Short-Term Effects of Manual Therapy on Heart Rate Variability, Mood State, and Pressure Pain Sensitivity in Patients With Chronic Tension-Type Headache: A Pilot Study

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Abstract

Objective: The purpose of this study was to investigate the immediate effects of head-neck massage on heart rate variability (HRV), mood states, and pressure pain thresholds (PPTs) in patients with chronic tension-type headache (CTTH).

Methods: Eleven patients (8 females), between 20 and 68 years old, with CTTH participated in this crossover study. Patients received either the experimental treatment (massage protocol) or a placebo intervention (detuned ultrasound). Holter electrocardiogram recordings (standard deviation of the normal-to-normal interval, square root of mean squared differences of successive NN intervals, index HRV, low-frequency component, and high-frequency component), PPT over both temporalis muscles, and Profile of Mood States questionnaire (tension-anxiety, depression-dejection, anger-hostility, vigor, fatigue, confusion) were obtained preintervention, immediately after intervention, and 24 hours postintervention. Self-reported head pain was also collected preintervention and 24 hours postintervention. Separate analyses of covariance (ANCOVAs) were performed with each dependent variable. The hypothesis of interest was group × time interaction.

Results: The ANCOVA showed a significant group × time interaction for index HRV ($F = 4.5$, $P = .04$), but not for standard deviation of the normal-to-normal interval ($F = 1.1$, $P = .3$), square root of mean squared differences of successive NN intervals ($F = 0.9$, $P = .3$), low-frequency component ($F = 0.03$, $P = .8$), or high-frequency component ($F = 0.4$, $P = .5$) domains. Pairwise comparisons found that after the manual therapy intervention, patients showed an increase in the index HRV ($P = .01$) domain, whereas no changes were found after the placebo intervention ($P = .7$). The ANCOVA also found a significant group × time interaction for tension-anxiety ($F = 5.3$, $P = .03$) and anger-hostility ($F = 4.6$, $P = .04$) subscales. Pairwise comparisons found that after the manual therapy intervention, patients showed a decrease in tension-anxiety ($P = .002$) and anger-hostility ($P = .04$) subscales, whereas no changes were found after the placebo intervention ($P > .5$ both subscales). No significant changes were found in PPT levels (right $F = 0.3$, $P = .6$, left $F = 0.4$, $P = .5$). A significant group × time interaction for pain ($F = 4.8$, $P = .04$) was identified. No influence of sex was found ($F = 1.5$, $P = .3$). Pairwise comparisons showed that head pain (numerical pain rating scale) decreased 24 hours after manual therapy ($P < .05$) but not after the placebo intervention ($P = .9$).

Conclusions: The application of a single session of manual therapy program produces an immediate increase of index HRV and a decrease in tension, anger status, and perceived pain in patients with CTTH. (J Manipulative Physiol Ther 2009;32:527-535)

Key Indexing Terms: *Tension-Type Headache; Heart Rate; Manual Therapy*

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Paper submitted March 12, 2009; in revised form April 29, 2009; accepted May 5, 2009.
0161-4754/$36.00

doi:10.1016/j.jmpt.2009.08.011

Tension-type headache is common in the general population with a reported 1-year prevalence rate of 38.3% for the episodic form and 2.2% for the chronic type.[1] In addition, the prevalence of this particular headache disorder has recently been increasing.[2] Tension-type headache may cause substantial levels of disability for the patient.[3]

Although there has recently been an increasing interest in the pathogenic mechanisms of tension-type headache, the true pathoanatomical mechanism remains unclear.[4] However, it seems that hyperexcitability of nociceptive pathways may play an important role in tension-type headache.[5] This sensitization process typically results in increased muscle tenderness[6,7] and decreased pressure pain thresholds (PPTs), particularly in patients with chronic tension-type headache (CTTH).[8,9] In addition, it has been postulated that CTTH could be the manifestation of referred pain from muscle trigger points (TrPs) located in head, neck, and shoulder musculature.[10-12] It has been shown that sympathetic facilitation of mechanical sensitization and facilitation of the local and referred pain reactions in muscle TrPs exists, confirming sympathetic responses elicited by muscle TrPs.[13] It therefore seems sensible that impairments in the autonomic nervous system (ANS) could be associated with tension-type headaches.

