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ORIGINAL RESEARCH ARTICLE

Remote Therapeutic Effectiveness of Acupuncture in Treating Myofascial Trigger Point of the Upper Trapezius Muscle

ABSTRACT

Chou L-W, Hsieh Y-L, Chen H-S, Hong C-Z, Kao M-J, Han T-I: Remote therapeutic effectiveness of acupuncture in treating myofascial trigger point of the upper trapezius muscle. Am J Phys Med Rehabil 2011;90:1036–1049.

Objective: This study aimed to investigate the remote effect of acupuncture (AcP) on the pain intensity and the irritability of the myofascial trigger point in the upper trapezius muscle.

Design: Forty-five patients were equally divided into three groups: patients in the placebo control group received sham AcP, those in the simple needling group were treated using simple needling, and those in the modified AcP received AcP with the rapid "screwed in and out" into multiple sites to elicit local twitch responses. The acupoints of *Wai-guan* and *Qu-chi* were treated. The outcome assessments included changes in subjective pain intensity, pressure pain threshold, range of motion, and mean amplitude of endplate noise in the myofascial trigger point region.

Results: Immediately after acupuncture, all measured parameters improved significantly in the simple needling and modified AcP groups, but not in the placebo control group. There were significantly larger changes in all parameters in the modified AcP group than that in the simple needling group.

Conclusions: The myofascial trigger point irritability could be suppressed after a remote acupuncture treatment. It appears that needling to the remote AcP points with multiple needle insertions of modified AcP technique is a better technique than simple needling insertion of simple needling technique in terms of the decrease in pain intensity and prevalence of endplate noise and the increase in pressure pain threshold in the needling sites (represented either AcP points and or myofascial trigger points). We have further confirmed that the reduction in endplate noise showed good correlation with a decreased in pain.

Key Words: Acupuncture, Endplate Noise, Myofascial Trigger Point, Pain Control, Remote Effects

Clinically, a myofascial trigger point (MTrP) is the most tender (hyperirritable) spot in a taut band of skeletal muscle fibers and is characterized by a specific pattern of referred pain and local twitch responses (LTRs).[1,2] Based on both human and animal studies, it has been suggested that there are multiple sensitive loci in an MTrP region.[3,4] These sensitive loci are probably nociceptors located in the endplate zone.[5] The prevalence of endplate noise (EPN), as recorded using electromyographic (EMG) equipment, is significantly higher in an MTrP region than in a non-MTrP region[6,7] and is highly correlated with the irritability (sensitivity) of an MTrP.[8] Recently, it was found that changes in EPN amplitude correlated significantly with changes in MTrP irritability.[9] Therefore, MTrP irritability can be assessed objectively by EPN prevalence or amplitude changes in the MTrP region.

Traditional acupuncture (AcP) therapy is probably the oldest type of dry needling. Dry needling (including AcP) has been reported to control the pain caused by MTrPs.[10–16] Acupuncture has been widely used for treating patients with acute or chronic pain. Previous reports on the efficacy of traditional acupuncture for pain control have yielded conflicting results.[17–22] Birch[23] claimed that the controversy stems from the variety of acupuncture therapies and that it is important to use standardized treatment methods, appropriate sham needle controls, and blind assessment to draw definitive conclusions (as in any therapeutic study).

In addition to direct needling of the painful MTrP, clinical studies have demonstrated a suppressive effect on MTrP after dry needling at a remote MTrP or acupuncture point either proximal or distal to the painful region.[24–28] A similar remote effect on pain control has also been documented in acupuncture therapy.[9,29,30] In clinical practice, patients often report severe pain in the upper trapezius muscle (shoulder and neck ache) but prefer not to have direct needling on this muscle. In such cases, remote needling can be a valuable therapeutic alternative. Indeed, remote needling therapy can also be used if there is another pathologic lesion in the painful region that precludes direct needling at the painful site.

For dry needling of MTrP, practitioners have been advised to obtain as many LTRs as possible to obtain rapid and maximal pain relief.[12,13,31–33] Multiple needle insertions into various sites in the MTrP regions are required to elicit multiple LTRs.[1,3] Recently, a modified acupuncture (MAcP) therapy similar to MTrP injection[34] has been developed and has excellent effectiveness on a patient with fibromyalgia.[34] This modified technique includes simultaneous twists of the acupuncture needle during "multiple rapid needle insertions" to facilitate needle insertion. Many previous studies with dry needling also applied the multiple needle insertion technique using injection needles or EMG needles.[12,13,15] However, in this technique, an acupuncture needle was used, and screwing technique was also added to facilitate the needle movement because it is very difficult to move the AcP needle through only direct needle insertion. In a recent study on its therapeutic effectiveness, the irritability (as measured by subjective pain intensity, pain threshold, and amplitude change of EPN) of the MTrP in the upper trapezius muscle was suppressed after needling remote acupuncture points.[9] This newly developed AcP method is referred to as the "screwed in-and-out" technique.[9] However, the effectiveness of this technique has not been compared with other needling techniques.

In this study, using the changes in the mean amplitude of endplate noise (EPN) recorded from the MTrP region as an objective outcome measurement, we compared the effectiveness of this new AcP technique with the simple needling techniques for treating MTrPs of the upper trapezius muscle in patients with chronic shoulder pain.

METHODS

Design and Setting

Patients were equally divided into three comparable groups: patients in the first group were treated using modified AcP (MAcP group), the second group, using simple needling (SN), and the third group, with a placebo (placebo control [PC] group). All patients were treated on two AcP points (also MTrPs) following a predetermined sequence (Fig. 1). For every patient, the subjective pain intensity, pressure pain threshold (PPT), and objective changes in the range of motion (ROM) of the cervical spine were assessed before and after treatment. EPN in the MTrP region of the upper trapezius muscle was monitored and assessed before, during, and after treatment (Fig. 1). The acupuncturist performing the intervention did not perform outcome assessment. Investigators conducting the outcome assessment were blind to the group assignment.

