditions that could mimic CTS such as proximal median neuropathy, cervical root involvement, or significant polyneuropathy.
- Evidence of underlying disorders such as diabetes mellitus, rheumatoid arthritis, hypothyroidism, pregnancy and trauma, suspected malignancy, and autoimmune or inflammatory disease.
- Patients who have contraindications for taking ibuprofen.
- Any patient who had contraindication for needling, such as bleeding tendency, local infection, severe needling phobia, or a history of needling shock.

After selecting patients based on the inclusion and exclusion criteria of the study, providing the necessary information to the patients about the benefits and side effects of the study, and obtaining consent from patients for the study, we randomly divided the study patients into two groups. For randomization, we used a block randomization

list (nonstratified, with the same block lengths, generated by a computer) sequentially. Patients in the control group received custom-made night wrist splints set at 0—5 degrees of the wrist extension (for 4 weeks) and 400 mg of ibuprofen (3 times a day for 10 days). The intervention group underwent conventional acupuncture (body acupuncture in which selected points are distributed in the head, neck, back, chest, abdomen, and limbs without using simulation, laser, or moxibustion) in eight sessions over 4 weeks (twice a week) and also received custom-made night wrist splints set at 0—5 degrees of the wrist extension. Acupuncture points used in this study included the same points that were used in previous studies [4,5,13,14] in addition to the points obtained by our clinical experience. These points are as follows:

PC-7 (Daling): Middle point of the distal transverse crease of the wrist, between the tendons of palmaris longus and flexor carpi radialis.
PC-4 (Ximen): 5 cun over the PC-7 (cun is measured using the middle finger. When the middle finger is flexed, the distance between the two ends of the interpharyngeal creases is equal to 1 cun).
PC-6 (Neiguan): 2 cun above the PC-7.
PC-8 (Laogong): On the palm, between the second and third metacarpals, proximal to the metacarpophalangeal joints.
HT-2 (Qingling): In the anteromedial of the arm, around the middle of arm's length.
HT-7 (Shengmen): On the end of the distal transverse creases at the ulnar side of the wrist.
HT-8 (Shaofu): Between the fourth and fifth metacarpal bones (on the palm).
LU-9 (Taiyuan): On the end of the radial side of the distal transverse crease of the wrist.
LI-11 (Quchi): In the elbow, the middle point of the outer end of the lateral elbow creases, and the lateral epicondyle of humerus.

Thus, nine needles were used for nine acupoints unilaterally for only the involved side. If any patient had bilateral hand involvement, only the more-affected hand was included in the study. In this method, thin sterile needles (0.25 × 40-mm size gauge) with high flexibility and safety were used. Acupuncture was performed while the patients lay relaxed on the examination table in the supine position. Needles were inserted vertically into specific points and kept in the points for 20 minutes. Details of the acupuncture are presented in Table 1 based on the Standards for Reporting Interventions in Clinical Trials of Acupuncture [15].

In the control group (ibuprofen and wrist splinting), patients with a history of either hypersensitivity to nonsteroidal anti-inflammatory drugs or gastrointestinal bleeding were excluded. Patients were advised to take the medication after meals, and if there were digestive problems, or they had any other symptoms, appropriate management was used.

In both groups, the Boston Carpal Tunnel Questionnaire (BCTQ) and the visual analog scale (VAS) scores were the primary outcome measures. The BCTQ evaluates functional status score (BCTQ FUNCT) and symptom severity score (BCTQ SYMPT). These scores are assessed by the eight-item and 11-item scales, respectively [16]. The items of each scale were scored from 1 (mildest) to 5 (most severe). The BCTQ SYMPT and FUNCT scores were calculated as the mean ± standard deviation for each item. We used the Persian version of BCTQ that has a reasonable reliability, sensitivity, and internal consistency [17].

Table 1 Standard for reporting intervention in the controlled trials of acupuncture.

Acupuncture rational	Fixed acupuncture points include the following: PC-7 (Daling), PC-4 (Ximen), PC-6 (Neiguan), PC-8 (Laogong), HT-2 (Qingling), HT-7 (Shengmen), HT-8 (Shaofu), LU-9 (Taiyuan), and LI-11 (Quchi) Eight sessions Unilateral points
Needling details	*Depth of insertion:* Standard to each point according to classic acupuncture point *Responses elicited: De qi* sensation *Manual:* Twirling with lifting —thrusting method stimulation Needles retained for 20 min *Needle type:* C&G, gauge and size: 0.25 × 40 mm
Treatment regimen	Two sessions/wk for 4 wks
Co intervention	None
Practitioner background	License certificated
Control intervention	None

Secondary outcome measures were extracted from electrodiagnostic study findings, which included median DSL, median DML, and median nerve conduction velocity (NCV).