In migraines, autonomic involvement has been identified.[14,15] However, previous studies of tension-type headache have rarely investigated the contribution of the ANS function and have primarily focused on involvement of the sympathetic system.[16,17] Numerous techniques exist to assess ANS function; nevertheless, techniques for evaluating parasympathetic activity have not been well established. Heart rate variability (HRV) has become the conventionally accepted term to describe variations of both instantaneous heart rate and rate recovery intervals.[18] Heart rate variability reflects the influence of the ANS on heart rate. Some studies found that manual therapy can influence HRV parameters in both healthy subjects[19] and patients with myofascial pain.[20] A recent study found that myofascial release therapy restored the HRV index and maintained high-frequency component (HF) domain of HRV during recovery after high intensity exercise.[21] It would be plausible to suggest that manual therapy aimed at inactivating muscle TrPs may have some impact on the ANS in patients with CTTH.

Population-based studies and clinical investigations found high comorbidity between headache and mood-anxiety disorders.[22] Furthermore, psychologic states (anxiety or depression) may influence quality of life and other clinical parameters in patients with CTTH.[23] Perozzo and Fondazione[24] found that patients with tension-type headache exhibited a significantly higher level of angry temperament, angry reaction anxiety, depression, or emotional liability. To the best of our knowledge, no study has investigated the effects of manual therapy on HRV parameters, psychologic disorders, PPT, and pain intensity in CTTH. Therefore, the purpose of this study was to investigate the immediate effects of head-neck massage on HRV, mood states, and PPT in patients with CTTH.

Methods

A placebo-controlled, repeated-measures, crossover, single-blind, randomized trial was used to investigate the effects of manual therapy in HRV parameters, psychologic disorders, pressure pain sensitivity, and pain intensity in patients with CTTH.

Subjects

Eleven patients (8 females), between 20 and 68 years old (mean, 51 ± 15 years), from the University Hospital San Cecilio (Granada, Spain) participated in this study between October 2007 and March 2008. Patients were diagnosed with CTTH by a neurologist experienced in the management of patients with CTTH according to criteria of the International Headache Society.[25] Headache features, temporal profile, family history, and medications were collected by the neurologist during the initial examination. To be eligible to participate, patients had to describe all the characteristics typical of CTTH: bilateral location, pressing and tightening pain, mild or moderate intensity (≤5 on 10 numerical pain rating scale [NPRS]), and no aggravation of headache during physical activity. In addition, patients had to have experienced headaches for at least 15 days in the prior month. No patients reported photophobia, phonophobia, vomiting, or nausea during the headache attacks. Other primary headaches (migraine) were excluded. A neuroimaging examination (magnetic resonance imaging or computed tomography) of the head was performed in all patients to exclude other disorders. Medication overuse for headache as defined by the International Headache Society[25] was ruled out by the neurologist. All patients had received several prophylactic drugs, but none was taking any migraine-preventive medications at the time of the study. Ethical Approval was granted by the local ethics committee (Granada 053). Informed consent was obtained from all participants, and procedures were conducted according to the Declaration of Helsinki.

Self-Reported Measures

A 10-point NPRS (0 = no pain, 10 = maximum pain) was used to assess current pain status.[26] Furthermore, the Profile of Mood States (POMS) questionnaire was used to evaluate mood state of the patient.[27] The POMS consists of 65 items grouped into 6 subscales: tension-anxiety, depression-dejection, anger-hostility, vigor, fatigue, and confusion.[28] Each subscale score is evaluated on a 5-point scale (0-4), with greater scores indicating a higher mood disorder. Subscale scores were converted into absolute T-scores (Spanish software)[29] for the statistical analysis, and the overall mood disturbance scores were also calculated.