Participants

Patients for this study were selected from the rehabilitation department of a university hospital by

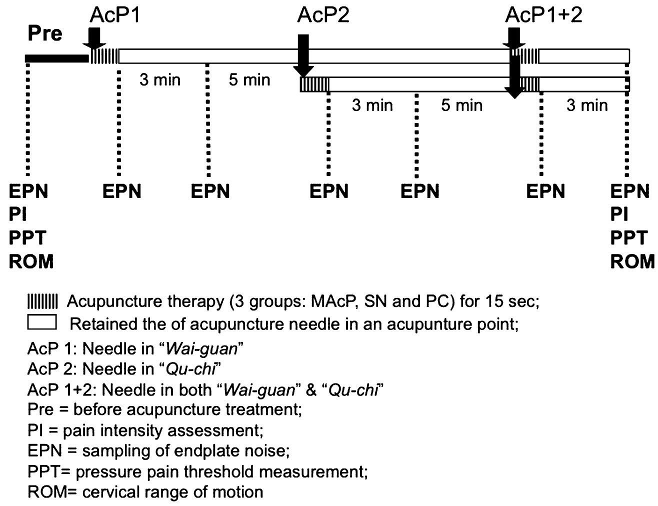

FIGURE 1 *Sequences of acupuncture therapy and assessment in the whole course of the experiment.*

a physiatrist who was not involved in the outcome measure. Inclusion was based on three criteria: (1) patients experienced chronic pain at subjective pain levels greater than 5/10 (where 0/10 = no pain; 10/10 = worst pain; 5/10 or lower = tolerable pain) on one side of the shoulder because of active MTrPs in the ipsilateral upper trapezius muscle; (2) patients had no previous acupuncture treatment; and (3) patients demonstrated poor response to previous conservative and noninvasive treatments such as oral medicine or physical therapy.

The exclusion criteria included the following: (1) patients with conditions of contraindication for needling, such as intake of anticoagulant medicine, local infection, malignancy, or pregnancy with threatened abortion; (2) patients with conditions that might interfere with assessments of pain intensity or pain threshold, such as use of analgesics or sedatives, substance abuse (including alcohol and narcotics), or cognitive deficiency; (3) those with previous trauma or surgery to the neck, upper back, or upper limb regions; and (4) patients with a history of significant neurologic disease involving the neck or upper limb (either central or peripheral in origin).

Assessment of patient suitability using the inclusion and exclusion criteria was based on the patients' detailed medical history and a physical examination. Selected patients were divided equally into three groups matched by sex and side of involvement. Patients were assigned to the MAcP, SN, or PC groups using a computerized randomization program. All patients gave informed consent, and the study was approved by the institutional review board of the university.

Identification of Myofascial Trigger Points

Active MTrP in the upper trapezius muscle was identified by the examiner using palpation examinations recommended by Travell and Simons,[1] Simons et al.,[2] and Gerwin et al.[35] and defined by the following criteria: (1) the most sensitive (tender) spot in a palpable taut band, (2) compression of this spot inducing pain qualitatively similar to the patient's usual clinical complaints (pain recognition), and (3) typical referred pain pattern elicited by compression of this spot as described by Travell and Simons,[1] Simons et al.,[2] and Gerwin et al.[35] The identified active MTrP of the upper trapezius muscle was marked on the skin within an area approximately 1 cm in diameter for the assessment of PPT and EPN.

Identification of Acupuncture Points

Two acupuncture points were selected for treatment in this study. The first AcP point, TE-5 (*Wai-guan*), is located in the extensor indicis muscle of the dorsal forearm between the radius and ulna and 3 cm superior to the dorsal transverse wrist crease. The second AcP point, LI-11 (*Qu-chi*), is located in the extensor carpi radialis longus muscle and on the lateral side of the cubital crease when the elbow is at its full flexion (Fig. 2). These two AcP points were determined and marked for subsequent study by a well-trained licensed acupuncture instructor who was not involved in the outcome assessment. Both AcP points have been selected frequently for neck and shoulder pain treatment.[36–38] The LI-11 AcP point is located in the meridian of the large intestine, and the TE-5 AcP

Qu-chi (LI-11) *Wai-guan* (TE-5)

FIGURE 2 *The patient was treated with acupuncture on the forearm, whereas amplitude of endplate noise was recorded from the myofascial trigger point in the ipsilateral upper trapezius muscle.*

point is located in the meridian of the triple heater (San-Jiao). Both meridians pass through the upper trapezius muscle in the shoulder. Using these two points for treating pain in the upper trapezius muscle was reasonable because we obtained satisfactory results needling these two AcP points in a previous study.[9,34] These two AcP points were also MTrPs (Ah-Shi points) as confirmed through a careful palpation examination and the occurrence of LTRs during needling.

Treatment Procedures

The same acupuncturist who initially identified the AcP points performed all treatment procedures. Patients were treated in a comfortable prone position, with the head turned toward the contralateral side and with the ipsilateral upper limb placed near the side of the examination table (Fig. 2). In this position, acupuncture needling to the forearm muscle and recording of EPN from the MTrP of the upper trapezius muscle on the same side could be performed simultaneously. During acupuncture treatment, patients were not able to observe either the treatment procedure on the forearm or the EMG recording of EPN from the MTrP of the upper trapezius muscle (Fig. 2).

Before the insertion of the acupuncture needle, the skin over the marked acupuncture point was cleaned with alcohol. For every patient in the MAcP or SN group, disposable acupuncture needles with a size of #30 and a length of 1 in or 1 ½ in (37 mm) were used.

