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Original Article

Use of pressure dynamometer in the assessment of the pressure pain threshold in trigger points in the craniocervical muscles in women with unilateral migraine and tension-type headache: An observational study

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ABSTRACT

Background: Tension type headache (TTH) and migraine are the most prevalent types of primary headaches with central sensitization and myofascial dysfunction linked to their chronicity. Osteopathic manipulative treatment (OMT) is used in the care of headache sufferers; however, there is a scarcity of high-quality evidence to determine the effectiveness of this intervention, and its underpinning biological correlates.
Objective: The objectives of this observational study were four-fold. Firstly, to estimate the PPT in diagnosed trigger points in craniocervical muscles in women with unilateral migraine or tension-type headache compared to asymptomatic women. Secondly, to assess between-group differences in PPT and pain intensity. Thirdly, to assess the impact of headache on quality of life (QoL) using the Headache Impact Test 6 (HIT-6) questionnaire on unilateral migraine and tension-type headache sufferers. Finally, to assess links between QoL, PPT, VAS and the score in the temporomandibular disorder screening questionnaire (TMDSQ).
Method: A sample of 60 women comprising of 20 patients with unilateral migraine, 20 patients with TTH and 20 asymptomatic were assessed using a portable digital dynamometer for PPT of trigger points found in the Temporalis (4 points), Sternocleidomastoid (6 points), Suboccipital (2 points), and Upper Trapezius (1 point) muscles. VAS was applied when pain was referred on a TP. All participants completed the TMDSQ questionnaire, and the migraine and TTH groups completed the HIT-6 questionnaire.
Results: Migraine and TTH groups presented lower PPT levels in all trigger points studied compared to the Control group ($p < 0.01$), except for the ECM clavicular TP_2L trigger point ($p = 0.27$). No statistically significant difference between migraine and TTH groups in PPT was found. Migraine and TTH groups showed higher pain intensity in all trigger points compared to Control group ($p < 0.01$). In the Migraine group, there was a positive association ($r = 0.47$, $p < 0.05$) between TMDSQ and HIT-6 scores.
Conclusion: Despite a greater impact on the QoL of women with unilateral migraine, there was no statistical difference in the PPT values for both unilateral migraine and TTH groups. In future studies, PPT might be used to monitor the effectiveness of OMT or other therapies in women suffering from unilateral migraine and TTH.

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Implications for practice

- Pain pressure threshold can be used to objectively assess headache sufferers as part of osteopathic diagnostic reasoning.
- Correlations between TMD Screening Questionnaire, Headache Impact Test and pain pressure threshold in women.
- Amongst migraineurs, there is a negative correlation between PPT and pain intensity in some of the head and neck muscles.
- This study revealed no significant differences in PPT in trigger points in migraine and tension-type headache sufferers.

Introduction

Tension-type headache (TTH) and migraine are the most prevalent types of primary headaches in the general population, and the most frequent causes of medical care for headache at all levels of complexity [1,2]. Headaches are significantly more prevalent in women than men, 18% vs. 6% [3], and with a ratio of 5:4 in TTH [4]. Headache disorders contribute to considerable reductions in functioning and in quality of life (QoL) [5]. Cervical and occipital symptoms are often associated with primary headaches, suggesting involvement of the cervical afferents of central pain processing, and are now considered a precipitating or perpetuating in these disorders [6]. Musculoskeletal conditions, such as trigger points (TPs), and forward head posture, are associated with TTH [7,8]. However, typically these conditions are not related to unilateral migraine [9]. Although migraine pain is most commonly perceived in the ophthalmic distribution of the trigeminal nerve, a substantial percentage of migraineurs are reported to experience pain in the cervical (39.7%) and occipital regions (39.8%) with their migraine attacks [10].

Generalized mechanical pain hypersensitivity has been demonstrated in patients with both chronic TTH and migraine as sign of central sensitization [11]. Other authors also reported that the referred pain provoked by TPs mimics the headache pattern of patients with TTH, migraine and cervicogenic headache [12,13]. There is controversy over whether TP are a peripheral or central nervous system phenomenon [14]. Referred pain, the most characteristic sign of a TP, is a central phenomenon initiated and activated by peripheral sensitization, whereby the peripheral nociceptive input from the muscle can sensitize dorsal horn neurons that were previously silent [15]. The most commonly accepted definition describes a TP as a hyperirritable spot in a taut band of a skeletal muscle, which is painful on compression, stretch, overload, or contraction of the muscle and usually has a distinct referred pain pattern [16]. Travell and Simons [16] mapped TPs in several body regions, and in the site of referred pain that might be latent or active. Active TPs cause spontaneous and referred pain [17,18]. In contrast, latent TPs are painful only on palpation with similar characteristics to active TPs present in asymptomatic areas. When submitted to stress, these points might become active and, thus, generate pain syndromes and disability [19,20]. Although TPs are regarded an important source of muscle pain, their diagnosis is still done by physical examination, both for clinical and research purposes [18]. Manual palpation is the most widely used clinical method to evaluate muscle pain and is considered an important part of the clinic exam. However, although widely used, the reliability of this test is typically poor [20].

