Electroacupuncture and splinting versus splinting alone to treat carpal tunnel syndrome: a randomized controlled trial

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Abstract

Background: The effectiveness of acupuncture for managing carpal tunnel syndrome is uncertain, particularly in patients already receiving conventional treatments (e.g., splinting). We aimed to assess the effects of electroacupuncture combined with splinting.

Methods: We conducted a randomized parallel-group assessor-blinded 2-arm trial on patients with clinically diagnosed primary carpal tunnel syndrome. The treatment group was offered 13 sessions of electroacupuncture over 17 weeks. The treatment and control groups both received continuous nocturnal wrist splinting.

Results: Of 181 participants randomly assigned to electroacupuncture combined with splinting (n = 90) or splinting alone (n = 91), 174 (96.1%) completed all follow-up. The electroacupuncture group showed greater improvements at 17 weeks in symptoms (primary outcome of Symptom Severity Scale score mean difference [MD] –0.20, 95% confidence interval [CI] –0.36 to –0.03), disability (Disability of Arm, Shoulder and Hand Questionnaire score MD –6.72, 95% CI –10.9 to –2.57), function (Functional Status Scale score MD –0.22, 95% CI –0.38 to –0.05), dexterity (time to complete blinded pick-up test MD –6.13 seconds, 95% CI –10.6 to –1.63) and maximal tip pinch strength (MD 1.17 lb, 95% CI 0.48 to 1.86). Differences between groups were small and clinically unimportant for reduction in pain (numerical rating scale –0.70, 95% CI –1.34 to –0.06), and not significant for sensation (first finger monofilament test –0.08 mm, 95% CI –0.22 to 0.06).

Interpretation: For patients with primary carpal tunnel syndrome, chronic mild to moderate symptoms and no indication for surgery, electroacupuncture produces small changes in symptoms, disability, function, dexterity and pinch strength when added to nocturnal splinting. **Trial registration:** Chinese Clinical Trial Register no. ChiCTR-TRC-11001655 (www.chictr.org.cn/showprojen.aspx?proj=7890); subsequently deposited in the World Health Organization International Clinical Trials Registry Platform (apps.who.int/trialsearch/Trial2.aspx?TrialID=ChiCTR-TRC-11001655).

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Primary carpal tunnel syndrome is one of the most common forms of peripheral entrapment neuropathy,[1] with an estimated prevalence of 2.7% in the general population.[2] It is a major cause of disability in the upper extremity,[3] incurring considerable limitation on daily activities among patients.[4] As a work-related disorder, carpal tunnel syndrome carries significant economic impact and often leads to compensation claims.[5] For patients with mild to moderate carpal tunnel syndrome without evidence of median nerve denervation, nocturnal wrist splinting or local steroid injection are 2 conservative treatments commonly recommended in primary care practice.[6] Splinting is often used as first-line treatment in primary care,[7–9] but a Cochrane review reported that splinting only slightly improved symptom scores for carpal tunnel syndrome at 4 weeks.[10] For steroid injection, a Cochrane review showed that steroid injection was superior to placebo injection in improving symptoms at 4 weeks, but longer term effect beyond 12 weeks was uncertain.[11] A recent randomized controlled trial (RCT) also showed that steroid injection provided more benefits than placebo at the 10th week of treatment, but there was no significant difference observed at 1-year follow-up.[12] Only one-third of patients with carpal tunnel syndrome who received steroid injections had longer term benefits[13] and some required an additional 2–3 injections to obtain relief.[13] However, 1 study conducted in Estonia reported that patients who received repetitive steroid injections were more likely to

have postoperative symptoms of carpal tunnel syndrome if they eventually opted for surgery.[14]

Acupuncture is commonly used to manage pain and neuropathy in Chinese medicine. A systematic review published in 2011 included 2 trials that compared acupuncture and steroid injection; acupuncture was found to be slightly better in reducing symptoms of carpal tunnel syndrome.[15] A randomized trial (n = 77) published in 2009 reported that patients receiving acupuncture treatment showed more improvement than those taking low-dose prednisolone orally.[16] However, another trial that compared acupuncture with splinting reported no significant difference between them.[17] Among controlled trials of sham acupuncture, 1 small randomized trial reported no significant symptom improvement,[18] but another trial suggested that there was symptom improvement.[19] These conflicting results do not provide clear evidence of the value of adding acupuncture to splinting in primary care settings.