Heart Rate Variability Measurement

Heart rate variability was assessed following the standard criteria of the Task Force.[18] Short-term HRV in time (standard deviation of the normal-to-normal interval [SDNN], square root of mean squared differences of successive NN intervals [RMSSD], and HRV index [number of all NN intervals/maximum of the all NN intervals]) and frequency (low-frequency component [LF], 0.04-0.15 Hz, or HF, 0.15-0.40 HF) domains were obtained using a 3-channel (1, right manubrial border of sternum—left anterior auxiliary line of sixth rib; 2, left manubrial border of sternum—1 inch to right of xiphoid process; 3, center of manubrium—left midclavicular line of sixth rib) electrocardiogram (ECG) (Norav Holter DL 800; Braemar, Burnsville, Minn), taking 5-minute recordings with the subject at rest and with no external stimulation at 3 time points: baseline, posttreatment, and 24 hours after treatment. The spectral analysis was calculated with NH300 Software (Norav, v.2.70, Baltimore, MD) using fast Fourier transform algorithms. The sampling rate was 128 samples per second, and the frequency filter was set at 0.05 to 60 Hz. Because of the low sampling rate, the software used an interpolation algorithm to improve *r*-peak detection.

Pressure Pain Threshold Assessment

Pressure pain threshold is defined as the minimal amount of pressure required for the sense of pressure to first change to pain.[30] An electronic algometer (Somedic AB, Farsta, Sweden) was used to measure PPT levels. The algometer consists of a 1-cm^2 rubber-tipped plunger mounted on a force transducer. The pressure was applied at a rate of 30 kPa/s. The participants were instructed to press a switch the instant the sensation changed from pressure to pain. The mean of 3 trials was calculated and used for main analysis. A 30-second rest period was provided between each measurement. This method has been shown to exhibit high reliability (intraclass correlation coefficient, 0.91; 95% confidence interval [CI], 0.82-0.97]).[31]

Interventions

Each patient attended 2 treatment sessions where they were randomly assigned to one of the following interventions at each visit: head-neck massage protocol (experimental) or detuned ultrasound (placebo). Both interventions were administered by a therapist with more than 5 years of clinical experience in manual therapy.

In the experimental session, patients received a series of manual therapies aimed to inactivating TrPs located in head and neck-shoulder muscles: temporalis, suboccipital, upper trapezius, splenius capitis, sternocleidomastoid, levator scapulae, and semispinalis capitis. Different TrP approaches, for example, pressure release, muscle energy, or soft tissue techniques, were applied to these muscles (Fig 1). The treatment session lasted approximately 40 minutes. The placebo condition consisted of a 40-minute application of detuned ultrasound applied over the same head and neck muscles as in the head-neck massage protocol. The position of the patient and the areas treated were identical for both treatment sessions.

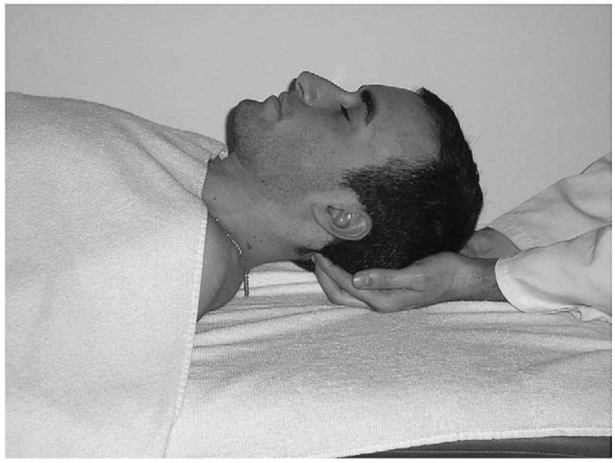

Fig 1. *Pressure inhibition of the suboccipital muscles.*

Study Protocol

Patients presented to the examination and treatment laboratory at the same time of day on 4 separate occasions (2 treatment sessions and two 24-hour postintervention assessments). Treatment sessions were at 1-week intervals. All sessions took place between 8 and 11 AM to avoid circadian rhythm-induced variations.[32,33] Participants were instructed to not take any analgesic or antiinflammatory medications for 72 hours before the first experimental session. In the first session, baseline Holter recording, PPT over both temporalis muscles and POMS measurements were obtained after a 10-minute rest period with the patient in the supine position. After preintervention data were collected, patients received the randomly assigned treatment (either the massage protocol or the detuned ultrasound procedure). The order of the interventions was randomly assigned by an assistant unaware of the purpose of the study. A computerized program was used to generate intervention allocation (experimental or placebo) of the study population. After the intervention, posttreatment measurements of Holter ECG, PPT levels, and POMS were obtained. In addition, postintervention measurements of Holter ECG, PPT, and POMS were obtained 24 hours after each intervention. All outcomes were collected by an assessor blinded to the treatment allocation of the patient. Self-reported headache pain was recorded preintervention and 24 hours postintervention.