Pain sensitivity can be assessed using an algometer to determine the Pressure Pain Threshold - PPT [21]. Algometry is a technique that quantifies the ability of perception and pain tolerance by pressure on the nociceptors [11]. PPT is influenced by age, sex and body regions [22]. One type of pressure algometer consists of a pressure threshold meter - Dynamometer [23]. The use of a tool (dynamometer or algometer) is particularly important relevant to research seeking standardization of procedures and for calibration and clinical training regarding the amount of pressure that must be exerted [24]. In both clinical and research settings, the pressure algometer greatly contribute to increased reliability in the diagnosis of TPs [25]. Recent research indicated that in migraine sufferers, PPT and reduced presence of muscle TPs are usually observed. However, there is scarce literature that compares PPT in unilateral migraine with TTH sufferers [11]. Fernández-de-las-Peñas and colleagues observed a decrease in PPT in patients with TTH; however, data on PPT of migraine sufferers are still contradictory [11].

Authors in the field of osteopathy have argued that the osteopathic concepts applied to the musculoskeletal system and the relations to other body systems are particularly suitable to the care of patients with headache [26]. Schabert and Crow suggest that the inclusion of OMT in a treatment regimen for migraine sufferers may reduce treatment costs [21]. Cerritelli and co-workers investigated the impact of migraine on QoL using the Headache Impact Test 6 (HIT-6), and found that OMT may be considered a valid procedure in the care of patients with TTH and migraine [27,28]. However, there is currently no research investigating the effectiveness of OMT in improving QoL and PPT.

Another important aspect that should be considered is that the clinical differentiation between primary headaches and temporomandibular disorders (TMD) can be challenging [29]. Some studies have confirmed that the presence of parafunctional habits, i.e., activities of the masticatory muscles, as clenching and grinding has an important role in TMD pain, whereas patients with sleep bruxism have an increased risk for the occurrence of myofascial pain [30]. Myofascial pain is regarded as a common source of TMD and a common cause of headache [31]. TMD is commonly associated with HTT however, this relationship has not yet been well established [29]. Migraine episodes are associated with reduced PPT of masticatory muscles [32]. Consequently, TMD is an important diagnostic factor in some patients with primary headaches [33]. Despite these relationships, research evaluating PPT in the craniocervical muscles [11,12] did not consider TMD in both headache and asymptomatic subjects.

The aims of this study were four-fold. Firstly, to estimate the PPT in diagnosed trigger points in craniocervical muscles in women with unilateral migraine or tension-type headache, compared to asymptomatic women. Secondly, to assess between-group differences in PPT and pain intensity. Thirdly, to assess the impact of headache on quality of life according to the questionnaire "Headache Impact Test" 6 (HIT-6) on unilateral migraine and tension-type headache sufferers. Finally, we assessed correlations between quality of life, PPT, VAS and the score in the temporomandibular disorder screening questionnaire (TMDSQ).

Method

Design

We used an observational design to estimate the PPT in diagnosed trigger points in craniocervical muscles and to compare differences in PPT and pain intensity in female adults with unilateral migraine, tension-type headache and asymptomatic females;

we also compared the impact of headache on QoL on those with unilateral migraine and TTH.

Sample

A sample of 60 female individuals was recruited from the Neurology Service at the Hospital São José in Santa Casa de Misericórdia Hospital Complex (ISCMPA) and from the student population at the Brazilian Institute of Osteopathy (IBO) from Porto Alegre, Brazil (1st year, 2nd year and 3rd year) between July and November 2012. The cases (n = 40) were recruited through posters placed at the Neurology Service Center in the Hospital ISCMPA and through ads at the IBO website. The posters placed at the Neurology Service invited women with the required inclusion, to participate as volunteers. The controls (n = 20) were recruited through posters placed on the IBO website: female students were invited to participate voluntarily and to attend to receive information regarding the study on a specific date. All participants were over 18 years of age and able to communicate in Portuguese.

In order to have a more homogenous sample, it consisted of women with headache history (one year or longer) and healthy women, aged between 18 and 50 years. The cases consisted of 20 women (35.8 ± 7.9 years old) suffering from unilateral migraine (Migraine group), and 20 women (34.4 ± 8.7 years old) with tension-type headache (TTH group). The controls consisted of 20 asymptomatic women (33.9 ± 9.0 years old). The clinical diagnosis was made by a neurologist at the Neurology Service of the Hospital ISCMPA, following the criteria of the "International Headache Society" (ICHD-2) [34]. For a sample size of 60 volunteers, it was verified a power of 0.85, an alpha equal to 0.05 and an effect size of 0.35. It was calculated considering the mean PPT values for Upper trapezius point TP_1.