Electroacupuncture is a technique in which a weak electric current is passed between 2 needles. We chose electroacupuncture because results from previous clinical trials and systematic reviews had suggested that it might be more effective in relieving pain than standard manual acupuncture.[20] These results have been attributed to the ablility of electroacupuncture to block pain by activating a variety of bioactive chemicals through peripheral, spinal and supraspinal mechanisms.[21] Therefore, we conducted a randomized trial to compare electroacupuncture combined with nocturnal splinting with nocturnal splinting alone for patients with carpal tunnel syndrome.

Methods

Trial design

We conducted a prospective randomized parallel group trial over 17 weeks. Enrolment started in January 2013, and follow-up was completed in April 2014.

Setting and participants

We advertised at various primary care clinics, in local newspapers and on social media. Respondents were examined by trial investigators and screened for eligibility at a family medicine teaching clinic of the Chinese University of Hong Kong. All electroacupuncture treatment was performed at this centre.

Inclusion criteria

To confirm their eligibility, we invited patients to fill in the Katz hand diagram questionnaire[22–25] under the guidance of a clinician. Patients aged 18–70 years with primary idiopathic carpal tunnel syndrome who fulfilled the following criteria were included: satisfying classic or probable criteria for carpal tunnel syndrome by Katz hand diagram (tingling or numbness in ≥ 2 of 4 radial fingers),[26] positive in at least 2 of 3 clinical tests (i.e., Phalen maneuver test, Tinel sign test, and the wrist flexion and median nerve compression test),[27] able to respond to questionnaires in Cantonese and able to provide written informed consent.

Exclusion criteria

We excluded patients with symptoms and signs suggestive of median nerve denervation with axonal loss, including thenar muscular atrophy or weakness, or persistent numbness.[28] We also excluded patients with secondary carpal tunnel syndrome owing to coexisting polyneuropathy, inflammatory arthropathy, pregnancy, diabetes mellitus, hypothyroidism, malignancy, rheumatoid arthritis, alcoholism, infections, space-occupying lesions (tumours, hypertrophic synovial tissue, fracture callus and osteophytes) and familial neuropathy.[29] Patients who had previous carpal tunnel release surgery, who were taking oral steroids or warfarin, who had received treatment with local steroid injections or acupuncture for carpal tunnel syndrome, or patients with other serious diseases requiring inpatient care were also considered ineligible. Patients with cervical radiculopathy were also excluded (see details in Appendix 1, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.151003/-/DC1. We did not perform a nerve conduction study to confirm the diagnosis, according to the current standard of primary care practice.

Randomization and interventions

After we confirmed eligibility and obtained-written informed consent, block randomization was applied to allocate patients to the electroacupuncture with nocturnal splinting (treatment) group and the nocturnal splinting only (control) group in a 1:1 ratio. We used the Random Allocation Software random block sizes option and did not prespecify the block size range.[30,31] We used a sequentially numbered procedure with opaque sealed envelopes to conceal the random sequence.[32] The sequence was generated and concealed by a trained research assistant, independent of the study, who was supervised by one of the authors (S.L.).

Patients who were randomly assigned to the electroacupuncture with splinting group received a prefabricated wrist splint (Medex Carpal Tunnel Splint W09) with neutral posi-