Statistical Analysis

Data were analyzed with SPSS version 15.0 (SPSS Inc, Chicago, Ill). Mean and standard deviations or 95% CIs of the

Table 1. *Preintervention scores of each condition (n = 11)*

	Experimental condition	Placebo condition
HRV		
SDNN (ms)	38.7 ± 19.3	53.1 ± 55.1
RMSSD (ms)	33.3 ± 20.3	43.8 ± 37.9
Index HRV	4.1 ± 1.8	5.3 ± 2.8
LF (ms^2)	115.0 ± 37.5	144.9 ± 62.9
HF (ms^2)	186.6 ± 56.4	144.4 ± 43.1
POMS		
Tension-anxiety	41.5 ± 9.1	39.7 ± 8.6
Anger-hostility	47.6 ± 11.7	43.6 ± 9.2
Depression-dejection	44.5 ± 8.0	43.6 ± 7.5
Vigor	47.0 ± 7.8	44.1 ± 4.8
Fatigue	43.4 ± 7.8	43.6 ± 7.9
Confusion	36.9 ± 7.3	35.8 ± 6.6
Pain measures		
PPT left temporalis (kPa)	218.7 ± 55.7	210.8 ± 52.9
PPT right temporalis (kPa)	213.1 ± 37.4	209.1 ± 62.3
NPRS (0-10)	4.1 ± 1.7	3.7 ± 0.9

Data are expressed as mean ± standard deviation.

values were calculated for each variable. The Kolmogorov-Smirnov test showed a normal distribution of the data ($P > .05$). Preintervention values before each condition were compared using the independent *t* tests for continuous data. A 2-way repeated-measures analysis of covariance (ANCOVA), with intervention (control, experimental) as the between-subjects variable, time (pre-post) as the within-subjects variable, and sex as covariate, was used to examine the effects of the intervention. Separate ANCOVAs were performed with each dependent variable. The hypothesis of interest was group × time interaction. If a significant interaction was identified, planned pairwise comparisons were performed to examine differences from baseline to each time point between groups to investigate if any between-group differences in change scores were statistically significant. A *P* value less than .05 was considered statistically significant.

Results

All participants (n = 11) completed the protocol, and the results from all of them were used in the main analysis. Therefore, 3 males and 8 females (mean age, 51 ± 15 years old [95% CI, 41-60 years]; mean weight, 66.6 ± 7.5 kg [95% CI, 61-71 kg.]; and mean height, 160 ± 3 cm [95% CI, 155-164 cm.]) were included. Preintervention scores of each variable were not significantly different between each condition: SDNN ($P = .4$), RMSSD ($P = .4$), index HRV ($P = .3$), LF ($P = .6$), HF ($P = .1$), tension-anxiety ($P = .6$), anger-hostility ($P = .4$), depression-dejection ($P = .8$), vigor ($P = .3$), fatigue ($P = .9$), confusion ($P = .7$), PPT right ($P = .7$) or left temporalis ($P = .6$), and head pain ($P = .5$) (Table 1).