The inclusion criteria for cases were women suffering from unilateral migraine, frequent episodic tension-type headache or chronic tension-type headache lasting over a year. Women in the control group did not have a history of headache or pain in the neck and shoulder regions. Asymptomatic women who showed any indication of TMD, i.e., a positive answer to the Screening Questionnaire for Temporomandibular Disorders (TMDSQ) recommended by the American Academy of Orofacial Pain [35] were excluded from the study. In the headache groups, individuals who were unable to provide a positive answer to the following questions *Have you had any recent trauma to the head, neck or jaw?* and *Have you had recent treatment for an unexplained problem in the jaw joint?* were excluded from the study. Moreover, women with a previous history of neck trauma or whiplash, and those with other primary headaches and a history of headache lasting less than a year, were excluded from the study.

Procedure

The study was approved by the Hospital São José da Irmandade Santa Casa de Misericórdia de Porto Alegre, Brazil (ISCMPA) Ethics Committee under the number CAAE-04236912.6.0000.5335 and all participants gave their verbal and written informed consent. After the provision of information regarding the study and the signing of the consent form, the following procedures took place: completion of the HIT-6 questionnaire by all participants in the migraine and TTH groups [36]; completion of TMDSQ by the entire sample [35], assessment of PPT in identified trigger points (TPs), and completion of the visual analog scale (VAS) on every occasion a participant reported pain in a TP.

A score was calculated from the data obtained from the HIT-6 by summing the points in each column, according to the answers. This test estimates the impact of headache:

- Mild impact (≤49 points);
- Moderate impact (50–55 points);
- Substantial impact (56–59 points);
- Intense impact (≥60 points).

Women in the Migraine and TTH groups retained the use of prescribed medication (tricyclic antidepressants). Despite this, 75% of women in the Migraine group and 90% on the TTH group did not use the prescribed drugs. However, they were not allowed to use analgesics 24 h before the dynamometric measurement.

During the examination, the women remained seated in a relaxed position, with a support at shoulder height, both feet placed on the floor and the upper limbs supported by a table in front of them. The TPs assessed were the same for all groups, regardless of being active or latent TPs.

For each chosen muscle, the TP was assessed once, first the right side and then the left side. The TPs were determined and mapped according to Travell and Simons [16]:

1. Temporalis muscle (4 points): temporalis anterior point TP_1, temporalis medium point TP_2, temporalis medium point TP_3 and temporalis posterior point TP_4;
2. Sternocleidomastoid muscle - ECM (6 points): ECM sternal division TP_1, ECM sternal division TP_2, ECM sternal division TP_3, ECM clavicular division TP_1, ECM clavicular division TP_2 and ECM clavicular division TP_3;
3. Suboccipital muscles (2 points): suboccipital point TP_1 and suboccipital point TP_2 located at the bone insertion of the suboccipital muscles;
4. Upper trapezius muscle (1 point): Upper trapezius point TP_1 located at the medium point of the scapula upper border.

TP diagnosis was performed following the diagnostic criteria described by Simons et al. [16] and Gerwin et al. [37]: [1] presence of a palpable taut band in a skeletal muscle; [2] presence of a hypersensitive tender spot in the taut band; [3] local twitch response elicited by the snapping palpation of the taut band; e [4] reproduction of the typical referred pain pattern of the TP in response to compression.

An examiner, who was not blinded to group, conducted all the measurements. The PPT assessment of the TPs was performed using a portable digital DD-500 Instrutherm Dynamometer [31,38] (Instrutherm®, São Paulo, Brazil) adapted to PPT assessment and with a measurement interval of 0 to 29 Kg, and 0.001 Kg of precision. The examiner underwent 20 h of training, in order to apply a constant speed of approximately 1.0 $kg/cm^2/s$ [38].

The dynamometer support point was held perpendicular to the skin overlying the TP. With the dynamometer indicator at zero, a compression was exerted gradually and steadily until the patient reported the onset of pain (PPT) in that point. Before starting the examination, all participants were instructed to indicate clearly (saying the word "pain") the exact moment when they felt that pressure would be converted into pain (the pain threshold). For this reason, we explained that the purpose of our study was to measure when the pain started and not the tolerance to it. Then the device was blocked using the Peak Hold button (maximum load). The values were recorded in Newtons converted to kgf for the PPT. The VAS score was recorded every time participants had referred pain on a TP [39].