Table 1: Participant characteristics at baseline

Characteristic	Treatment group (electroacupuncture with splinting at night) *n* = 90	Control group (splinting at night only) *n* = 91
Age, yr; mean ± SD	51 ±10.2	51 ± 8.7
Female, *n* (%)	77 (86)	81 (89)
Education level, *n* (%)		
Primary or below	7 (8)	10 (11)
Secondary	60 (67)	56 (62)
Tertiary* or above	23 (26)	25 (27)
Employed, *n* (%)	51 (57)	59 (65)
Duration of symptoms, *n* (%)		
> 1 yr	69 (77)	59 (65)
≤ 1 yr	21 (23)	32 (35)
Duration of symptoms, mo; mean ± SD	50 ± 52.7	51 ± 59.9
Had treatment for the dominant hand, *n* (%)	70 (78)	73 (80)
Smoking status, *n* (%)		
Currently smoke	4 (4)	3 (3)
Smoked previously	5 (6)	1 (1)
Passively smoke	19 (21)	17 (19)
Alcohol consumption, *n* (%)†		
Do not drink	21 (23)	21 (23)
1–9 drinks/wk	69 (77)	68 (75)
≥ 10 drinks/wk	0 (0)	2 (2)
Splint compliance during the trial,%; mean ± SD‡	82 ± 24	85 ± 21
BCTQ score, mean ± SD§		
SSS (range 1–5)	2.32 ± 0.62	2.40 ± 0.69
FSS (range 1–5)	1.91 ± 0.68	1.99 ± 0.74
DASH score (range 0–100), mean ± SD§	33.2 ± 16.8	34.5 ± 18.9
NRS for pain intensity (range 0–10), mean ± SD§	4.38 ± 2.62	4.52 ± 2.78
SWMT diameter, mm; mean ± SD¶		
Thumb	3.72 ± 0.54	3.60 ± 0.53
First finger	3.61 ± 0.49	3.48 ± 0.52
Middle finger	3.61 ± 0.52	3.53 ± 0.51
Little finger	3.40 ± 0.48	3.43 ± 0.47
Time to complete DMMPUT, s; mean ± SD**		
Not blinded	21.2 ± 9.3	22.3 ± 13.6
Blinded	45.4 ± 20.1	45.3 ± 18.4
Tip pinch strength, lb; mean ± SD**	8.00 ± 3.43	8.29 ± 3.62

Note: BCTQ = Boston Carpal Tunnel Questionnaire, DASH = Disabilities of the Arm, Shoulder and Hand Questionnaire, DMMPUT = Dellon-modified Moberg pick-up test, FSS = Functional Status Scale, NRS = numeric rating scale, SSS = Symptom Severity Scale, SWMT = Semmes–Weinstein Monofilament Test.
*Tertiary education refers to all postsecondary education including, but not limited to, universities.
†One standard drink corresponds to 150 mL of wine, 355 mL of beer or 44 mL of spirits.
‡Patient compliance for splinting was defined as (total no. of nights that splints were worn)/(total no. of nights across duration of trial) × 100. Patients from both groups had similar high compliance rates for wrist splinting, and there was no significant difference between groups. It is unlikely that such a slight variation in compliance for wrist splinting would have had an impact on outcomes. Therefore, we did not consider this variation in the analysis of covariance reported in Table 2.
§A higher rating indicates greater severity.
¶Sensation in each finger was evaluated using 5 monofilaments of increasing diameter (i.e., 2.83 (best), 3.61, 4.31, 4.56 and 6.65). Mean diameter values for cutaneous sensation were reported and a decrement indicates improvement.
**Mean values were calculated by averaging results from 3 attempts by each participant.

tioning.[33] In addition, these patients were given a 10-minute structured education by the investigator about the use of splints.[34] Patients were asked to use the splint every evening for 8 hours during the study period.[35] Patients with symptoms in both hands were offered bilateral splinting. The electroacpuncture protocol can be found in Appendix 1.

Patients assigned to the splinting only group received splints and the structured education as for the electrouncture group. These patients were registered on a waiting list and were offered electroacupuncture treatment after their last follow-up visit at week 17 as a form of compensation. In both groups, all participants had the expectation of receiving electroacupuncture, because the study procedures were explained to all potential participants before enrolment.

Outcomes

As recommended by the American Academy of Orthopaedic Surgeons,[36] we used the Symptom Severity Scale of the Boston Carpal Tunnel Questionnaire[37] as the primary outcome. In this scale, a summary score of 1 to 5 is obtained, with a higher score indicating greater symptom severity.[38] Secondary outcomes were Functional Status Scale of the Boston Carpal Tunnel Questionnaire,[37] Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire,[39] pain intensity measured using the numeric rating scale, sensation measured using the Semmes–Weinstein monofilament test, dexterity measured using the Dellon-modified pick-up test and maximal tip pinch strength. We monitored adverse events related to electroacupuncture and splinting using a previously published approach.[40] Details of outcomes and measurement methods for adverse events can be found in Appendix 1.