At baseline and 1 month after the intervention, data related to primary and secondary outcome measures were assessed in both groups. None of the participants dropped out in this study. Normality for variables was assessed using the Kolmogorov—Smirnov test. Parametric data were analyzed using independent and paired sample *t*-tests and nonparametric data were analyzed using Mann—Whitney and Wilcoxon tests. A p value < 0.05 was considered statistically significant.

3. Results

A total of 59 patients fulfilled the inclusion criteria and were enrolled in our study. Nine patients were excluded due to severe CTS ($n = 7$) and rheumatoid arthritis ($n = 2$). Finally, a total of 50 patients (50 hands) were randomly assigned to the acupuncture and ibuprofen groups (25 patients in each group) and the treatment outcomes were evaluated (Fig. 1).

With regard to demographic characteristics, the mean age of the patients in the acupuncture group was 44.5 ± 8.5

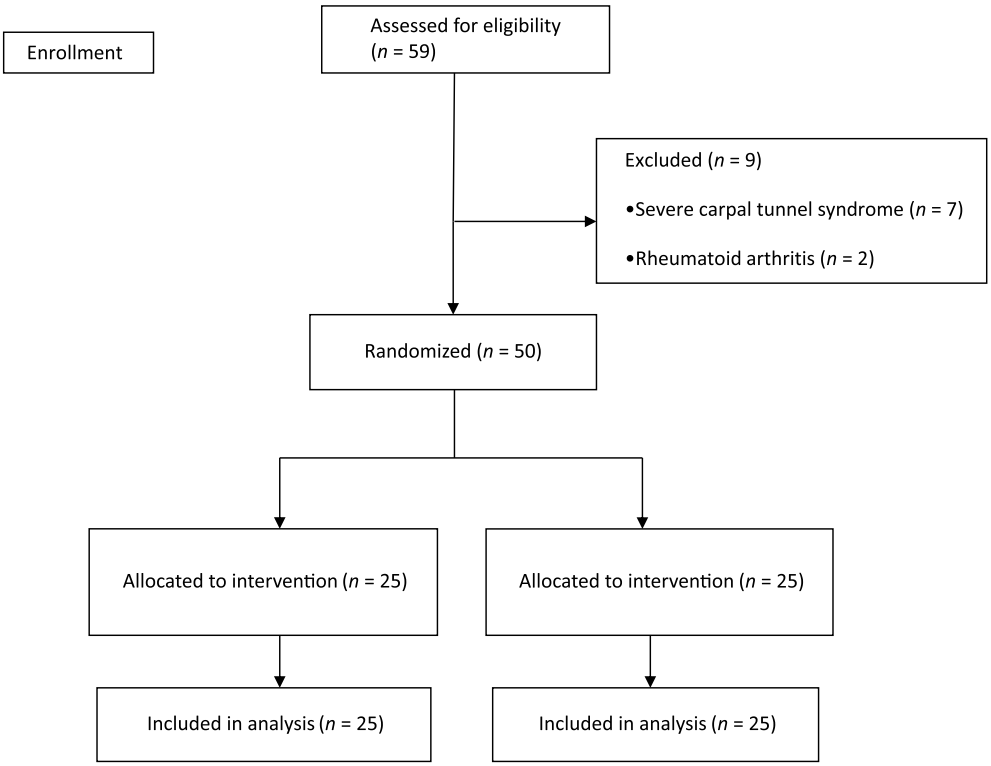

Figure 1 The study flowchart.

years (range, 32—52 years; 24 female patients). The mean age of the patients in the ibuprofen group was 42.5 ± 7.6 years (range, 35—49 years; 23 female patients). Thus, there was no statistically significant difference in demographic data between the two groups ($p > 0.05$).

No significant differences were observed between the two groups at baseline in the VAS score, symptoms score, function score, and electrophysiological parameters ($p > 0.05$). The mean VAS score was statistically similar between the two groups at baseline ($p \sim 1$), showing the success of randomization. After the intervention, the mean VAS score was significantly different in both groups ($p < 0.001$) and a statistically significant difference was found in the mean VAS score between the two groups, which was in favor of the acupuncture group ($p = 0.001$). The clinical characteristics and electrophysiological parameters of the patients at baseline and 1 month after the intervention are presented in Table 2.