Statistical analysis

Data distribution was checked by Shapiro Wilk test. For the analysis between groups (Control vs Migraine vs TTH) we used one-way ANOVA with Tukey's post-hoc test for the Pressure PP and age;

and Kruskal Wallis's test followed by Mann-Whitney U Tests with adjusted P-values for multiple statistical tests to decrease the risk of type I error, for the pain intensity on craniocervical trigger points. Descriptive data were analyzed by Mann-Whitney *U* Test (TMDSQ and HIT-6), Fisher's Exact Test (Medication) and Chi-square test (TTH type). The correlations between PPT and the pain intensity of the trigger points, and between the pain intensity of the trigger points and TMDSQ and HIT-6 were analyzed by Spearman's rank correlation coefficient. Data were presented as mean ± standard deviation, median (P25-P75), and frequencies of occurrence (absolute and relative), when appropriate.

All analysis was done using the PASW statistic 18.0 software (SPSS Inc., Chicago, USA), with a significant level (α) of 5% ($P < 0.05$).

Results

There was a greater impact of QoL in the Migraine group than in the TTH group, what was evidenced by higher values in the Headache Impact Test (HIT-6) ($P = 0.005$). There were no significant differences between groups for medication (Beta-blockers and Tricyclic antidepressants), TMDSQ and TTH type ($P > 0.05$) (Table 1).

Migraine and TTH groups presented lower PPT levels in all trigger points studied compared to Control group ($P < 0.01$), except for the ECM clavicular TP_2L trigger point ($P = 0.272$). However, there was no statistical difference between Migraine and TTH groups ($P > 0.05$) (Table 2). Additionally, Migraine and TTH groups showed higher pain intensity in all trigger points compared to Control group ($P < 0.01$), except for the Temporalis TP_1R, Temporalis TP_2R trigger point of the Migraine group and for the Temporalis TP_1R, Temporalis TP_1L, Temporalis TP_2R, Temporalis TP_2L, Temporalis TP_4L, ECM clavicular TP_2R and ECM clavicular TP_3R trigger points of the TTH groups ($P > 0.05$). The pain intensity in all trigger points was similar between Migraine and TTH groups ($P > 0.05$) (Table 3).

Interestingly, we observed several weak ($r < 0.4$) and moderate ($0.4 < r < 0.8$) significant negative associations between PPT and pain intensity of the trigger points, independently of the studied group ($P < 0.05$) (Table 4). Furthermore, we found significant moderate positive associations ($0.4 < r < 0.8$, $P < 0.05$) in Migraine group between: pain intensity in the ECM sternal TP_2L, ECM sternal TP_3R, ECM clavicular TP_1R, ECM clavicular TP_2R, Suboccipital TP_2R, Trapezius TP_1R and Trapezius TP_1L trigger points and the score obtained in the TMDSQ; and pain intensity in the Temporalis TP_3R, ECM sternal TP_3R, ECM sternal TP_3L, ECM clavicular TP_1R, ECM clavicular TP_1L, ECM clavicular TP_2R, ECM clavicular TP_2L, ECM clavicular TP_3R, ECM clavicular TP_3L, Suboccipital TP_2R and Suboccipital TP_2L trigger points and the Headache Impact Test (HIT-6) (Table 5). Interestingly in the migraine group there was a significant correlation between quality of life and pain intensity. There were no significant associations for the TTH group ($P > 0.05$) (Table 5). There were significant associations between HIT-6 and TMDSQ for the Migraine group ($r = 0.475$, $P < 0.05$). There was no significant association in TTH group ($r = 0.1$; $P = 0.675$).

Discussion

Our study has shown that migraine and TTH groups presented lower PPT levels in all trigger points studied compared to the Control group, except for the ECM clavicular TP_2L trigger point. However, there was no statistical difference between Migraine and TTH groups. Migraine and TTH groups showed higher pain intensity in all trigger points compared to Control group. The pain intensity in all trigger points was similar between Migraine and TTH groups. We observed several significant negative correlations between PPT and the pain intensity of the trigger points, independently of the studied group. Furthermore, the study showed that the intensity of pain is related to impairment in quality of life migraine group.

In this study, with the same number of subjects, we evaluated the PPTs at 11 points in the trapezius. Fernández-de-las-Peñas et al. observed that patients with chronic TTH and migraine have generalized lower PPT levels in the trapezius muscle region compared with controls. Chronic TTH patients also have lower PPTs in the trapezius muscle than migraine subjects. The topographical pressure pain map revealed that the upper part of the trapezius muscle is the most sensitive part of the muscle in both patient and control groups [15]. In another study comparing the PPT at nine points of the temporal muscle in individuals with unilateral migraine with healthy individuals, it was observed that the group with unilateral migraine had lower PPT values in all nine points

Table 1
Sample characterization.