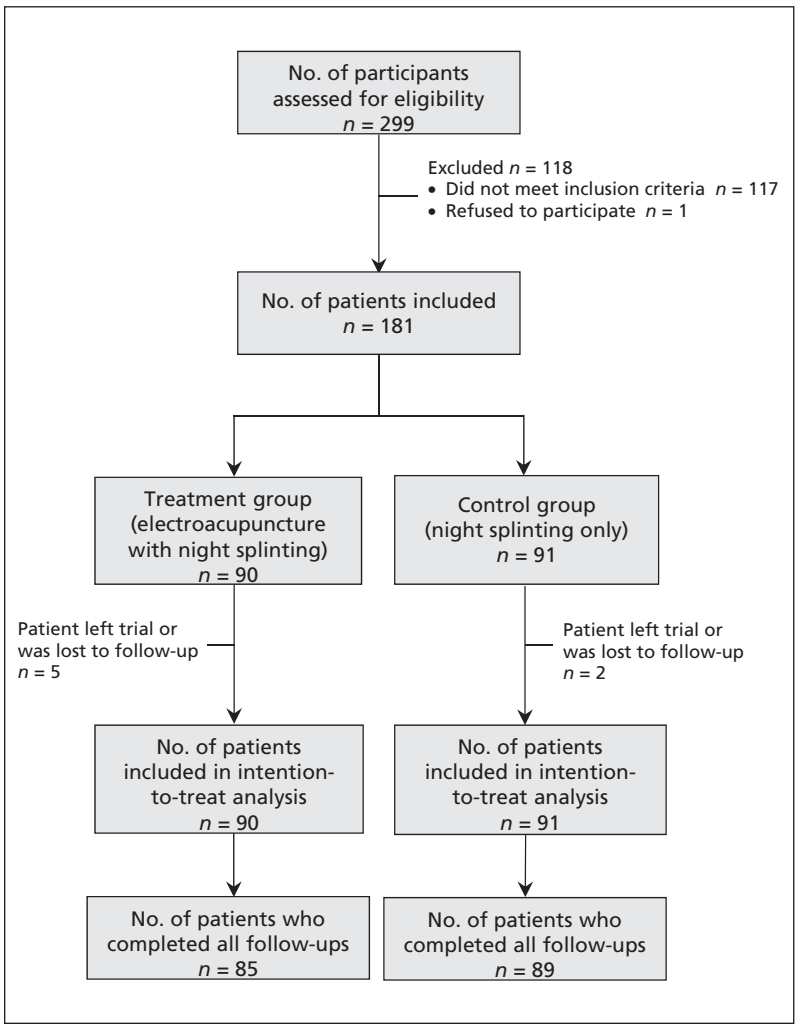

Figure 1: Participant recruitment flow diagram.

Statistical analysis

We employed double entry to all study data and applied appropriate data cleaning to ensure data quality. All eligible patients were included and randomly assigned in the primary analysis, based on the intent-to-treat principle. Appendix 2 (available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.151003/-/DC1) provides details about estimation of sample size, statistical analyses, minimally important differences (MIDs) for each outcome and the application of cumulative distribution functions for data presentation.

Ethics approval

The trial was approved by the Joint Chinese University of Hong Kong – New Territories East Cluster Clinical Research Ethics Committee (CRE-2010.379).

Results

A total of 181 participants were randomly assigned to this trial. Ninety participants were assigned to the treatment group (electroacupuncture combined with splinting) and 91 were assigned to the control group (splinting at night only). All patients provided baseline data, and characteristics of the 2 groups were generally similar (Table 1). All patients were included in the intention-to-treat analysis. We defined a patient as having dropped out of the trial if they did not complete assessment at week 17. Five patients dropped out of the treatment group, and those patients who completed the trial achieved 100% and 82% compliance to treatment with electroacupuncture and splinting, respectively. Two patients dropped out of the control group, and those patients who completed the trial had a compliance rate to treatment with splinting of 85%. None of the

patients in the splinting treatment group received electroacupuncture treatment for carpal tunnel syndrome during the 17-week follow-up period. Figure 1 shows how patients were recruited and the reasons for patient exits from the trial. Main results for all outcomes are shown in Table 2. Recruitment started in January 2013, and the last follow-up was conducted in April 2014. Less than 1% of the data were missing and were imputed.

Primary outcome

For Symptom Severity Scale score at week 5 and week 17 of the trial, patients in the electroacupuncture combined with splinting treatment group improved more than those in the splinting treatment only group (Table 2). The mean change in Symptom Severity Scale score from baseline to week 17 was –0.25 (95% CI –0.37 to –0.12) in the electroacupuncture combined with splinting treatment group and –0.09