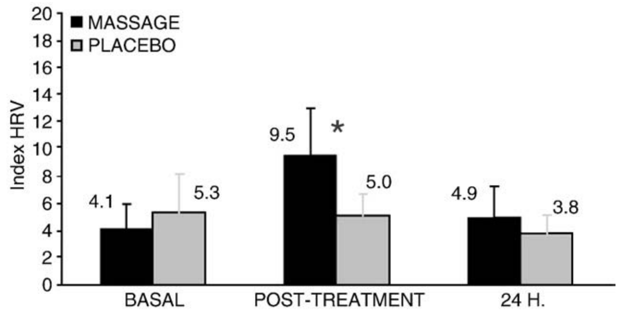

Fig 2. *Changes in the index of HRV preintervention, postintervention, and 24 h after each intervention (mean and standard deviation). Asterisks indicate statistical significance (P < .05).*

Effects of Manual Therapy on HRV

The analysis of variance showed a significant group × time interaction for index HRV (F = 4.5, $P = .04$), but not for SDNN (F = 1.1, $P = .3$), RMSSD (F = 0.9, $P = .3$), LF (F = 0.03, $P = .8$), or HF (F = 0.4, $P = .5$) domains. Furthermore, sex did not influence the comparative analysis (F = 0.07, $P = .8$). Pairwise comparisons found that after the manual therapy intervention, patients showed an increase in the index HRV ($P = .01$) domain, whereas no changes after the placebo intervention was found ($P = .7$). Nevertheless, 24 hours after each condition, both subscales returned to preintervention scores (Fig 2). Table 2 summarizes pre- and postintervention scores of each domain of HRV assessed.

Effects of Manual Therapy on Mood State (POMS)

The ANCOVA showed a significant group × time interaction for tension-anxiety (F = 5.3, $P = .03$) and anger-hostility (F = 4.6, $P = .04$) subscales, but not for depression-dejection (F = 0.6, $P = .4$), vigor (F = 0.2, $P = .6$), fatigue (F = 1.4, P 0.3), and confusion (F = 1.8, $P = .2$). Again, sex did not influence the analysis (F = 0.3, $P > .6$). Pairwise comparisons found that after the manual therapy intervention, patients showed a decrease in tension-anxiety ($P = .002$) and anger-hostility ($P = .04$) subscales, whereas no changes were identified after the placebo intervention ($P > .5$, both subscales). Nevertheless, 24 hours after each condition, both subscales returned to preintervention scores (Fig 3). Table 3 details pre- and postcondition scores of each subscale of the POMS.

Effects of Manual Therapy Protocol on Pressure Pain Sensitivity and Pain

The ANCOVA showed a significant group × time interaction for pain (F = 4.8, $P = .04$) but not for PPT levels in either right (F = 0.3, $P = .6$) or left (F = 0.4, $P = .5$) temporalis muscles. No influence of sex was found (F = 1.5, $P = .3$). Pairwise comparisons showed that head pain (NPRS) remained decreased 24 hours after manual therapy ($P < .05$) but not after the placebo intervention ($P = .9$). Table 4

Table 2. *Pre-post (mean ± standard deviation) and change scores (mean, 95% CI) of each domain of HRV after both conditions*

		Experimental condition	Placebo condition
SDNN (ms)	Preintervention	53.0 ± 55.0	38.7 ± 19.3
	Postintervention	120.8 ± 73.6	46.2 ± 20.2
	Pre- and postchange	67.8 (95% CI, 47.7-88.5)	7.5 (95% CI, 2.8-17.8)
	24 h postintervention	61.4 ± 45.1	35.3 ± 18.6
	Prechange and 24 h postchange	8.4 (95% CI, 4.7-20.4)	−3.4 (95% CI, −14.2 to −2.0)
RMSSD (ms)	Preintervention	43.8 ± 37.9	33.3 ± 20.3
	Postintervention	109.9 ± 85.3	48.4 ± 30.6
	Pre- and postchange	66.1 (95% CI, 37.3-94.9)	15.2 (95% CI, 7.5-27.9)
	24 h postintervention	54.5 ± 28.2	30.6 ± 14.6
	Prechange and 24 h postchange	10.7 (95% CI, 6.0-27.4)	−2.6 (95% CI, −6.4 to −0.6)
Index HRV (no. of all NN intervals/maximum of the all NN intervals) *	Preintervention	4.1 ± 1.8	5.3 ± 2.8
	Postintervention	9.5 ± 3.4	5.0 ± 1.6
	Pre- and postchange	5.4 (95% CI, 2.5-8.3)	−0.3 (95% CI, −1.8 to 2.3)
	24 h postintervention	4.9 ± 2.3	3.8 ± 1.4
	Prechange and 24 h postchange	0.8 (95% CI, 0.6-1.4)	1.6 (95% CI, 0.4-3.6)
LF (0.04-0.15 Hz) (ms^2)	Preintervention	117.1 ± 34.5	134.5 ± 65.9
	Postintervention	121.2 ± 42.1	119.2 ± 59.7
	Pre- and postchange	4.1 (95% CI, 3.2-4.8)	−15.4 (95% CI, −22.8 to −8.4)
	24 h postintervention	111.9 ± 49.7	136.7 ± 63.2
	Prechange and 24 h postchange	−5.3 (95% CI, −7.5 to −4.1)	2.2 (95% CI, −7.1 to 6.9)
HF (0.15-0.40 HF) (ms^2)	Preintervention	186.5 ± 56.4	142.4 ± 43.1
	Postintervention	170.4 ± 74.4	180.4 ± 58.4
	Pre- and postchange	−15.7 (95% CI, −39.3 to −11.8)	38.0 (95% CI, 9.7-58.2)
	24 h postintervention	184.5 ± 69.1	165.8 ± 79.3
	Prechange and 24 h post change	−2.0 (−2.4 to −0.6)	23.4 (95% CI, 9.6-46.9)