Variables	Control Group (n = 20)	Migraine Group (n = 20)	TTH Group (n = 20)	P-Values
Age [mean (±standard deviation)] (year)	34.0 ± 9.1	34.7 ± 8.1	33.4 ± 8.8	0.885[b]
Medication [No. (%)]				
Yes	–	5 (25.0)	2 (10.0)	0.204[c]
No	–	15 (75.0)	18 (90.0)	
TMDSQ [median (P25%-P75%)] (score)	–	4.0 (3.0–5.8)	3.0 (3.0–5.8)	0.687[d]
HIT-6 [median (P25%-P75%)] (score)	–	66.0 (61.0–70.0)	60.0 (56.3–64.0)	0.005[d,a]
Mild impact (≤49 points) [No. (%)]	–	0 (0.0)	1 (5.0)	
Moderate impact (50–55 points) [No. (%)]	–	1 (5.0)	3 (15.0)	
Substantial impact (56–59 points) [No. (%)]	–	1 (5.0)	5 (25.0)	
Intense impact (≥60 points) [No. (%)]	–	18 (90.0)	11 (55.0)	
TTH type				
Episodic TTH	–	–	6 (30.0)	0.074[e]
Chronic TTH	–	–	14 60.0)	

TMDSQ: Temporomandibular Disorders Screening Questionnaire.
HIT-6: Headache Impact Test 6.
TTH: Tension Headache.
Episodic Tension-type Headache (Episodic TTH) and Chronic Tension-Type Headache (Chronic TTH).
[a] Significant difference ($P < 0.05$).
[b] One-way ANOVA.
[c] Fisher's Exact Test.
[d] Mann–Whitney *U* Test.
[e] Chi-Square Test.

Table 2
Pain pressure threshold measurement (dynamometer) of the trigger points, in kgf.

Trigger points	Control Group (n = 20) Mean ± SD	Migraine Group (n = 20) Mean ± SD	TTH Group (n = 20) Mean ± SD	P-Values[b]
Temporalis TP_1R	1.69 ± 0.36	0.88 ± 0.23[a]	0.94 ± 0.23[a]	<0.001
Temporalis TP_1L	1.63 ± 0.35	0.86 ± 0.25[a]	0.80 ± 0.26[a]	<0.001
Temporalis TP_2R	1.70 ± 0.37	0.91 ± 0.33[a]	1.03 ± 0.76[a]	<0.001
Temporalis TP_2L	1.60 ± 0.36	0.80 ± 0.28[a]	0.86 ± 0.34[a]	<0.001
Temporalis TP_3R	1.77 ± 0.50	0.93 ± 0.32[a]	0.89 ± 0.36[a]	<0.001
Temporalis TP_3L	1.68 ± 0.41	0.75 ± 0.27[a]	0.88 ± 0.40[a]	<0.001
Temporalis TP_4R	1.82 ± 0.51	0.86 ± 0.28[a]	0.77 ± 0.31[a]	<0.001
Temporalis TP_4L	1.73 ± 0.47	0.77 ± 0.23[a]	0.82 ± 0.31[a]	<0.001
ECM sternal TP_1R	1.26 ± 0.49	0.63 ± 0.31[a]	0.61 ± 0.19[a]	<0.001
ECM sternal TP_1L	1.19 ± 0.51	0.62 ± 0.32[a]	0.63 ± 0.21[a]	<0.001
ECM sternal TP_2R	1.14 ± 0.45	0.58 ± 0.26[a]	0.53 ± 0.18[a]	<0.001
ECM sternal TP_2L	1.09 ± 0.35	0.61 ± 0.21[a]	0.59 ± 0.20[a]	<0.001
ECM sternal TP_3R	1.28 ± 0.41	0.72 ± 0.30[a]	0.69 ± 0.15[a]	<0.001
ECM sternal TP_3L	1.27 ± 0.39	0.79 ± 0.34[a]	0.71 ± 0.20[a]	<0.001
ECM clavicular TP_1R	1.31 ± 0.47	0.59 ± 0.24[a]	0.69 ± 0.20[a]	<0.001
ECM clavicular TP_1L	1.23 ± 0.45	0.65 ± 0.25[a]	0.66 ± 0.17[a]	<0.001
ECM clavicular TP_2R	1.32 ± 0.46	0.65 ± 0.22[a]	0.61 ± 0.18[a]	<0.001
ECM clavicular TP_2L	1.16 ± 0.35	0.62 ± 0.21	0.61 ± 0.20	0.272
ECM clavicular TP_3R	1.44 ± 0.44	0.79 ± 0.21[a]	0.75 ± 0.18[a]	<0.001
ECM clavicular TP_3L	1.41 ± 0.36	0.75 ± 0.27[a]	0.75 ± 0.18[a]	<0.001
Suboccipital TP_1R	1.79 ± 0.54	0.84 ± 0.36[a]	0.82 ± 0.28[a]	<0.001
Suboccipital TP_1L	1.68 ± 0.45	0.86 ± 0.41[a]	0.82 ± 0.23[a]	<0.001
Suboccipital TP_2R	1.63 ± 0.39	0.77 ± 0.27[a]	0.73 ± 0.22[a]	<0.001
Suboccipital TP_2L	1.63 ± 0.28	0.80 ± 0.29[a]	0.77 ± 0.25[a]	<0.001
Trapezius TP_1R	1.81 ± 0.43	0.73 ± 0.31[a]	0.81 ± 0.46[a]	<0.001
Trapezius TP_1L	2.32 ± 2.41	0.75 ± 0.28[a]	0.83 ± 0.35[a]	0.001

TTH: Tension Headache.
R: Right.
L:Left.
[a] Significant difference compared to Control Group (Tukey's post hoc tests: $P < 0.05$).
[b] P-Values for One-way ANOVA.