Table 2: Outcomes, by follow-up time

Outcome	Change from baseline, mean (95% CI)		Change in score, MD (95% CI)*	*p**
	Treatment group (electroacupuncture with nocturnal splinting)	Control group (nocturnal splinting only)		
BCTQ score				
SSS				
Week 1	0.04 (–0.03 to 0.12)	0.01 (–0.08 to 0.10)	0.02 (–0.09 to 0.13)	0.8
Week 2	–0.01 (–0.09 to 0.07)	–0.02 (–0.13 to 0.08)	–0.01 (–0.13 to 0.11)	0.9
Week 5	–0.17 (–0.28 to –0.06)	–0.06 (–0.19 to 0.07)	–0.15 (–0.29 to –0.01)	0.04
Week 17	–0.25 (–0.37 to –0.12)	–0.09 (–0.25 to 0.06)	–0.20 (–0.36 to –0.03)	0.02
FSS				
Week 1	0.14 (0.05 to 0.23)	0.09 (0.00 to 0.18)	0.05 (–0.08 to 0.17)	0.5
Week 2	0.11 (0.00 to 0.22)	0.07 (–0.04 to 0.17)	0.03 (–0.12 to 0.17)	0.7
Week 5	–0.01 (–0.12 to 0.11)	0.06 (–0.07 to 0.18)	–0.09 (–0.24 to 0.06)	0.3
Week 17	–0.16 (–0.28 to –0.04)	0.02 (–0.13 to 0.17)	–0.22 (–0.38 to –0.05)	0.01
DASH score				
Week 1	0.09 (–1.65 to 1.82)	0.36 (–1.76 to 2.48)	–0.44 (–3.09 to 2.21)	0.8
Week 2	–1.45 (–3.48 to 0.58)	–0.54 (–3.02 to 1.94)	–1.11 (–4.19 to 1.97)	0.5
Week 5	–4.02 (–6.48 to –1.56)	–0.87 (–3.92 to 2.19)	–3.50 (–7.16 to 0.16)	0.06
Week 17	–7.75 (–10.55 to –4.95)	–1.53 (–5.15 to 2.09)	–6.72 (–10.9 to –2.57)	< 0.01
NRS on pain intensity				
Week 1	–0.22 (–0.68 to 0.23)	–0.43 (–0.89 to 0.04)	–0.14 (–0.40 to 0.68)	0.6
Week 2	–0.30 (–0.81 to 0.21)	–0.50 (–1.01 to 0.01)	0.13 (–0.46 to 0.72)	0.7
Week 5	–0.68 (–1.18 to –0.19)	–0.55 (–1.11 to 0.02)	–0.22 (–0.81 to 0.36)	0.5
Week 17	–1.22 (–1.79 to –0.65)	–0.61 (–1.22 to 0.00)	–0.70 (–1.34 to –0.06)	0.03
SWMT sensation diameter at week 17, mm				
Thumb	–0.29 (–0.43 to –0.14)	–0.17 (–0.28 to –0.06)	–0.05 (–0.21 to 0.11)	0.5
First finger	–0.28 (–0.41 to –0.15)	–0.12 (–0.22 to –0.01)	–0.08 (–0.22 to 0.06)	0.3
Middle finger	–0.28 (–0.40 to –0.15)	–0.13 (–0.24 to –0.01)	–0.11 (–0.26 to 0.04)	0.2
Little finger	–0.15 (–0.26 to –0.03)	–0.14 (–0.26 to –0.03)	–0.02 (–0.16 to 0.12)	0.8
Time to complete DMMPUT at Week 17, s				
Not blinded	–2.11 (–4.36 to 0.13)	–0.80 (–3.21 to 1.61)	–1.87 (–4.61 to 0.88)	0.2
Blinded	–6.50 (–9.84 to –3.15)	–0.32 (–4.27 to 3.63)	–6.13 (–10.6 to –1.63)	< 0.01
Tip pinch strength at week 17, lb	1.75 (1.27 to 2.22)	0.52 (–0.02 to 1.06)	1.17 (0.48 to 1.86)	< 0.01

Note: BCTQ = Boston Carpal Tunnel Questionnaire, CI = confidence interval, DASH = Disabilities of the Arm, Shoulder and Hand Questionnaire, DMMPUT = Dellon–modified Moberg pick-up test, FSS = Functional Status Scale, MD = mean difference, NRS = numeric rating scale, SSS = Symptom Severity Scale, SWMT = Semmes–Weinstein Monofilament Test.
*The estimated MD for changes in score and *p* values of scores between groups were obtained using analysis of covariance.