After the intervention, in electrophysiological parameters, DSL was significantly decreased in both groups

Table 2 Mean BCTQ SYMPT, BCTQ FUNCT, and VAS scores and electrophysiologic measurements before and after intervention in the two groups.

	Study groups	Before (Mean ± SD)	After (Mean ± SD)	*p* in each group	*p* (after intervention between two groups)
BCTQ SYMPT	Acupuncture	28.14 ± 4.004	17.28 ± 2.716	< 0.001	< 0.001
	Ibuprofen	29.08 ± 3.628	23.08 ± 4.76	< 0.001	
BCTQ FUNCT	Acupuncture	17.708 ± 2.561	11.00 ± 0.780	< 0.001	< 0.001
	Ibuprofen	18.00 ± 3.00	12.840 ± 1.929	< 0.001	
VAS	Acupuncture	7.32 ± 0.94	3.8 ± 0.78	< 0.001	0.001
	Ibuprofen	7.32 ± 1.06	4.64 ± 0.7	< 0.001	
Median distal motor latency	Acupuncture	4.22 ± 0.43	3.97 ± 0.35	< 0.001	0.097
	Ibuprofen	4.26 ± 0.51	4.17 ± 0.47	< 0.001	
Median distal sensory latency	Acupuncture	3.97 ± 0.16	3.68 ± 0.21	< 0.001	< 0.001
	Ibuprofen	4.06 ± 0.17	3.94 ± 0.17	< 0.001	
Median nerve conduction velocity	Acupuncture	32.28 ± 2.74	37.04 ± 2.15	< 0.001	0.002
	Ibuprofen	31.72 ± 2.22	35.28 ± 1.72	< 0.001	

BCTQ FUNCT = Boston Carpal Tunnel Questionnaire Functional Status Score; BCTQ SYMPT = Boston Carpal Tunnel Questionnaire Symptom Severity Score; SD = standard deviation; VAS = visual analog scale.

($p < 0.001$) and the difference was statistically significant between the two groups, and this difference was also in favor of the acupuncture group ($p < 0.001$). The NCV was significantly different in both groups ($p < 0.001$) and the difference was statistically significant between the two groups, again in favor of the acupuncture group ($p = 0.002$). DML significantly decreased in both groups ($p < 0.001$) but there was no statistically significant difference between the two groups ($p > 0.05$).

After the intervention, the mean BCTQ SYMPT and BCTQ FUNCT scores were significantly different in both groups ($p < 0.001$) but a statistically significant difference was found in the mean scores between the two groups in favor of the acupuncture group ($p < 0.001$). In BCTQ SYMPT, the patients who received acupuncture had more improvement in all items except for weakness and difficulty with the grasping and use of small objects compared with patients receiving ibuprofen (Table 3). In BCTQ FUNCT, we found more improvement in using a personal phone and in doing housework in the patients treated with acupuncture compared with those treated by ibuprofen (Table 4).

4. Discussion

Our results showed that patients with CTS who received acupuncture had greater improvement in pain reduction than patients who received ibuprofen. Decreased numbness and tingling at night improved in patients treated with acupuncture compared with those treated with ibuprofen, and frequency of waking up due to pain or tingling and numbness at night was far less in patients treated with acupuncture than in those treated with ibuprofen. Patients treated with acupuncture had a greater improvement in electrodiagnostic parameters (expect DML) compared with the group that received the anti-inflammatory treatment. The patients' function in performing daily activities including using a personal phone and doing housework had more improvement in the acupuncture group compared with the ibuprofen group, but the difference was not statistically significant in the other functional items.

In a study conducted in the United States in 2002, low-level laser therapy with transcutaneous electrical nerve stimulation applied on the acupuncture points significantly reduced pain in CTS patients [4]. To reduce the symptoms of patients and improve electrodiagnostic parameters, a specific mechanism has not yet been identified. Recently, researchers have found that in the functional magnetic resonance imaging of patients with CTS, acupuncture stimulation induces changes in brain processing or responses to a coordinated limbic activity [18–20]. Other studies show that acupuncture has anti-inflammatory and immune-modulation effects [21–23].

In a clinical trial study in Taiwan in 2009, 77 patients with CTS confirmed by nerve conduction study were selected and divided into two groups. There were 38

Table 3 Mean Boston Carpal Tunnel Questionnaire symptom severity score items before and after intervention within the groups.