Table 3
Pain measurement (VAS pain) on the trigger points.

Trigger points	Control Group (n = 20) Median (P25 – P75)	Migraine Group (n = 20) Median (P25 – P75)	TTH Group (n = 20) Median (P25 – P75)	P-Values[b]
Temporalis TP_1R	3.0 (1.4–4.8)	4.8 (3.0–6.8)	4.0 (2.3–7.8)	0.091
Temporalis TP_1L	3.0 (1.3–5.9)	7.0 (4.0–8.0)[a]	5.0 (2.3–7.8)	0.010
Temporalis TP_2R	2.5 (1.0–5.0)	4.0 (3.0–7.9)	4.5 (3.0–6.8)	0.038
Temporalis TP_2L	3.0 (1.6–5.0)	6.0 (4.0–8.4)[a]	5.0 (3.0–6.4)	0.004
Temporalis TP_3R	2.8 (2.0–4.9)	5.8 (4.0–8.0)[a]	6.0 (4.3–7.0)[a]	0.001
Temporalis TP_3L	3.0 (2.0–5.0)	6.0 (4.3–8.0)[a]	5.5 (3.3–7.0)[a]	0.001
Temporalis TP_4R	2.8 (1.1–5.0)	5.8 (4.0–8.0)[a]	6.0 (4.0–7.4)[a]	0.003
Temporalis TP_4L	3.0 (1.6–6.0)	7.3 (5.0–8.9)[a]	6.0 (5.0–7.8)	0.002
ECM sternal TP_1R	3.0 (1.2–4.3)	7.0 (4.1–9.8)[a]	5.5 (3.0–7.9)[a]	<0.001
ECM sternal TP_1L	3.7 (1.6–4.1)	7.5 (5.5–8.4)[a]	5.8 (3.0–8.0)[a]	<0.001
ECM sternal TP_2R	3.8 (2.0–5.6)	8.3 (5.5–9.0)[a]	7.0 (3.0–8.8)[a]	<0.001
ECM sternal TP_2L	2.9 (1.8–4.0)	8.5 (5.5–9.0)[a]	6.5 (4.0–8.0)[a]	<0.001
ECM sternal TP_3R	3.0 (1.6–5.1)	7.0 (4.3–8.9)[a]	5.5 (3.3–7.0)[a]	<0.001
ECM sternal TP_3L	2.3 (1.1–4.8)	5.5 (3.3–7.9)[a]	5.5 (4.0–7.0)[a]	0.001
ECM clavicular TP_1R	3.0 (1.4–5.8)	6.5 (4.3–9.4)[a]	6.0 (4.3–7.0)[a]	0.003
ECM clavicular TP_1L	2.5 (1.5–4.5)	7.0 (4.0–9.0)[a]	6.0 (4.0–7.0)[a]	0.001
ECM clavicular TP_2R	2.5 (2.0–6.8)	8.5 (5.5–9.5)[a]	7.0 (5.0–8.0)	0.004
ECM clavicular TP_2L	3.0 (2.0–5.9)	8.0 (5.0–9.4)[a]	6.0 (5.0–8.0)[a]	0.002
ECM clavicular TP_3R	3.0 (1.9–5.0)	7.5 (4.0–8.4)[a]	6.0 (3.3–7.0)	0.003
ECM clavicular TP_3L	3.0 (1.9–5.0)	7.0 (4.0–9.0)[a]	5.8 (3.3–7.0)[a]	0.001
Suboccipital TP_1R	3.0 (1.2–4.9)	7.3 (4.1–8.0)[a]	7.0 (3.0–8.0)[a]	<0.001
Suboccipital TP_1L	3.0 (1.0–5.0)	7.0 (5.0–8.6)[a]	7.0 (4.0–8.0)[a]	<0.001
Suboccipital TP_2R	3.0 (1.6–5.0)	7.0 (5.0–8.0)[a]	8.0 (4.0–8.8)[a]	<0.001
Suboccipital TP_2L	2.8 (1.3–4.8)	6.8 (5.0–8.0)[a]	6.5 (4.0–8.0)[a]	<0.001
Trapezius TP_1R	3.5 (2.0–5.0)	8.4 (6.3–9.4)[a]	7.5 (6.0–8.8)[a]	<0.001
Trapezius TP_1L	3.0 (2.0–6.0)	8.3 (6.0–9.9)[a]	6.5 (5.1–8.0)[a]	<0.001

TTH: Tension Headache.
R: Right.
L:Left.
[a] Significant difference compared to Control Group (adjusted P-values for Mann-Whitney U Tests: $P < 0.017$).
[b] P-Values for Kruskal Wallis's test.