For treating patients in the MAcP group, a newly modified technique was used for acupuncture therapy. Acupuncture needles were inserted into the regular depth in the subcutaneous layer. Similar to the technique of MTrP injection as suggested by Simons et al.[2] and Hong,[3,13] the needle was moved "in and out" into different directions at a speed of about 2 cm/sec to elicit LTRs. Simultaneous rotation of the needle was also performed to facilitate the in-and-out movement ("screwing in and out" technique[9]). With this rapid needle movement (high pressure), the LTRs were much easier to elicit (inducing the "*De-qi*" effect). This technique continued for 15 secs to further elicit as many LTRs as possible, then the needle insertion was maintained without any movement for 3 mins or longer for the temporary relief of pain accompanied with LTRs. The sequence of treatment is presented in Figure 1. For each subject, the TE-5 AcP point was treated first. About 5 mins after the completion of the needle manipulation (screwing in-and-out) at TE-5 point, the LI-11 point was treated with the same procedure, whereas the acupuncture needle remained motionless in the TE-5 point. Five minutes after the completion of the needle manipulation at the LI-11 point, both needles were manipulated ("screwed in and out") simultaneously for 15 secs and then maintained in a steady position for another 3 mins. The acupuncturist simultaneously used two hands for the manipulation of the two needles. This procedure required a significant period of practice to avoid needle bending or cork-screw deformity.

For treatment of patients in the SN group, acupuncture needles were inserted into the regular depth at both acupuncture points. Afterward, the needle was maintained without movement throughout the course of treatment. Theoretically, an LTR should be elicited only occasionally in response to a single-needle insertion. However, in our study, we did not observe any LTR during simple needling therapy.

In the PC group, each patient was treated with an acupuncture needle inserted into a rubber connector that was firmly taped onto the marked point for acupuncture.[9,39] There was needle-to-skin contact, and the patient would be able to feel the sharp needle tip; the needle, however, did not penetrate the skin. The needle was maintained in the previously mentioned position throughout the course of the treatment.

Assessment of Subjective Pain Intensity

Patients reported pain intensity based on a numerical rating scale from 0 to 10, with 0 representing "no pain" and 10 representing "worst imaginable pain." Pain intensity in the upper trapezius region was assessed before and after the completion of acupuncture therapy (Fig. 1). Pain intensity was not assessed during treatment because severe pain at the acupuncture site during needle manipulation in some patients of the MAcP group might interfere with feeling in the upper trapezius region. The duration of pain relief after treatment was assessed through telephone follow-up 1 mo after completion of the study because we expected that the duration of effectiveness might be similar to that observed following treatment of MTrP with dry needling.[13]

Assessment of Pressure Pain Threshold

Pressure algometry was used to measure pain threshold. The procedure was similar to that recommended by Fischer.[40,41] For each patient, PPT at the marked MTrP in the upper trapezius muscle was measured by a well-trained assistant who was blind to the treatment (MAcP, SN, or PC).

After the tests were explained, the patient was asked to completely relax in a comfortable chair. The metal rod of the algometer was placed perpendicularly on the skin surface of the marked area, and the pressure of compression was increased gradually at a speed of approximately 1 kg/sec. The patient was instructed to say "Pain" as soon as any increase in pain intensity or discomfort was felt; compression was stopped as soon as the patient said "Pain." The patient was asked to remember this level of pain or discomfort and to use the same criterion for the next measurement. Three repetitive measurements were performed at intervals of 30–60 secs at one site. The average value of the three readings (expressed as kilograms per square centimeter) was recorded for data analysis of the PPT measurement.

Assessment of ROM

The ROM of neck bending to the contralateral side (stretching of the ipsilateral upper trapezius muscle) was measured using a large-scale goniometer. The patient was asked to sit straight, with the back of the head just in front of the goniometer, which was fixed to the sliding bar of a body-height measuring device. This height was adjusted so that the center of the goniometer was level with the C7 spinous process. An indicator was fastened perpendicularly to the occipitus using a strap around the forehead and occipitus; the indicator was fixed to the patient's head using a velcro fastener. The patient was then asked to bend the neck to the side, and the angle was recorded. To measure the maximum active ROM, each patient was also requested to bend the neck fully toward the nonpainful side without moving the trunk.

Assessment of Changes in EPN

Equipment

A portable, miniature, two-channel digital EMG (Neuro-EMG-Micro; Neurosoft, Ivanovo, Russia) was used for this study. Intramuscular EMG activity was recorded using 37-mm disposable, monopolar Teflon-coated EMG needle electrodes. The length of the exposed needle tip ranged from 0.4 to 0.5 mm. The gain was set at 20 μV per division for recordings from both the first and second channels. The low-cut frequency filter was set at 100 Hz, and the high-cut frequency filter was set at 1000 Hz. Sweep speed was 10 msecs per division. The first channel recorded EMG activity from the active electrode, which was moved around the MTrP site to find the optimal position for EPN recording. The second channel recorded EMG activity from the active (recording) electrode at the control site (electrically silent site) in the muscle tissue adjacent to the MTrP site, where no EMG activity could be recorded and no pain could be elicited at the insertion site of the recording needle connecting the second channel (so that it was not a latent MTrP). A third needle electrode served as the common reference electrode by connecting it to channels one and two through "Y" connectors (Fig. 3). The common reference needle electrode was placed in the subcutaneous tissue, approximately 2–3 cm from the active recording site. In such an arrangement, action potentials recorded from the first channel can be confirmed as those recorded exactly from the recording needle tip of the first channel if the recording from the second channel is flat (electrically silent with no baseline fluctuations higher than 5 μV). A ground electrode was placed on the skin of the ipsilateral shoulder. Recordings were performed at room temperature (21°C ± 1°C).