* Significant intervention × time interaction (ANOVA test).

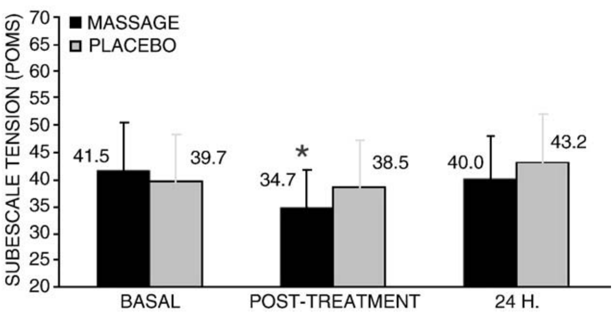

Fig 3. *Changes in the tension-anxiety subscale of the POMS questionnaire preintervention, postintervention, and 24 hours after each intervention (mean and standard deviation). Asterisks indicate statistical significance (P <.05).*

summarizes pre- and postcondition scores of PPT levels and head pain (NPRS).

Discussion

The results of our study showed that a single session of a manual therapy protocol aimed to inactivate muscle TrPs decreases the emotional tension and increases HRV, immediately after treatment, as compared with detuned ultrasound, in patients with CTTH. Nevertheless, we only found a transient effect of the treatment, which may have a limited clinical significance.

It has previously been identified that manual therapy associated with active aerobic recovery can restore balance to the ANS of an individual after exercise.[21] Our study found that a single 40-minute session of manual therapy is a simple method to increase HRV values as evidenced by HRV index at short-term. Our results are consistent with previous studies, which have investigated the parasympathetic effects of manual therapy, despite the older age and different characteristics of the patients used in other studies.[34-36] In addition, our study is the first to analyze changes in parasympathetic system in patients with CTTH who had not undergone surgical intervention as in other studies.[37,38]

A number of studies have used sympathetic nervous system activity in an attempt to quantify the physiologic effects of other manual therapies (mobilization and manipulation).[39-43] Many of these studies showed that spinal manipulative therapy produces a significant sympathoexcitatory response when compared with a placebo or control group.[40,42,43] A number of these studies also showed that a hypoalgesic effect accompanied the spinal mobilizations to a magnitude that was also statistically significant when compared with placebo and control groups.[39,41,42] Vicenzino et al in a double-blind, placebo-controlled, repeated-

Table 3. *Pre-post (mean ± standard deviation) and change scores (mean, 95% CI) of each subscale of the POMS questionnaire*