Table 4
Spearman's correlation coefficient between PPT and pain intensity of the trigger points for all sample and by group.

Pressure × Pain on the trigger point	All Sample (n = 60)	Control Group (n = 20)	Migraine Group (n = 20)	TTH Group (n = 20)
Temporalis TP_1R	−0.283*	0.062	−0.342	−0.132
Temporalis TP_1L	−0.391**	−0.107	−0.156	−0.352
Temporalis TP_2R	−0.287*	0.006	−0.335	0.095
Temporalis TP_2L	−0.305*	0.072	−0.267	0.168
Temporalis TP_3R	−0.323*	−0.074	−0.239	0.163
Temporalis TP_3L	−0.322*	−0.184	−0.018	0.189
Temporalis TP_4R	−0.374**	−0.121	−0.082	0.137
Temporalis TP_4L	−0.451**	−0.262	−0.448*	0.109
ECM sternal TP_1R	−0.441**	0.378	−0.567**	−0.205
ECM sternal TP_1L	−0.365**	0.298	−0.173	−0.276
ECM sternal TP_2R	−0.400**	−0.075	−0.412	−0.019
ECM sternal TP_2L	−0.340**	−0.102	0.270	−0.166
ECM sternal TP_3R	−0.331**	0.080	−0.337	0.241
ECM sternal TP_3L	−0.328*	0.048	−0.323	0.147
ECM clavicular TP_1R	−0.396**	0.122	−0.418	−0.071
ECM clavicular TP_1L	−0.207	0.080	−0.086	0.236
ECM clavicular TP_2R	−0.245	−0.158	−0.141	0.164
ECM clavicular TP_2L	−0.344**	−0.248	−0.061	0.007
ECM clavicular TP_3R	−0.356**	−0.049	−0.172	−0.071
ECM clavicular TP_3L	−0.337**	0.034	0.007	0.170
Suboccipital TP_1R	−0.529**	−0.022	−0.415	−0.174
Suboccipital TP_1L	−0.360**	0.261	−0.119	0.050
Suboccipital TP_2R	−0.473**	−0.172	0.131	−0.283
Suboccipital TP_2L	−0.379**	0.134	−0.093	0.034
Trapezius TP_1R	−0.612**	0.142	−0.462*	−0.313
Trapezius TP_1L	−0.648**	0.232	−0.466*	−0.526*

*P < 0.05; **P < 0.01.
TTH: Tension Headache.
R: Right.
L:Left.

Table 5
Spearman's correlation coefficient between pain intensity, TMDSQ and HIT-6 scores of the Migraine and TTH groups.

Pain on the trigger point	Migraine Group		TTH Group	
	TMDSQ	HIT-6	TMDSQ	HIT-6
Temporalis TP_1R	0.215	0.340	0.158	−0.129
Temporalis TP_1L	0.262	0.217	0.006	−0.240
Temporalis TP_2R	0.219	0.081	0.080	−0.143
Temporalis TP_2L	0.092	0.226	−0.178	−0.168
Temporalis TP_3R	0.304	0.457*	−0.101	−0.110
Temporalis TP_3L	0.222	0.373	−0.231	−0.200
Temporalis TP_4R	0.282	0.310	−0.197	−0.092
Temporalis TP_4L	0.410	0.436	−0.308	−0.040
ECM sternal TP_1R	0.167	0.330	−0.067	−0.044
ECM sternal TP_1L	0.315	0.369	−0.097	−0.036
ECM sternal TP_2R	0.284	0.399	−0.049	−0.053
ECM sternal TP_2L	0.485*	0.388	−0.023	0.031
ECM sternal TP_3R	0.623**	0.591**	−0.320	−0.086
ECM sternal TP_3L	0.416	0.729**	0.186	−0.120
ECM clavicular TP_1R	0.515*	0.586**	−0.093	0.016
ECM clavicular TP_1L	0.443	0.659**	−0.171	−0.204
ECM clavicular TP_2R	0.594**	0.581**	−0.080	0.014
ECM clavicular TP_2L	0.394	0.507*	−0.070	−0.040
ECM clavicular TP_3R	0.434	0.516*	−0.149	0.060
ECM clavicular TP_3L	0.399	0.614**	0.044	0.035
Suboccipital TP_1R	0.089	0.407	−0.228	0.045
Suboccipital TP_1L	−0.080	0.225	−0.195	−0.107
Suboccipital TP_2R	0.450*	0.523*	0.185	0.136
Suboccipital TP_2L	0.255	0.486*	0.047	0.011
Trapezius TP_1R	0.750**	0.403	0.114	0.387
Trapezius TP_1L	0.611**	0.264	0.198	0.244

*P < 0.05; **P < 0.01.
TTH: Tension Headache.
R: Right.
L:Left.

compared to the observed values in the control group [12].