Procedure for Searching for the EPN Loci

The active recording needle in the first channel was inserted into the MTrP region of the upper trapezius muscle to search for the EPN. The electrode tip was initially placed in the subcutaneous layer under the margin of the marked region at a depth of approximately 1–2 mm into the muscle. The needle was moved into the muscle tissue gently and slowly through the least possible distance (usually 1–2 mm) with simultaneous rotation to facilitate smooth entry without eliciting an LTR similar to that used in previous studies.[6–8,42] As

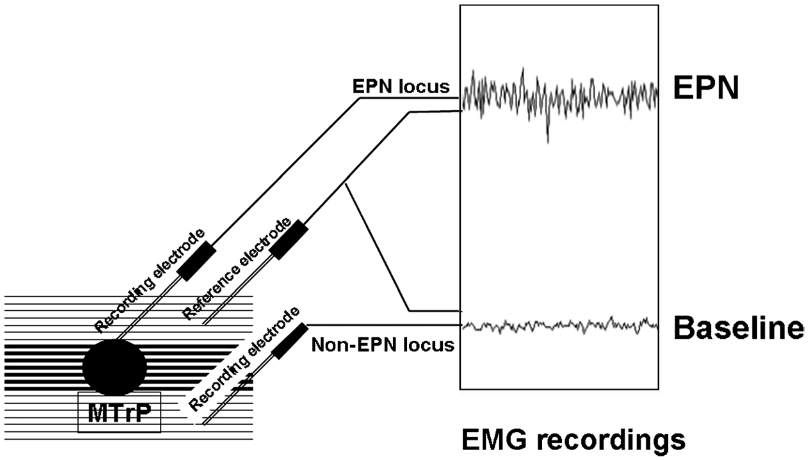

FIGURE 3 *Placement and connection of electrodes for EPN assessment and the recorded EPN traces from the first channel (top right) compared with a control trace recorded from the second channel (bottom right). EPN indicates endplate noise; MTrP, myofascial trigger point; EMG, electromyographic.*

soon as an EPN with a maximal amplitude (higher than 10 μV) could be recorded, the examiner stopped moving the needle to ensure that this EPN could run continuously on the recording screen with constant amplitudes. The recording needle was then fixed firmly onto the skin using tape to avoid any further movement. The acupuncturist began the AcP therapy (Fig. 1) as soon as the EPN amplitude was stable. Continuous EPN traces were recorded throughout the course of the treatment (AcP or placebo) to provide opportunities for continuous visual observation of EPN changes.

Measurement of EPN Amplitude

Selected EPN recordings (100-msec sweeps) were analyzed by the same investigator who conducted the EPN assessment before treatment. Sweeps were recorded at the initiation of treatment, during acupuncture, and 3 mins after the completion of the acupuncture treatment (Fig. 1). The mean amplitude of the EPN was calculated using embedded software in the Neuro-EMG-Micro equipment.

Statistical Analysis

Mean and standard deviations for pain intensity, PPT, range of neck side bending (ROM), and mean EPN amplitude were calculated. For the assessment of pain intensity, PPT, and range of neck motion, paired *t* test was used to assess the differences between the means before and after AcP treatment, whereas one-way analysis of variance was used to compare means among the three groups. Temporal changes in mean EPN amplitude before, during, and after acupuncture were assessed using repeated-measures analysis of variance. The threshold for statistical significance was $P < 0.05$. All data were analyzed using the Statistical Package for the Social Sciences version 10.0 for Windows.

RESULTS

Demographic Information

A total of 45 patients (15 in each group) with unilateral MTrPs in the upper trapezius muscle were enrolled in this study (Fig. 4). Every patient reported pain intensity greater than 5/10 for a period longer than 3 mos. Patients usually sought treatment when the pain level reached 5/10 or higher. Table 1 shows patient demographic information. There were no significant differences in demographic parameters between the three groups.

Pain Intensity (Verbally Reported Numerical Pain Scale)

Compared with baseline data before treatment, the pain intensity of the upper trapezius muscle significantly decreased after the completion of treatment in the MAcP and SN groups ($P<0.05$) (Table 2). However, in the PC group, there was no significant change in pain intensity after treatment ($P > 0.05$). The mean verbally reported pain scale in the MAcP group was significantly lower than that in any of the other two groups following treatments ($P < 0.05$). Based on the follow-up telephone call, the duration of pain relief lasted significantly longer ($P < 0.05$) in the MAcP group than in either the SN or PC group.

Pressure Pain Threshold

As shown in Table 2, there was significant increase in pain threshold after completion of the MAcP and SN treatments ($P < 0.05$), but not after