		Experimental condition	Placebo condition
Tension-anxiety [a]	Preintervention	41.5 ± 9.1	39.7 ± 8.6
	Postintervention	34.7 ± 6.9	38.5 ± 8.6
	Pre- and postchange	−6.8 (95% CI, −9.9 to −3.7)	−1.2 (95% CI, −4.1 to −0.7)
	24 h postintervention	40.0 ± 8.1	43.2 ± 8.4
	Prechange and 24 h postchange	−1.5 (95% CI, −4.5 to 1.5)	3.5 (95% CI, 7.4-0.4)
Depression-dejection	Preintervention	44.5 ± 8.0	43.6 ± 7.5
	Postintervention	41.6 ± 4.9	42.3 ± 6.7
	Pre- and postchange	−2.8 (95% CI, −6.6 to −0.9)	−1.3 (95% CI, −2.4 to −0.6)
	24 h postintervention	44.3 ± 7.8	45.7 ± 8.8
	Prechange and 24 h postchange	−0.2 (95% CI, −3.2 to 2.9)	2.1 (95% CI, −3.1 to 5.4)
Anger-hostility [a]	Preintervention	47.6 ± 11.7	43.6 ± 9.2
	Postintervention	40.6 ± 4.9	42.6 ± 8.9
	Pre- and postchange	−7.0 (95% CI, −13.7 to −3.3)	−1.0 (95% CI, −2.3 to 1.3)
	24 h postintervention	44.6 ± 9.6	47.2 ± 9.0
	Prechange and 24 h postchange	−3.0 (95% CI, −7.4 to −1.3)	3.6 (95% CI, −2.5 to 8.1)
Vigor	Preintervention	47.0 ± 7.8	44.1 ± 4.8
	Postintervention	47.1 ± 8.4	43.5 ± 5.9
	Pre- and postchange	0.1 (95% CI, −3.2 to 3.1)	−0.6 (95% CI, −3.1 to 2.0)
	24 h postintervention	46.9 ± 5.5	45.2 ± 4.5
	Prechange and 24 h postchange	−0.1 (95% CI, −3.6 to 3.5)	1.1 (95% CI, −2.9 to 4.2)
Fatigue	Preintervention	43.4 ± 7.8	43.6 ± 7.9
	Postintervention	39.8 ± 5.1	41.4 ± 7.2
	Pre- and postchange	−3.5 (95% CI, −6.5 to −1.4)	−2.2 (95% CI, −4.9 to 0.3)
	24 h postintervention	41.7 ± 5.2	45.6 ± 9.1
	Prechange and 24 h postchange	−1.6 (95% CI, −5.7 to 2.6)	2.0 (95% CI, 6.9 to −2.9)
Confusion	Preintervention	36.9 ± 7.3	35.8 ± 6.6
	Postintervention	33.5 ± 4.3	34.4 ± 5.6
	Pre- and postchange	−3.4 (95% CI, −6.1 to 1.1)	−1.4 (95% CI, −4.7 to 1.9)
	24 h postintervention	35.4 ± 5.4	38.5 ± 9.0
	Prechange and 24 h postchange	−1.5 (95% CI, −5.5 to 2.5)	2.7 (95% CI, −2.9 to 6.3)

[a] Significant intervention × time interaction (ANCOVA test).

Table 4. *Pre-post (mean ± standard deviation) and change scores (mean, 95% CI) of headache pain and PPTs in the temporalis muscle after each condition*

		Experimental condition	Placebo condition
PPT left temporalis	Preintervention	218.7 ± 55.7	210.3 ± 52.9
	Postintervention	203.2 ± 53.9	204.4 ± 64.0
	Pre- and postchange	−15.5 (95% CI, −28.4 to −9.5)	−6.1 (95% CI, −17.5 to −2.3)
	24 h postintervention	222.2 ± 61.6	220.9 ± 63.4
	Prechange and 24 h postchange	4.5 (95% CI, 3.8-5.7)	10.6 (95% CI, 6.2-22.4)
PPT right temporalis	Preintervention	213.1 ± 37.4	206.1 ± 59.9
	Postintervention	211.2 ± 50.8	213.6 ± 61.8
	Pre- and postchange	1.9 (95% CI, 0.8-4.2)	7.6 (95% CI, 3.3-17.7)
	24 h postintervention	242.6 ± 82.7	215.7 ± 76.9
	Prechange and 24 h postchange	29.5 (95% CI, 16.4-55.4)	9.6 (95% CI, 6.2-16.4)
NPRS [a]	Preintervention	4.1 ± 1.7	3.7 ± 0.9
	24 h postintervention	3.1 ± 1.4	3.6 ± 1.3
	Prechange and 24 h postchange	−1.1 (95% CI, −2.0 to −1.0)	−0.1 (95% CI, −0.15 to 0.0)

Pressure pain thresholds are expressed in kilopascal. Numerical pain rate scale: absolute values, 0-10.