Considering women with migraine and healthy women, we evaluated the PPT at points of craniocervical muscles, and observed similar results to those observed in previous research [9]. In those studies, they used the average value of three results obtained with an algometer in anatomical points. In the present study, we used only one measure in trigger points due to the nociceptive activity generated by TPs, which leads to the sensitization of peripheral sensory neurons and to the subsequent central sensitization [40] and pericranial muscle hypersensitivity in the headaches [41]. PPT levels are considered a valuable clinical test for the evaluation of pericranial muscle sensitivity [11]. PPT recordings are recommended by the IHS classification [34]. Bevilaqua-Grossi et al. had as a result the fact that the PPT values obtained by the pressure algometry and the adapted to algometry showed excellent levels of intraclass correlation coefficient (ICC) for intra-rater reliability [38]. Despite claims in the literature that lower PPT indicate sensitization of peripheral sensory neurons, it can nonetheless be argued that lower PPTs are in fact a non-specific measure of severity of a pain syndrome and that higher PPTs following a manual therapy intervention is evidence in favour of a positive effect of that intervention.

Myofascial trigger points can contribute to central sensitization process and chronicity of headache [42]. Fernández-de-las-Peñas et al. studied myofascial trigger points, neck mobility and forward head posture in unilateral migraine [9] and in TTH [8] comparing with a control group. In these studies, they used the same diagnostic criteria and location of trigger points that we used in our study. Comparing the groups of patients with migraine and the control group, they found that the total number of active TPs was higher in the migraine group, with no difference between groups with respect to latent TPs, and also that TPs in the muscles of the head and neck can play an important role in generating, maintaining and perpetuating migraine [9]. As for TTH, the group with TTH showed higher number of TPs in the right trapezius and bilaterally in the temporalis muscle; however, the presence of TPs

was not related to any of headache parameters (intensity, duration and frequency) [8]. Fernández-de-las-Peñas & Dommerholt propose that the adequate management of TP may prevent and reverse the development of pain propagation in chronic pain conditions, because inactivation of TP attenuates central sensitization [15].

The Migraine group presented higher impairment on QoL than TTH group evidenced by higher values in the HIT-6. In women with migraine and TTH, the results of the Screening Questionnaire Temporomandibular Disorders (TMDSQ) suggest possible symptoms of TMD. There was a significant association between HIT-6 and TMDSQ for the migraine group; however, there was no significant association in the TTH group. According to Ballegaard et al., 56.1% of patients with headache have TMD, with no significant difference between the types of headache, but the prevalence of TMD tended to be higher among patients with both migraine [43] and TTH concomitantly [42]. Migraine attack is associated with a significant reduction in PPT values of masticatory muscles, which appears to be influenced by the presence of myofascial TMD pain [31]. Considering the PPT, the TMDSQ score and the impact of headache (HIT-6), there were no studies correlating these aspects, even with high prevalence of parafunctional habits and symptoms of TMD in primary headaches [32]. Considering these arguments, it would be important, in future research and with a larger sample, in addition to a daily selection of subjects with primary headaches, to perform a multidisciplinary diagnosis of TMD in primary headaches and to evaluate the influence of temporomandibular myofascial pain on the PPT of the masticatory muscles and in the quality of life in individuals with primary headache with and without TMD.

Our study has some limitations. The main one is that the principal researcher was not blinded to the groups. She knew which individuals were in the control group and which were in the group with headaches. However, she did not know which participants were in the migraine group and TTH group. Notwithstanding this, this limitation can probably have a major impact on the results. The participants knew which group they took part in because the group of headaches was previously diagnosed by a neurologist. The second limitation is the small sample size. Type II errors could have happened, so readers should interpret with caution the results from the present study. Another point to be considered was that in this research, PPT was not measured in the extra-trigeminal regions. In future studies, it would be important to investigate PPT in the trigemino-cervical and extra-trigeminal (distant pain-free) regions in individuals with TTH and migraine.

Conclusion

The results show that the pressure pain threshold in trigger points evaluated in patients with migraine and TTH was reduced compared to the control subjects. There was a significant negative correlation between pressure and the intensity of pain in points between migraine groups and TTH. Even with a greater impact on quality of life for women with unilateral migraine compared with women with TTH, the PPT in trigger points in the two groups showed no significant statistical difference.

Our results suggest that, in future studies, the PPT can be used as a tool to objectively assess pain, which is one of the diagnostics criteria commonly used in osteopathic practice to locate regions with altered sensitivity and associated soft tissue and mobility changes. We would argue that the PPT can be used as an indicator of the effectiveness of osteopathic treatment or other therapeutic approaches in the care of women with unilateral migraine and tension-type headache.

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