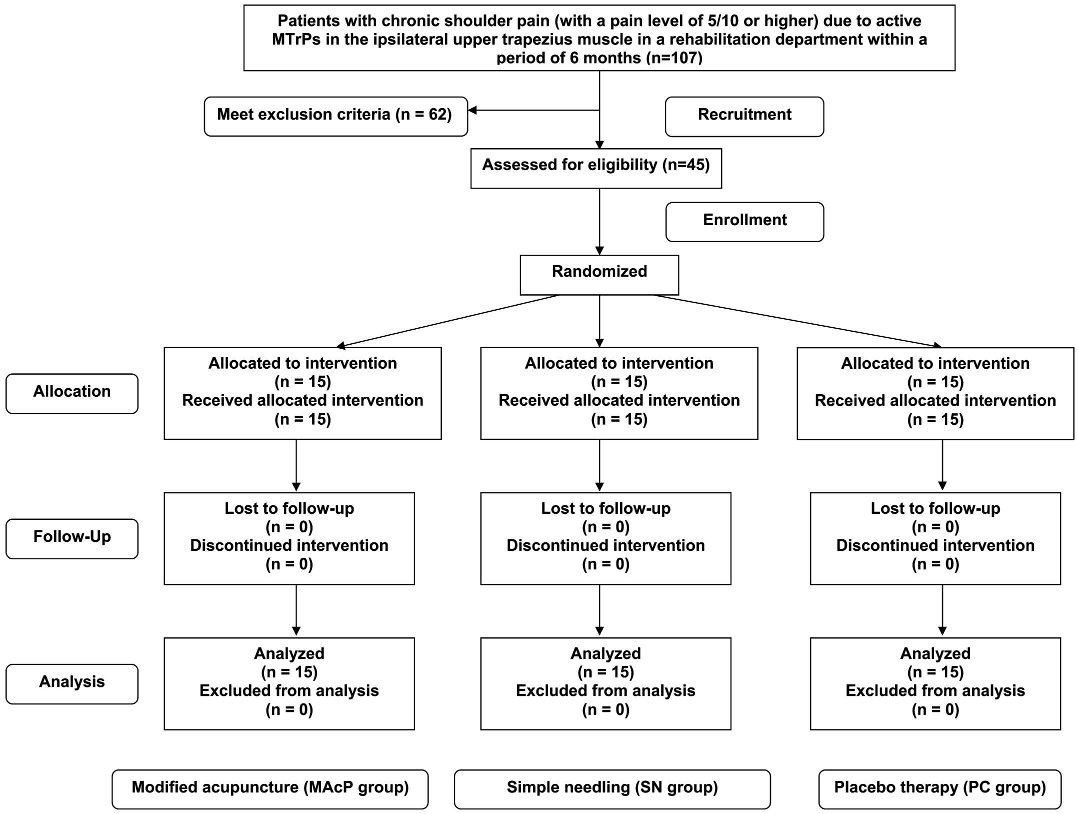

FIGURE 4 *Flow chart summarizing follow-up on clinical outcomes and treatment preferences. MTrP indicates myofascial trigger points.*

PC treatment ($P > 0.05$). The degree of improvement in the PPT was significantly higher in the MAcP group than in either the SN or PC group ($P < 0.05$).

ROM of the Neck

As listed in Table 2, there were significant increases in mean ROM after both MAcP and SN treatments ($P < 0.05$) but not following sham (PC) treatment ($P > 0.05$). The degree of improvement (expressed as % increase = [(data after treatment − data before treatment)/data before treatment] × 100%) of ROM during neck side bending was significantly higher in the MAcP group than that in the SN or PC groups ($P < 0.05$).

Mean Amplitude of EPN

The changes in mean EPN amplitude before, during, and after treatment in the three groups are presented in Figure 5. In the MAcP group, every

TABLE 1 Demographic data of patients

Group	PC	SN	MAcP	P^{a}
Total number of subjects	15	15	15	
Age, mean ± SD (range), yrs	33.9 ± 8.3 (22–50)	34.2 ± 7.7 (22–47)	34.1 ± 10.7 (23–58)	>0.05
Sex, *n*				
Male	8	7	7	>0.05
Female	7	8	8	>0.05
Side, *n*				
Right	8	8	7	>0.05
Left	7	7	8	>0.05
Pain duration, mos	6.2 ± 2.2	6.1 ± 2.3	6.1 ± 2.2	>0.05
Initial pain intensity (score, 0–10)	7.6 ± 1.1	7.3 ± 1.2	7.7 ± 1.0	>0.05
Initial pressure pain threshold, kg/cm^2	2.4 ± 0.5	2.5 ± 0.6	2.5 ± 0.5	>0.05
Initial neck range of motion, degrees	47.3 ± 9.0	47.7 ± 8.4	47.7 ± 8.8	>0.05

[a]Analysis of variance was used.

PC, Placebo Control; SN, Simple Needling; MAcP, Modified Acupuncture.

TABLE 2 Pain intensity, pressure pain threshold, and range of motion before and after treatment

Acupuncture Group	Before Treatment	After Complete Treatment	Changes,[a] %	P,[b] Before *vs.* After	Duration of Effectiveness, Days
Verbally reported pain scale (0–10)					
MAcP	7.73 ± 1.03	3.40 ± 1.06	−55.55% ± 13.49%	$P < 0.05$	4.73 ± 1.49
SN	7.33 ± 1.18	5.80 ± 1.01	−20.43% ± 10.86%	$P < 0.05$	1.93 ± 1.44
PC	7.60 ± 1.12	7.07 ± 0.88	−6.51% ± 7.47%	$P > 0.05$	0.53 ± 0.64
MAcP *vs.* SN *vs.* PC[c]	$P > 0.05$	$P < 0.05$	$P < 0.05$		
MAcP *vs.* SN[d]	NA	$P < 0.05$	$P < 0.05$		$P < 0.05$
MAcP *vs.* PC[d]	NA	$P < 0.05$	$P < 0.05$		$P < 0.05$
SN *vs.* PC[d]	NA	$P < 0.05$	$P < 0.05$		$P < 0.05$
Pressure pain threshold, (kg/cm^2)					
MAcP	2.37 ± 0.47	3.99 ± 0.60	73.16% ± 35.23%	$P < 0.05$	
SN	2.49 ± 0.65	2.88 ± 0.58	16.86% ± 9.68%	$P < 0.05$	
PC	2.50 ± 0.47	2.66 ± 0.47	6.84% ± 9.68%	$P > 0.05$	
MAcP *vs.* SN *vs.* PC[c]	$P > 0.05$	$P < 0.05$	$P < 0.05$		
MAcP *vs.* SN[d]	NA	$P < 0.05$	$P < 0.05$		
MAcP *vs.* PC[d]	NA	$P < 0.05$	$P < 0.05$		
SN *vs.* PC[d]	NA	$P > 0.05$	$P < 0.05$		
Range of motion of neck, degrees					
MAcP	47.33 ± 9.04	60.00 ± 11.50	27.63% ± 15.76%	$P < 0.05$	
SN	47.67 ± 8.42	52.00 ± 6.76	10.09% ± 8.43%	$P < 0.05$	
MAcP *vs.* SN *vs.* PC[c]	$P > 0.05$	$P > 0.05$	$P < 0.05$		
MAcP *vs.* SN[d]	NA	NA	$P < 0.05$		
MAcP *vs.* PC[d]	NA	NA	$P < 0.05$		
SN *vs.* PC[d]	NA	NA	$P > 0.05$		
PC	47.67 ± 8.84	49.33 ± 7.29	4.31% ± 6.35%	$P > 0.05$	

Values are expressed as mean ± SD.