(95%CI –0.25 to 0.06) in the splinting treatment only group. The mean difference (MD) in change from baseline to week 17 between the 2 groups was –0.20 (95% CI –0.36 to –0.03). The cumulative distribution function for Symptom Severity Scale score reduction is shown in Appendix 3 (Figure 1, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.151003/-/DC1), with a vertical line denoting a MID threshold of 0.33. Forty participants (47.0%) in the electroacupuncture combined with splinting treatment group achieved clinically important reduction in Symptom Severity Scale score compared with 32 (36.0%) in the splinting treatment only group, but we found no significant difference ($p = 0.1$) (Table 3).

Table 3: Participants with clinically important changes in outcomes, by follow-up time*

Outcome	No. (%) of participants: Treatment group (electroacupuncture with nocturnal splinting) $n = 90$	Control group (nocturnal splinting only) $n = 91$	p§
BCTQ score			
SSS			
Week 1	11 (12.2)	19 (20.9)	0.1
Week 2	19 (21.1)	23 (25.3)	0.5
Week 5†	33 (37.9)	27 (30.0)	0.3
Week 17‡	40 (47.1)	32 (36.0)	0.1
FSS			
Week 1	7 (7.8)	17 (18.7)	0.03
Week 2	15 (16.7)	15 (16.5)	1.0
Week 5†	19 (21.8)	18 (20.0)	0.8
Week 17‡	30 (35.3)	21 (23.6)	0.09
DASH score			
Week 1	7 (7.8)	16 (17.6)	0.05
Week 2	17 (18.9)	19 (20.9)	0.7
Week 5†	24 (27.6)	21 (23.3)	0.5
Week 17‡	40 (47.1)	26 (29.2)	0.02
Pain intensity			
Week 1	18 (20.0)	20 (22.0)	0.7
Week 2	21 (23.3)	24 (26.4)	0.6
Week 5†	27 (31.0)	28 (31.1)	1.0
Week 17‡	34 (40.0)	31 (34.8)	0.5
Blinded DMMPUT completion time			
Week 17‡	32 (37.6)	17 (19.1)	< 0.01
Tip pinch strength			
Week 17‡	39 (45.9)	32 (36.0)	0.2

Note: BCTQ = Boston Carpal Tunnel Questionnaire, DASH = Disability of Hand and Shoulder Questionnaire, DMMPUT = Dellon-modified Moberg pick-up test, FSS = Functional Status Scale.
*Threshold for a minimally important difference is defined as a half of the baseline SD for SSS, FSS, DASH and DMMPUT, 1.66 lb for tip pinch strength, and 2 for pain intensity measured on a numerical rating scale.
†Particpants left trial ($n = 87$ for the treatment group, $n = 90$ for the control group).
‡Particpants left trial ($n = 85$ for the treatment group, $n = 89$ for the control group).
§Two-sided p values for comparing proportions of patients showing clinically important changes between groups.

Secondary outcomes and adverse events

At week 17, patients in the electroacupuncture combined with splinting treatment group showed more improvement in Functional Status Scale score, Disabilities of the Arm, Shoulder and Hand Questionnaire score, pain, blinded Dellon-modified Moberg pick-up test score and maximal tip pinch strength compared with patients in the splinting treatment only group (Table 2). However, significant differences were only observed in scores for the Disabilities of the Arm, Shoulder and Hand Questionnaire ($p = 0.02$) and the blinded Dellon-modified Moberg pick-up test ($p < 0.01$) for the proportion of patients achieving clinically important improvement (Table 3). Cumulative distribution functions for these outcomes are shown in Appendix 3 (Figures 2–6). Adverse events from electroacupuncture were infrequent and mild. Detailed results on secondary outcomes and adverse events are found in Appendix 4 (available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.151003/-/DC1).

Interpretation

Main findings

We found that treatment using electroacupuncture provided small improvements in symptoms, disability, function, dexterity and pinch strength among patients with chronic mild to moderate symptoms of primary carpal tunnel syndrome when combined with nocturnal splinting. Except for disability and dexterity, the proportion of patients who had clinically important benefit from treatment was not significantly different when comparing add-on electroacpuncture with splinting. The electroacupuncture protocol evaluated in this trial is a safe procedure that is easily replicable by trained acupuncturists.

Our data also suggest that splinting alone was inadequate for relieving symptoms and improving functions in this group of patients, because there were no significant improvements in any outcomes in the splinting treatment only group.

