Trigger Point Sensitivity Is a Differentiating Factor between Cervicogenic and Non-Cervicogenic Headaches: A Cross-Sectional, Descriptive Study

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ABSTRACT

Purpose: A common factor in all forms of headache is the presence of myofascial trigger points (TrPs). The aim of this study was to compare the presentation of patients with cervicogenic headaches and patients with non-cervicogenic headaches in the sensitivity of TrPs in their upper trapezius, sternocleidomastoid, temporalis, and posterior cervical muscles. **Method:** This was a descriptive, cross-sectional study. The following variables were compared between patients with cervicogenic ($n = 20$) and patients with non-cervicogenic ($n = 20$) headaches: sensitivity (pain-pressure threshold) of TrPs in the upper trapezius, sternocleidomastoid, posterior cervical, and temporalis muscles (using a handheld, digital algometer); level of disability (using the Henry Ford Hospital Headache Disability Inventory questionnaire); demographics (age, sex); anthropometrics (BMI); and clinical presentation (duration and intensity of symptoms). The independent Student t -test and χ^2 test were used to determine the differences between the two groups. Effect sizes (Cohen's d) were calculated when relevant. **Results:** The two groups were similar in level of disability, demographic and anthropometric data, and clinical presentation. However, TrP sensitivity in the right upper trapezius ($p = 0.006$; Cohen's $d = 0.96$) and the left upper trapezius ($p = 0.003$; Cohen's $d = 1.06$) muscles was higher in the cervicogenic group. **Conclusions:** Increased sensitivity of TrPs in the upper trapezius muscle may be used as a differentiating factor in the diagnosis of cervicogenic headaches. This finding emphasizes the importance of integrating this muscle into the rehabilitation programs of patients with cervicogenic headache.

Key Words: headache; muscles; pain; trigger points.

RÉSUMÉ

Objectif: les zones gâchettes myofasciales (ZG) sont un facteur courant de toutes les formes de céphalées. La présente étude visait à comparer la présentation de la sensibilité des ZG chez les patients atteints de céphalées cervicogéniques par rapport à celle des patients atteints de céphalées non cervicogéniques dans le trapèze supérieur, le muscle sternocléidomastoïdien, le muscle temporal et le muscle cervical postérieur. **Méthodologie:** dans la présente étude transversale descriptive, les chercheurs ont comparé les variables suivantes entre les patients atteints de céphalées cervicogéniques ($n = 20$) et non cervicogéniques ($n = 20$): sensibilité (seuils de douleur aux points de pression) des ZG dans le trapèze supérieur, le muscle sternocléidomastoïdien, le muscle cervical postérieur et le muscle temporal (à l'aide d'un algomètre numérique portatif); taux d'incapacité (à l'aide du questionnaire du répertoire du degré d'incapacité lié aux céphalées du Henry Ford Hospital); données démographiques (âge, sexe); valeurs anthropométriques (IMC) et présentation clinique (durée et intensité des symptômes). Ils ont utilisé le test de Student indépendant et le test du chi carré pour établir les différences entre les deux groupes. Ils ont calculé les tailles d'effet (d de Cohen) lorsque la situation le justifiait. **Résultats:** le taux d'incapacité, les données démographiques, les données anthropométriques et la présentation clinique des deux groupes étaient semblables. Cependant, la sensibilité des ZG dans le trapèze supérieur droit ($p = 0,006$; d de Cohen = $0,96$) et le trapèze supérieur gauche ($p = 0,003$; d de Cohen = $1,06$) était plus élevée dans le groupe cervicogénique. **Conclusions:** la plus grande sensibilité des ZG dans le trapèze supérieur peut représenter un facteur de différenciation pour diagnostiquer les céphalées cervicogéniques. Cette observation fait ressortir l'importance d'intégrer ce muscle aux programmes de réadaptation des patients atteints de ce type de céphalées.

A headache is one of the most common disorders of the nervous system, one that leads to substantial levels of disability¹ and has a marked predominance among women.² Jull and Sterling³ substantiated this and furthermore reported that headaches were often related to personal, biomechanical, and socio-economic circumstances.