[a]Changes (%) = (predata − postdata)/predata × 100%.

[b]Tested using paired t test.

[c]Tested using analysis of variance.

[d]Tested using post hoc test, Scheffe method.

MAcP, Modified Acupuncture; SN, Simple Needling; PC, Placebo Control; NA, not applicable.

patient exhibited an increased EPN amplitude upon initiation of the needle manipulation (screwing in and out) that decreased within a few seconds following completion of the needle movement. In the MAcP treatment group, there was a tendency for the simultaneous two-needle manipulation to exert larger changes in mean EPN amplitude than needle manipulation at only one AcP point. Changes in EPN amplitude were more modest in the SN group, whereas EPN amplitude did not change significantly in the PC group.

Statistical analyses of the changes in the mean EPN amplitude in all three groups are listed in Table 3. After the completion of the treatments, the mean EPN amplitudes were reduced ($P < 0.05$) in the MAcP and SN groups but not in the PC group ($P > 0.05$). The percentage of amplitude change (% increase = [(data after treatment − data before

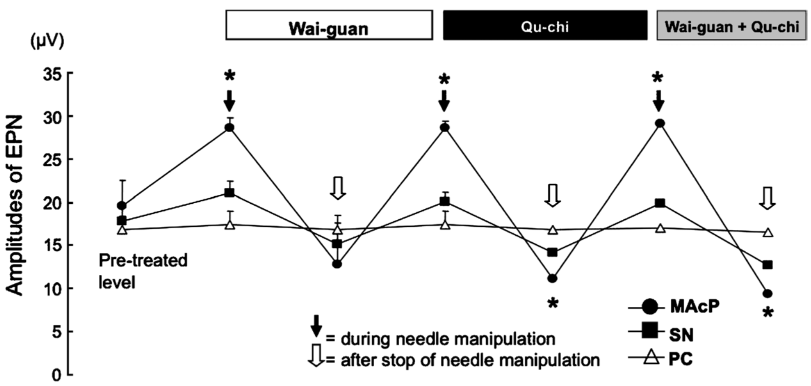

FIGURE 5 *The changes of the mean EPN amplitude in the three treatment groups. EPN indicates endplate noise; MAcP, modified acupuncture; SN, simple needling; PC, placebo therapy.*

TABLE 3 The serial changes of EPN amplitudes (in microvolts) in different treatment groups

				Statistics		
Acupuncture Procedure	MAcP	SN	PC	MAcP *vs.* SN	MAcP *vs.* PC	SN *vs.* PC
Baselines	19.61 ± 2.15	17.79 ± 1.33	16.85 ± 1.58			
Wai-guan: during needling	28.63 ± 2.92	21.08 ± 1.53	17.40 ± 1.56	$P > 0.05$	$P < 0.05$[a]	$P > 0.05$
3 mins later	12.75 ± 1.20	15.14 ± 1.31	16.85 ± 1.59	$P > 0.05$	$P > 0.05$	$P > 0.05$
Qu-chi: during needling	28.57 ± 4.83	17.40 ± 1.60	17.40 ± 1.60	$P > 0.05$	$P < 0.05$[a]	$P > 0.05$
3 mins later	11.07 ± 0.78	16.78 ± 1.57	16.78 ± 1.57	$P > 0.05$	$P < 0.05$[a]	$P > 0.05$
Two points: during needling	29.09 ± 4.43	19.91 ± 1.53	17.00 ± 1.65	$P > 0.05$	$P < 0.05$[a]	$P > 0.05$
3 min later	9.32 ± 0.75	12.72 ± 1.61	16.48 ± 1.61	$P > 0.05$	$P < 0.05$[a]	$P > 0.05$
Statistics: baseline *vs.* completion	$P < 0.05$	$P < 0.05$	$P > 0.05$			

Values are expressed as mean ± SD.

[a]Post hoc test; Scheffe method was used.

MAcP, Modified Acupuncture; SN, Simple Needling; PC, Placebo Control; EPN, endplate noise.

treatment)/data before treatment] × 100%) was significantly higher ($P < 0.05$) in the MAcP group than in the SN or PC groups during needling treatment and 3 mins after needle manipulation was stopped (Fig. 6).

DISCUSSION

Summary of the Important Findings in this Study

This study demonstrated that MAcP treatment provided better effectiveness than did SN therapy for suppressing irritability (i.e., pain intensity, pain threshold, and EPN amplitude) of a remote MTrP and releasing muscle tightness in the shoulder and neck. We further confirmed that the changes in mean EPN amplitude are a good objective outcome measurement.

Dry Needling and AcP for Pain Control

The multiple insertion technique was originally developed by Travell and Simons,[1] who performed this procedure slowly. Considering the time consumed and the possibility of cutting muscle fibers because of the side movement of the needle, Hong[13,43] suggested a "fast-in and fast-out technique" to keep the straight needle insertion (avoiding side movement) easily and to shorten the time of injection and found that LTRs could be elicited much more easily this way than with slow needle insertion. It has also been suggested that LTRs should be elicited through dry needling during treatment of MTrPs.[12,13] To elicit many LTRs, the needle should be inserted into multiple sites (tiny loci) in the MTrP region. Fast needle movement is required to produce high pressure (force = mass × acceleration) to facilitate LTR occurrence and to avoid side movement of the needle that may cause traction injury to the muscle fibers.[3,13,43] Considering the greater possibility of muscle fiber damage from multiple fast needle insertions, Chu[12] suggested the use of an EMG needle for fast movement. However, EMG needles are relatively large and may not be tolerable for some patients. Furthermore,