Parameter	Study groups	Before (mean ± SD)	After (mean ± SD)	p in each group	p (between groups after intervention)
S1	Acupuncture	3.16 ± 0.764	1.76 ± 0.597	< 0.001	0.004
	Ibuprofen	3.16 ± 0.624	2.32 ± 0.690	< 0.001	
S2	Acupuncture	2.94 ± 0.464	1.76 ± 0.523	< 0.001	0.001
	Ibuprofen	2.96 ± 0.676	2.40 ± 0.645	0.010	
S3	Acupuncture	2.28 ± 0.614	1.60 ± 0.500	< 0.001	0.001
	Ibuprofen	2.60 ± 0.577	2.2 ± 0.577	0.002	
S4	Acupuncture	2.08 ± 0.493	1.60 ± 0.500	0.001	0.002
	Ibuprofen	2.24 ± 0.597	2.08 ± 0.493	0.248	
S5	Acupuncture	2.76 ± 0.831	1.60 ± 0.500	< 0.001	< 0.001
	Ibuprofen	3.08 ± 0.812	2.32 ± 0.627	0.004	
S6	Acupuncture	3.08 ± 0.572	1.32 ± 0.476	< 0.001	< 0.001
	Ibuprofen	2.96 ± 0.611	2.20 ± 0.645	< 0.001	
S7	Acupuncture	1.28 ± 0.458	1.04 ± 0.200	0.011	0.147
	Ibuprofen	1.16 ± 0.374	1.17 ± 0.381	1.000	
S8	Acupuncture	3.04 ± 0.676	1.84 ± 0.374	< 0.001	0.002
	Ibuprofen	3.16 ± 0.624	2.32 ± 0.627	< 0.001	
S9	Acupuncture	2.96 ± 0.611	1.84 ± 0.374	< 0.001	0.007
	Ibuprofen	3.16 ± 0.624	2.28 ± 0.978	< 0.001	
S10	Acupuncture	3.08 ± 0.400	1.88 ± 0.332	< 0.001	< 0.001
	Ibuprofen	3.24 ± 0.831	2.64 ± 0.757	0.007	
S11	Acupuncture	1.48 ± 0.510	1.04 ± 0.200	0.002	0.085
	Ibuprofen	1.36 ± 0.490	1.20 ± 0.408	0.102	

S1 = severity of pain at night; S2 = wake up at night in the past 2 weeks; S3 = pain in daytime; S4 = times of pain during the daytime; S5 = duration of pain episode during the daytime; S6 = numbness; S7 = weakness; S8 = tingling; S9 = severity of numbness or tingling at night; S10 = frequency of waking up due to tingling and numbness at night; S11 = difficulty with the grasping and use of small objects; SD = standard deviation.

Table 4 Changes in Boston Carpal Tunnel Questionnaire functional status items, comparing mean values before and after intervention within the two groups.

Parameter	Study groups	Before (mean ± SD)	After (mean ± SD)	*p* in each group	*p* between groups after intervention
Writing	Acupuncture	1.76 ± 0.436	1.08 ± 0.282	< 0.001	0.236
	Ibuprofen	1.88 ± 0.536	1.24 ± 0.523	< 0.001	
Buttoning of clothes	Acupuncture	1.64 ± 0.490	1.00 ± 0.000	< 0.001	0.161
	Ibuprofen	1.64 ± 0.569	1.08 ± 0.277	< 0.001	
Holding a book while reading	Acupuncture	2.00 ± 0.417	1.09 ± 0.288	< 0.001	0.449
	Ibuprofen	2.04 ± 0.611	1.16 ± 0.374	< 0.001	
Gripping of a telephone handle	Acupuncture	3.28 ± 0.614	1.92 ± 0.282	< 0.001	< 0.001
	Ibuprofen	3.52 ± 0.510	2.64 ± 0.569	< 0.001	
Opening of jars	Acupuncture	1.56 ± 0.507	1.08 ± 0.282	< 0.001	0.640
	Ibuprofen	1.46 ± 0.509	1.13 ± 0.338	0.002	
Household chores	Acupuncture	3.20 ± 0.577	1.96 ± 0.204	< 0.001	< 0.001
	Ibuprofen	3.44 ± 0.507	2.60 ± 0.645	< 0.001	
Carrying of grocery bags	Acupuncture	3.04 ± 0.455	1.92 ± 0.282	< 0.001	0.263
	Ibuprofen	2.92 ± 0.640	2.04 ± 0.455	< 0.001	
Bathing and Dressing	Acupuncture	1.24 ± 0.436	1.00 ± 0.000	0.011	1.00
	Ibuprofen	1.36 ± 0.490	1.00 ± 0.000	0.001	