The International Headache Society^{4(p.760)} has described cervicogenic headache as a “headache caused

by a disorder of the cervical spine and its component bony, disc and/or soft tissue elements, usually but not invariably accompanied by neck pain.” The clinical presentation of this type of headache is mostly unilateral, but it can also be bilateral and provoked by cervical movements.⁵ Often occurring after whiplash trauma, this type of headache is associated with a reduction in neck range of movements and ipsilateral shoulder and

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arm pain.² Non-cervicogenic headaches are headaches that are not associated with cervical origin or dysfunction, such as vascular headaches or those caused by occipital neuralgia or other causes.⁴

The diagnosis of cervicogenic headache and, thus, the differentiation between cervicogenic and non-cervicogenic headaches can be a significant clinical challenge. The first attempt at setting out diagnostic criteria for cervicogenic headache was made in 1990.⁶ Although the publication of those criteria brought focus to the field of cervicogenic headache research, certain aspects have proved difficult to embrace—for example, that these headaches should be strictly unilateral and include several accompanying symptoms, such as nausea, vomiting, flushing, dizziness, phono- and photophobia, blurred vision, and dysphagia. These aspects have made the criteria too specific and detailed for general practice,⁷ and they have highlighted the need for clear criteria of cervical musculoskeletal impairment to identify cervicogenic headache sufferers. In addition, it appears that migraine headache demonstrates neck-associated symptoms, such as occipital tenderness and trigger points (TrPs) thought to be characteristic of cervicogenic headache, thereby making it problematic to differentiate migraine headache from cervicogenic headache.²

One of the common factors in all forms of headache is the presence of TrPs. A TrP is described as a hyper-irritable spot associated with a taut band of skeletal muscle.⁸ It is painful on compression or stretch and can give rise to typical, referred pain patterns and autonomic phenomena (e.g., vasoconstriction, pilomotor response, and hypersecretion), which are commonly associated with headaches.⁸ A variety of factors, such as chronic injury and overload of muscles,⁹ muscle overuse, or direct trauma,¹⁰ may play a role in forming TrPs. When considering the cervical region, TrPs are commonly present in the upper trapezius, sternocleidomastoid, posterior cervical, and temporalis muscles.¹¹ Fernandez-de-Las-Peñas and colleagues¹² suggested that the pain profile of neck and head syndromes was directly linked to referred pain from TrPs in the posterior cervical, head, and shoulder muscles, which typically refer pain to the temporal and frontal areas of the head.⁸ Despite the widespread debate surrounding the pathogenesis of TrPs, the existence of the clinical phenomena cannot be denied,^{13,14} and taut bands, which can be assessed quantitatively, exist and represent localized areas of increased muscle stiffness.¹⁵

The differentiation between cervicogenic and non-cervicogenic headache is challenging because of the overlap in symptoms experienced by patients with cervicogenic and non-cervicogenic headaches as well as the paucity of research on this topic. Identifying the factors that differentiate between cervicogenic and non-cervicogenic headache is important and will advance the currently available diagnostic criteria. Because of the lack of

research pertaining to the sensitivity of TrPs and their relationship to headache, a need exists to explore the sensitivity of specific TrPs commonly associated with headaches. Therefore, the aim of this study was to compare the presentation of patients with cervicogenic headaches and patients with non-cervicogenic headaches in the sensitivity of TrPs⁸ (according to the pain-pressure threshold, or PPT) in their upper trapezius, sternocleidomastoid, temporalis, and posterior cervical muscles. We also measured potential confounding variables such as demographic and anthropometric data, clinical presentation (using a demographic and anthropometric questionnaire), and level of disability (using the Henry Ford Hospital Headache Disability Inventory [HDI] questionnaire¹⁶).

METHODS

Study design and setting

This was a quantitative, cross-sectional, descriptive study. All data were collected at an outpatient-based musculoskeletal clinic.