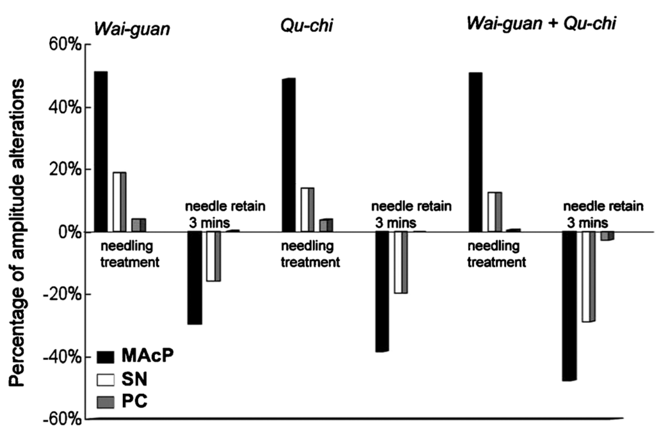

FIGURE 6 *The percentage amplitude change during and after needle manipulation (needle retained for 3 mins) in the three groups. MAcP indicates modified acupuncture; SN, simple needling; PC, placebo therapy.*

EMG needles are expensive. Instead, Gunn[16] used a small-size acupuncture needle for dry needling, but he did not emphasize multiple needle insertions at a fast speed.

In regular acupuncture therapy, immediate pain relief can be obtained only if the patient experiences the *De-qi* reaction during therapy, which has been described as soreness, numbness, heaviness, tingling, and sometimes muscle twitching.[14,17,44,45] These *De-qi* sensations can be elicited from some but not all acupoints during needling; this is probably related to the characteristics of the acupoints or the needling method used by the acupuncturist. Muscle twitching during the occurrence of *De-qi* is similar to the LTRs elicited by the high-pressure stimulation to nociceptors during MTrP injection.[3,31–33,43] Melzack[46] considered it hyperstimulation analgesia. Some authorities have suggested that the mechanism of acupuncture is probably similar to that of MTrP injections or dry needling of MTrPs.[3,12,15,32,43,46] The mechanism of immediate local pain relief at the site of needling after acupuncture or dry needling has been considered to be mediated via the neural pathway[10,32] because the biochemical reaction would be much slower than neural impulses. It has been suggested that strong (high pressure) stimulation from the needle tip to the nociceptor evokes a strong spinal cord reflex that elicits an LTR. In turn, this deactivates the “MTrP circuit” in the spinal cord[31,33] via the descending pain inhibitory system elicited by strong painful stimuli (hyperstimulation analgesia). Accompanied phenomena with pain relief in this study included increased PPT, increased ROM caused by decreased tightness of the involved muscle fibers (taut bands), and decreased EPN amplitudes. Simons et al.[2] and Simons[47] suggested that EPNs are caused by the excessive leakage of acetylcholine from the muscle endplates that causes focal depolarization (nonpropagated potentials) of sarcomeres within the endplate zone without spreading out (no action potentials) to the whole muscle fiber. Therefore, sarcomere shortening will only occur around the endplate zone with a relative lengthening of the sarcomeres in the two ends and concomitant tightness in the muscle fibers (taut band). The reduced EPN amplitude after needling in this study suggests reduced acetylcholine leakage after treatment, thus relieving muscle tightness.

In recent studies, Shah et al.[48] and Shah[49] found that the concentrations of all analyzed biochemical substances were significantly higher in active than in latent or normal subjects. He has further found that those biochemical levels were remarkably elevated in the MTrP region during LTRs, followed by a slow return to baseline. However, substance P and calcitonin gene-related peptide were the only two biochemicals for which concentrations during the recovery period after the LTRs were significantly below the baseline concentrations.[48] Reduced substance P and calcitonin gene-related peptide may explain the immediate pain relief experienced following LTRs during MTrP injection. Therefore, the possible mechanism of pain relief after LTR could be central (as mentioned previously), local (as suggested by Shah[49]), or both. Furthermore, EPN changes could also be affected by sympathetic tone[42,50] through mechanisms that again could be mediated centrally, locally, or both.

Mechanism of the Remote Effect of AcP

In many cases, the sites of acupuncture needling are remote to the painful site.[36–38,51] Based on the principle of traditional acupuncture, Tseng et al.[26] and Tsai et al.[28] demonstrated an effective way to inactivate a severe (hyperirritable) MTrP by the injection of other MTrPs remote to this MTrP. The injected MTrP was also an AcP point (*A-Shi* point).

According to the theory of traditional Chinese acupuncture, needling of an acupuncture point can induce specific therapeutic effects both locally or at a distance through the acupuncture “meridians” system.[44,52] Regarding the mechanism of remote acupuncture effects, it is probably related to a spinal cord mechanism similar to the MTrP mechanism.[4,32] A recent study by Hsieh et al.[27] demonstrated that dry needle-evoked inactivation of a primary[25] MTrP could inhibit the activity of satellite MTrPs situated in the zone of pain referral of this primary MTrP. It is possible that the activation of the nociceptors in the skin or muscles through needle stimulation (high pressure) can send strong sensory impulses to the spinal cord or higher centers to activate the descending pain inhibitory system for the central desensitization of all the related “neural circuits” of pain modulation (similar to the MTrP circuits described by Hong[31,33]).

MAcP Therapy

Nabeta and Kawakita[53] applied an acupuncture technique, called “sparrow pecking,” that used an alternative pushing and pulling of the needle on the tender points for neck and shoulder pain. However, they did not apply the technique of multiple insertions, and only performed “in-and-out” in one track.

Using this MAcP therapy, we can combine the advantages of both MTrP injection (rapid multiple insertions to elicit many LTRs) and AcP (small-diameter needle without a sharp cutting-end edge to avoid tissue damage and excessive pain). Because the small-diameter needle is too flexible to do fast-in and fast-out movements smoothly, simultaneous twisting (screwing) of the needle is used to facilitate needle movement. Pain caused by MAcP therapy is lower than that elicited by MTrP injection with Hong's[3,43] technique, but the pain is still higher than that caused by regular AcP treatment. However, the effectiveness is superior to regular AcP. The pain caused by this procedure is usually tolerable for most patients, even the patient with fibromyalgia.[34] Therefore, most patients could accept this new procedure.