SD = standard deviation.

patients in the acupuncture group and 39 patients in the steroid group; the global symptom scores (GSSs) of the two groups were then compared. The GSS included five main symptoms, including pain, numbness, paresthesia, weakness/clumsiness, and nocturnal awakening. Of the five main symptoms, only nocturnal awakening showed a significant decrease in the acupuncture group compared with the steroid group. In addition, patients in the acupuncture group showed a significant decrease in DML compared with the steroid group [13]. In our study, of the five symptoms (pain, numbness, paresthesia, weakness, and nocturnal awakening), four symptoms including pain, paresthesia, numbness, and waking up at night showed a good recovery following acupuncture treatment. In addition, in electrodiagnostic parameters, improvements in NCV and DSL were seen in those treated with acupuncture compared with patients who received ibuprofen. In both studies, acupuncture was performed in eight sessions over 4 weeks (twice a week) and only the hand that was more affected was used for acupuncture. In the Taiwanese study, acupuncture was performed only in the PC-6 and PC-7 and only the GSSs and electrodiagnostic parameters were assessed, however, in our study, other points were added and in addition to GSS and electrodiagnostic parameters, the functional status score was also assessed. With regard to the functional status score, we found a statistically significant improvement in the acupuncture group.

In a study carried out in 2012 by Khosrawi et al [14] in Iran, 64 patients with mild to moderate CTS were enrolled and divided into two groups (32 patients in each group; age range, 25–65 years, which is similar to this study). Patients in the acupuncture group who also received splints were compared with patients in the control group who received splints, VITB1, VITB6, and sham acupuncture. The clinical symptoms of CTS in the acupuncture group improved more, and with regard to electrodiagnostic parameters only NCV was better. In this study also, acupuncture was performed only in the PC-6 and PC-7 points for eight sessions of 60-minute duration (2 sessions/week) and the splint was used for 4 weeks [14]. However, in our study, receiving acupuncture for 20 minutes/session and wearing the splint for 4 weeks showed a significant improvement in symptoms and all electrodiagnosis parameters in the acupuncture group. Thus, it seems that performing acupuncture in other areas had a better effect on symptoms and electrodiagnostic parameters due to the release of more neurotransmitters in the central nervous system, and a better local blood supply directed toward the median nerve.

In our study, none of the patients treated with acupuncture developed complications, whereas five patients treated with ibuprofen had gastrointestinal side effects (we then used omeprazole); however, none of them withdrew from the study due to the adverse effects. Therefore, acupuncture is superior in safety as well.

The limitations of this study include the low number of treatment sessions in the group treated with acupuncture. If the number of treatment sessions were added, better therapeutic results may have been obtained.

In this study, in addition to traditional acupuncture points, more points were used based on our clinical experience. Because of the fact that previous studies have also shown improvement in symptoms, improvement in electrodiagnostic parameters was variable. It seems that the further improvement in symptoms and electrophysiological parameters (although it was not statistically significant) is due to the extra acupuncture points. Further studies are needed to confirm our results. In addition, we now need to assess the long-term effects of acupuncture on mild to moderate CTS.

The results of our study showed that short-term acupuncture treatment is more effective than ibuprofen for mild to moderate CTS. Overall, it seems that

acupuncture is a relatively uncomplicated and safe treatment option for patients with mild to moderate CTS and can improve symptoms and electrodiagnostic parameters.

Disclosure statement

The authors declare that they have no conflicts of interest and no financial interests related to the material of this manuscript.

Acknowledgments

This study is a part of the thesis written by E.B. (No. 4619). Hence, we would like to express our sincere gratitude to Shiraz University of Medical Sciences for supporting the study. The authors would like to thank Dr. Nasrin Shokrpour at the Center for Development of Clinical Research of Nemazee Hospital, Shiraz, Iran for editorial assistance and Sareh Roosta for statistical analysis.

References

[1] Ashraf A, Moghtaderi AR, Yazdani AH, Mirshams S. Evaluation of effectiveness of local insulin injection in none insulin dependent diabetic patient with carpal tunnel syndrome. *Electromyogr Clin Neurophysiol*. 2008;49:161—166.