Comparison with other studies

Despite uncertainty on its effectiveness, wrist splinting is recommended as a first-line conservative treatment by several authorities, includ-

ing the National Institute for Health and Care Excellence in the United Kingdom,[41] American Academy of Orthopaedic Surgeons[42] and the American College of Occupational and Environmental Medicine;[43] however, no specific recommendation for or against acupuncture exists. This is in line with the mixed results from existing trials involving acupuncture for carpal tunnel syndrome.

Limitations

The positive effects of acupuncture observed based on outcomes reported by participants could be biased by participant expectancy and lack of blinding of participants in the study. Nevertheless, a systematic review suggested that the impact of patient expectancy on acupuncture outcome is uncertain,[44] and a more recent study reported that baseline expectancy may not predict treatment response when electroacupuncture is applied.[45] Although the impact of expectancy on patient-reported outcomes may be small in this trial, lack of patient blinding may still incur positive bias on effect size.[46] Despite the lack of blinding and control for expectancy, the add-on benefits of electroacupuncture were seen in the assessor-blinded objective outcomes (blinded Dellon-modified Moberg pick-up test and maximal tip pinch strength), which are known to be unaffected by a lack of patient blinding.[47]

We did not choose to add a sham control group for this trial because we wanted to determine the overall (specific effect of treatment with electroacupuncture and nonspecific effect of the whole treatment process) add-on benefit of electroacupuncture in a primary care setting where splinting is often used as a first-line treatment. From a pragmatic perspective, the nonspecific benefits of electroacupuncture characterized by patient-reported outcomes may be interpreted as clinical effect instead of bias.[48,49]

Another limitation is that the generalizability of the results may be limited because this trial was performed at a single centre. Also, we acknowledge that higher needle numbers and more frequent sessions may have a positive correlation with effect size.[50] Our results concur with the later observation as most outcomes in our study did not show significant benefits until week 17. However, it is uncertain that a different regimen of acupuncture (e.g., shorter intervention period) would provide a different effect. Finally, a lack of established MID values for some of the outcomes in this study may cause the interpretation of our results to vary when these MID values become available through an anchor- or consensus-based approach.[51]

Our study has several strengths, including a high compliance rate for electroacupuncture treatment (100%) and wrist splinting (> 80% in both groups). Included participants were mainly female, which reflects the prevalence pattern for carpal tunnel syndrome in the community.[52,53]

Because we recruited patients with a clear clinical diagnosis of carpal tunnel syndrome as set out by current guideline recommendations, we did not perform nerve conduction studies; this reflects routine practice in primary care settings.

Among patients with injuries to the upper extremity, the Katz diagram has a negative predictive value of 91% when the result does not indicate classic or probable diagnosis, ruling out a substantial portion of patients without carpal tunnel syndrome.[23] If we assume a conservative prevalence of 50% of carpal tunnel syndrome in this sample, the positive and negative predictive values of wrist flexion and nerve compression tests were 94% and 87%, respectively.[27] Independent of prevalence, high-quality studies have shown that the Phalen manuever test and Tinel sign test have favourable diagnostic likelihood ratios (Phalen mean positive likelihood ratio 2.68 and mean negative likelihood ratio 0.54; Tinel mean positive likelihood ratio 2.95 and mean negative likelihood ratio 0.57).[54] Therefore, we believe that the diagnostic criteria we used in this trial are satisfactory.

Diagnosis of carpal tunnel syndrome using ultrasonography has emerged as an alternative to nerve conduction studies and, because it has similar performance, a lower cost and higher patient acceptance,[54] future trials may consider ultrasonography as an additional inclusion criterion.

We chose a 17-week follow-up duration, which is in line with current guideline recommendations for conservative treatment. Nevertheless, observing the longer term impact of electroacupuncture would require extended research.

Conclusion

There is no current consensus on appropriate treatment for patients with chronic (≥ 6 mo) mild to moderate symptoms of carpal tunnel syndrome.[55] Most participants in our trial had chronic symptoms for more than 2 years, with moderate severity at enrolment. Our results showed the potential benefit of combining electroacupuncture with nocturnal splinting treatment for patients with chronic mild to moderate symptoms of longer duration. Indeed, the National Institute for Health and Care Excellence guideline recommends the use of steroid injection or surgery if conservative treatment fails to improve symptoms after 3 months. Use of steroid injections for treatment is not a com-

mon practice in primary care settings in Hong Kong. In this trial, those patients who had received steroid injections were excluded. Future trials may want to evaluate the benefit of combining electroacupuncture treatment with steroid injections.

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