[a] Significant intervention × time interaction (ANCOVA test).

measures study investigated the effects of cervical mobilizations (Maitland, grade 3 lateral glides) on PPTs and skin conductance in the limbs of subjects with lateral epicondylalgia.[42] The results showed not only a statistically significant increase in sympathoexcitatory response and hypoalgesia but also a strong correlation (r = 0.82, P = .05) between the hypoalgesic effect and sympathoexcitatory response produced with spinal mobilization.[42] It is also possible that this may have also occurred with the manual therapy techniques used in the current study.

In addition, it is possible that the physiologic mechanism by which the intervention works may be associated with stimulation of central control mechanisms (periaqueductal gray area).[44,45] This may result in a reflex stimulation of descending inhibitory mechanisms.[42,46-48] Nevertheless, it seems that more than one mechanism explains the effects of manual therapy,[49] and there is insufficient evidence to claim a major role for either peripheral or central mechanisms. Future research is necessary to determine whether manual therapy exerts its effects either through mechanical or neurophysiologic mechanisms or through both.

Following the same hypotheses as other authors on the psychologic effects of massage,[34,50] this study confirms that manual therapy does not induce changes in mood state. However, the short-term effects after the massage session were associated with a decrease in tension-anxiety and lower anger-hostility levels, which differed from the placebo condition. These changes may be related to the ability of manual therapy to produce a parasympathetic vegetative response associated with massage-induced improvements in HRV, blood pressure,[21] and immune function[51] Chronic tension-type headache is associated with an increase in anxiety, depression, and an impairment of anger control.[23,24] In the current study, the manual techniques apparently influenced the patients' mood state by decreasing the emotional tension and anger, although only at short-term.

Limitations

There are a few limitations to consider in this study. Only one therapist performed all the manual techniques, which may limit the generalizability of results. However, these techniques are commonly used in clinical practice and require minimal training. Hence, we expect that other clinicians may be able to provide similar treatments with similar results. We also used a small sample size with a 24-hour follow-up only. In fact, we only found a transient effect of the treatment, which may have limited clinical significance. It is possible that subsequent sessions may have a greater and longer lasting effect on clinical outcomes. Future studies using larger sample sizes with long-term follow-up periods are needed to elucidate the clinical relevance of the current findings. We also cannot exclude the placebo effects associated with hands-on technique, which in itself is capable of eliciting a sympathoexcitatory response.[43] However, it has been shown that manual techniques result in an increased sympathetic response when compared with a placebo technique, which consisted of solely manual contact.[43]` Future studies should compare the manual techniques used in the current study to a placebo technique, which includes manual contact with the patient. Finally, we should recognize that blinding of patients may not be effective because the placebo intervention differed from the treatment physically. Therefore, the placebo effect associated with hands-on technique should not be ignored. Future randomized controlled trials should include a hands-on placebo intervention to further elucidate the real effects of the treatment protocol applied in the current pilot study.

Conclusions

The application of a single session of manual therapy program produces an immediate increase of index HRV and a decrease in tension, anger status, and perceived pain in patients with CTTH. Nevertheless, we only have found a transient effect of the treatment, which may have limited clinical significance. Future studies investigating the effects of numerous treatment sessions are needed to elucidate the clinical relevance of the current findings.

Practical Applications

- The application of a session of head-neck massage produces an immediate increase of the index HRV in patients with CTTH.
- The application of a session of head-neck massage produces an immediate decrease in tension, anger status, and perceived pain in patients with CTTH.

Funding Sources and Potential Conflicts of Interest

No funding sources or conflicts of interest were reported for this study.

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