[2] Washington State Department of Labor and Industries. *Work-Related Carpal Tunnel Syndrome Diagnosis and Treatment Guideline*. Olympia: Washington State Department of Labor and Industries; 2014.

[3] Schulman RA, Liem B, Moroz A. Treatment of carpal tunnel syndrome with medical acupuncture. *Med Acupunct*. 2008;20:163—167.

[4] Naeser MA, Hahn KA, Lieberman BE, Branco KF. Carpal tunnel syndrome pain treated with low-level laser and microamperes transcutaneous electric nerve stimulation: a controlled study. *Arch Phys Med Rehabil*. 2002;83:978—988.

[5] Freedman J. Acupuncture for carpal tunnel syndrome. *Acupunct Med*. 2002;20:39—40.

[6] Kumnerddee W, Kaewtong A. Efficacy of acupuncture versus night splinting for carpal tunnel syndrome: a randomized clinical trial. *J Med Assoc Thai*. 2010;93:1463—1469.

[7] Yang CP, Wang NH, Li TC, Hsieh CL, Chang HH, Hwang KL, et al. A randomized clinical trial of acupuncture versus oral steroids for carpal tunnel syndrome: a long-term follow-up. *J Pain*. 2011;12:272—279.

[8] Sim H, Shin BC, Lee MS, Jung A, Lee H, Ernst E. Acupuncture for carpal tunnel syndrome: a systematic review of randomized controlled trials. *J Pain*. 2011;12:307—314.

[9] Weinstein A, Pan J, Richardson P. A controlled pilot trial of acupuncture for carpal tunnel syndrome. *Clin Acupunct Orient Med*. 2003;4:48.

[10] National Institutes of Health. Acupuncture. *NIH Consensus Statement Online*. 1997;15:1—34. Available at: http://consensus.nih.gov/1997/1997acupuncture107html.htm [Date accessed: December 4, 2014].

[11] O'Connor D, Marshall S, Massy-Westropp N. Non-surgical treatment (other than steroid injection) for carpal tunnel syndrome. *Cochrane Database Syst Rev*. 2003:CD003219.

[12] Ernst E. Acupuncture: what does the most reliable evidence tell us? *J Pain Symptom Manage*. 2009;37:709—714.

[13] Yang CP, Hsieh CL, Wang NH, Li TC, Hwang KL, Yu SC, et al. Acupuncture in patients with carpal tunnel syndrome: a randomized controlled trial. *Clin J Pain*. 2009;25:327—333.

[14] Khosrawi S, Moghtaderi A, Haghighat S. Acupuncture in treatment of carpal tunnel syndrome: a randomized controlled trial study. *J Res Med Sci*. 2012;17:1—7.

[15] MacPherson H, Altman DG, Hammerschlag R, Youping L, Taixiang W, White A, et al. Revised STandards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA): extending the CONSORT statement. *J Evid Based Med*. 2010;3:140—155.

[16] Levine DW, Simmons BP, Koris MJ, Daltroy LH, Hohl GG, Fossel AH, et al. A self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome. *J Bone Joint Surg Am*. 1993;75:1585—1592.

[17] Afshar AR, Yekta Z, Etemadi A, Mirzatoloee F. Outcome measurement questionnaires for carpal tunnel syndrome. *Iran J Orthop Surg*. 2005;4:46—50.

[18] Asghar AU, Green G, Lythgoe MF, Lewith G, MacPherson H. Acupuncture needling sensation: the neural correlates of deqi using fMRI. *Brain Res*. 2010;1315:111—118.

[19] Napadow V, Liu J, Li M, Kettner N, Ryan A, Kwong KK, et al. Somatosensory cortical plasticity in carpal tunnel syndrome treated by acupuncture. *Hum Brain Mapp*. 2007;28:159—171.

[20] Napadow V, Kettner N, Liu J, Li M, Kwong KK, Vangel M, et al. Hypothalamus and amygdala response to acupuncture stimuli in carpal tunnel syndrome. *Pain*. 2007;130:254—266.

[21] Kavoussi B, Ross BE. The neuroimmune basis of anti-inflammatory acupuncture. *Integr Cancer Ther*. 2007;6:251—257.

[22] Zijlstra FJ, van den Berg-de Lange I, Huygen FJ, Klein J. Anti-inflammatory actions of acupuncture. *Mediators Inflamm*. 2003;12:59—69.

[23] Takahashi T, Sumino H, Kanda T, Yamaguchi N. Acupuncture modifies immune cells. *J Exp Clin Med*. 2009;1:17—22.