Based on the traditional acupuncture viewpoint, simultaneous stimulation of two AcP points can enhance efficacy because of the "accumulation of energy,"[36–38] similar to the enhancement of central desensitization through multiple afferent stimuli as a consequence of hyperstimulation analgesia.[46] This is probably the reason why simultaneous needle manipulation at two AcP points can provide a better analgesic effect than a single-needle stimulation.

In this study, we compared the MAcP technique with an SN technique. The SN technique is similar to Badry's[11] superficial needling, which is actually a hybrid of "sham" needling and the "simple AcP" technique. In our clinical observation in oriental countries, many so-called "traditional acupuncturists" just provide a simple needle insertion with no attempt to elicit *De-qi* effectiveness (similar to local twitch response), but they still claimed satisfactory effects after therapy. In old Chinese acupuncture books,[54] *De-qi* effectiveness was mentioned and considered a good indicator of a satisfactory acupuncture result. However, it was never emphasized that every single acupuncture therapy should obtain the *De-qi* effectiveness. Using a single insertion technique, it appears difficult to obtain the *De-qi* effect or local twitch responses. This is probably the major reason to explain that acupuncture therapy may or may not be effective for pain control in previous studies.[17–22] We have emphasized the importance of multiple needle insertions for acupuncture similar to that originally suggested by Travell and Simons[1] for the MTrP injection. The facilitation to obtain LTRs (or *De-qi* effects) by using this technique was probably the major reason why this technique was superior to the traditional SN technique.

Short-Term Effectiveness of Acupuncture Therapy

In most occasions, acupuncture or MTrP dry needling (or injection) was used for a temporary pain control that, sometimes, is very important in clinical practice.[3,31] Hong[3,31] has emphasized that the underlying cause of muscle pain (or myofascial pain) should be eliminated completely before considering MTrP injection. However, in some occasions (such as difficulty in or delay of identification of the underlying etiology of muscle pain, difficulty in or delay of successful therapy for the underlying etiology of muscle pain, severe or intolerable muscle pain, persistent pain after elimination of underlying etiology of muscle pain, etc.), MTrP needling or injection is a viable alternative. Therefore, a very long-term effectiveness of acupuncture or MTrP dry needling was usually not expected, and they were usually performed clinically for temporary pain control. Hong[13] found that MTrP injection or needling was effective for up to 2 wks. In this study, we found that pain relief following remote acupuncture using this new technique lasted for only 1 wk or less on average. This appears to be much shorter than the effects observed following direct needling to an MTrP.[3,32,43] Pain relief for few days may be clinically significant, however, if it allows the patient to reduce oral medication (especially narcotic drugs) or if the patient can be treated repetitively. However, it is unclear whether this new technique can provide longer pain relief than other techniques when used repeatedly.

Limitations of This Study

The first and most critical limitation is the small sample size caused by the difficulty of patient selection. The statistical analyses showed significant changes in both subjective and objective assessments compared with a control group; therefore, the information still provided a significant demonstration of the superior efficacy of this new technique over simple needling.

A second limitation is the difficulty in pain intensity assessment on the proximal MTrP of the upper trapezius muscle during acupuncture on the remote sites because the pain elicited by remote needling could mask the pain in the proximal MTrP. Therefore, only the pain intensity before and after needling was assessed in this study.

The third issue is the difficulty in performing a blind study on AcP therapy. We tried to select patients with no previous AcP treatment for this study to reduce bias. However, the sharp pain produced when LTRs were elicited during multiple needling insertions could indirectly inform a patient about the "real needle treatment." Therefore, a patient who received MAcP therapy may be aware of receiving the real needling treatment, whereas this probably did not occur in the other two groups. The blindness in this study might not be validated.

The fourth limitation is the difficulty in the continuous monitoring of EPN. Although the recording electrode is tightly taped on the skin, a slight movement of the needle is still possible and may interfere with the changes in EPN amplitude. During the treatment with MAcP, severe pain in the needling region of the forearm may cause a slight movement in the ipsilateral shoulder, although most of the subjects could tolerate the pain and remain relaxed. Therefore, the increase in EPN amplitude immediately after MAcP could be related to the pain from peripheral needling. However, the subsequent decrease in EPN amplitude following treatment was definitely related to the MAcP therapy. One may question the possibility of eliciting LTRs when the peripheral (remote) pain occurred and caused a slight movement of the recording needle. However, in the whole experiment, we never observed any LTR accompanied with the monitored EPN tracings. Therefore, the therapeutic effectiveness manifested with reduced EPN amplitude should not be related to the pain caused by remote MAcP therapy. It may also be further questioned that the EMG needle for EPN recording may have the effect of a superficial dry needle[11] so that the upper trapezius pain can be treated in this way. However, this effect can be ignored because of the significant differences in all outcome measures among the three groups.

In the future, similar studies should be conducted on a large sample with a better control group and a better way to assess the pain intensity and a long-term follow-up after repeated treatments is strongly suggested. It is also important to try needling on other AcP points in remote regions.

CONCLUSIONS

We have further confirmed that the mean amplitude of EPN, as recorded by EMG, is highly correlated with the irritability (sensitivity) of an MTrP. Furthermore, changes in EPN amplitude can be used as an objective outcome measurement. We have also found that MTrP irritability can be suppressed after a remote acupuncture treatment. It seems that needling to the remote AcP points with multiple needle insertions of MAcP technique is a better technique than simple needling insertion of SN technique in terms of the decrease in pain intensity and prevalence of EPN and the increase in PPT in the needling sites (which represented either AcP points or MTrPs).

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