Sample size and selection

We recruited 20 participants with cervicogenic headaches and 20 participants with non-cervicogenic headaches. Post hoc power calculations were performed; a power of 81.9% based on an effect size of 0.96 was found, and a power of 90.2% based on an effect size of 1.06 was determined (computed using $\alpha = 0.05$). Male and female participants aged 18–60 years were included if they met the criteria set by the International Headache Society⁴; namely, they were experiencing headaches that were not associated with nausea (but photophobia and phonophobia might be present) and lasted between 30 minutes and 7 days.

The criteria that were used to allocate participants to the cervicogenic headache group were based on those of Zito and colleagues¹⁷ and conformed to the International Headache Society's criteria.⁴ The inclusion and exclusion criteria for the study are shown in Table 1. English-speaking and non-English-speaking participants were invited to participate.

Instrumentation and outcome measures

A handheld, digital algometer (JTECH Medical, Salt Lake City, UT) with a round tip of 1 centimetre squared was used to measure the sensitivity of TrPs. The construct validity of the algometer was found to be excellent when applying pressure on a force plate ($r = 0.990$), and the algometer produced consistent results, which indicated excellent reliability ($r = 0.999$).¹⁹ The HDI questionnaire was used to measure the level of disability caused by headaches, and its test–retest reliability was found to be excellent.¹⁶ The demographic and anthropometric questionnaire requested information on age, sex, and BMI. The assessment of pain intensity was based on a numerical pain rating scale (NPRS).²⁰

Table 1 Inclusion and Exclusion Criteria

Criteria	Participants
Inclusion	Experiencing headaches not associated with nausea (but photophobia and phonophobia might be present) and lasting 30 min–7 d.
Cervicogenic headache	Had the following impairments: <ol style="list-style-type: none"> 1. Measurement of cervical flexion and extension decreased by at least 20°¹⁸ 2. Manual assessment of O/C1, C1/C2, C2/C3 (painful segmental dysfunction) 3. Muscle extensibility of the upper trapezius, scalenes, levator scapulae, short cervical extensors, pectoralis major and minor (increased muscle tightness or tone)
Non-cervicogenic headache	Not experiencing cervicogenic headache.
Exclusion	Individuals who had used pain or anti-inflammatory medication in the 24 h immediately before evaluation, had previous cervical spine surgery, had comorbid conditions, or were under physiotherapy management in the 4 w before the start of data collection.

O = occipit; C = cervical level.

Procedures

The researcher (Pramod) underwent 2 hours of training in using the algometer before data collection began. Medical practitioners (general practitioners, physicians, orthopaedic surgeons, neurosurgeons, and physiotherapists) in a predetermined demographic area were invited to refer patients for inclusion in this study. A consecutive sampling method was used. Before being included, each participant was given verbal and written information, and written informed consent was obtained from each participant.

After completing the demographic and anthropometric questionnaire, participants provided clinical information regarding the duration of their headaches and level of pain. A research assistant then assessed the information and allocated each participant to the appropriate study group. The research assistant had 15 years of manual therapy experience and had undergone 16 hours of training related to the project. The researcher explained the HDI questionnaire to the participants, and they were then requested to complete it. The researcher, who was blinded to the patients' backgrounds and clinical information, including group allocation, performed the TrP sensitivity assessment (PPT). The participants were seated and examined by manual palpation; all were assessed in the same sitting position.

The guidelines laid out by Simons and colleagues⁸ were followed to determine the presence of at least one active TrP in each of the following muscles: upper trapezius, sternocleidomastoid, posterior cervical, and temporalis. These muscles were chosen because their TrPs consist of typical pain referral patterns to the head.⁸ Simons and colleagues⁸ described a myofascial TrP as a hyper-irritable spot associated with a taut band of a skeletal muscle that is painful on compression or stretch and that can give rise to a typical referred pain pattern or autonomic phenomena. Palpation was carried out mainly by using the thumb and index finger, and the participant responded by verbally reporting any local or

referred pain it produced. If a selected muscle did not have a TrP, an "N" was marked on the data collection sheet. When the researcher located a TrP, he positioned the algometer¹⁹ on it and gradually increased the compression pressure perpendicularly on the muscle (see Figure 1). PPT was recorded (in kg/cm²) as the minimum amount of pressure needed to elicit pain.²¹ Each participant verbally indicated the point at which the sensation of pressure became painful. The measurement for each TrP was taken three times by re-setting the algometer for each reading at each point.²²

Ethical considerations

Ethical clearance was granted by the Human Research Ethics Committee of the University of the Witwatersrand. Potential participants were informed that refusing to participate would not incur any penalty or loss of benefits to which they would otherwise be entitled. Each participant was given a unique identification number to maintain strict confidentiality throughout the study.

Data analysis

Data were analyzed using STATA, version 12 (StataCorp, College Station, TX). Inferential statistics were used to analyze the following variables: PPT of TrPs in the upper trapezius, sternocleidomastoid, posterior cervical, and temporalis muscles in kilograms/centimetre squared (continuous data); HDI questionnaire (continuous); demographic (age [continuous] and sex [dichotomous]) and anthropometric data (BMI; continuous); pain intensity on the NPRS (range 0–10; ordinal or discrete); and duration of headache (continuous). Levene's Test of Equality of Variances was used to establish the distribution of data.

We analysed an average among the three measures taken for each participant. Differences between the cervicogenic and the non-cervicogenic headache groups on the continuous variables were determined using the independent Student *t*-test and on the categorical data using the χ^2 test. Statistical significance was set at 5%.

Figure 1 Testing trigger point sensitivity (pressure-pain threshold) using the algometer.

Effect sizes were calculated using Cohen's *d*; an effect sizes of 0.2 was interpreted as small; 0.5, as medium; and 0.8 as large.²³

RESULTS

Although both English-speaking and non-English-speaking participants were invited to participate, all participants indicated a preference for English. Women constituted 95% ($n = 19$) of the cervicogenic group and 80% ($n = 16$) of the non-cervicogenic group ($p = 0.15$). No statistically significant difference was found between the two groups in demographic data, anthropometric data, or duration of symptoms, as shown in Tables 2 and 3. Response patterns were found to be similar between the cervicogenic and non-cervicogenic participants across the HDI questionnaire items and NPRS score.

TrP sensitivity is shown in Table 2. Comparing the results indicates a statistically significant difference between the two groups in TrP sensitivity, as shown in Table 3—specifically, in both the right upper trapezius ($p = 0.006$; Cohen's $d = 0.96$) and the left upper trapezius ($p = 0.003$; Cohen's $d = 1.06$).

DISCUSSION

The aim of this study was to compare the sensitivity of TrPs in 20 patients experiencing cervicogenic headaches with that in 20 patients experiencing non-cervicogenic headaches. We found evidence of a statistically significant difference between the two study groups in TrP sensitivity in both the right upper trapezius ($p = 0.006$) and the left upper trapezius ($p = 0.003$) muscles. In addition to this statistical significance, the effect size (Cohen's d) was found to be both large (0.96) for the right upper trapezius and (1.06) for the left upper trapezius. The algometer reading is low when a patient can withstand only a minimal amount of pressure (threshold) before feeling pain. Therefore, because cervicogenic headache participants had a lower algometer reading (thus, a higher sensitivity to the TrP), this would imply that TrP sensitivity was significantly higher in cervicogenic participants than in non-cervicogenic participants in both the right and the left upper trapezius muscles.

We found an increase in sensitivity in patients with headaches when compared to healthy controls. Couppe and colleagues²⁴ studied a group of 20 patients diagnosed with chronic tension-type headaches and 20 healthy, age- and sex-matched control participants. Higher pain intensity upon palpation of TrPs was reported in the headache group than in the healthy control group. It should be noted that those researchers compared their participants with headache to healthy control participants, whereas in our study both groups experienced headaches, of which one type was of cervicogenic origin and the other of non-cervicogenic origin. Despite this difference between the two studies, the increase in sensitivity emphasizes the difference in muscular status in TrP sensitivity in patients with or without headache and even in patients with different types of headache.

In our study, we found no difference in the sensitivity of TrPs in the sternocleidomastoid, temporalis, or posterior cervical muscles. This finding was unexpected because patients with cervicogenic headache often present with myofascial TrP pain, particularly from over-activity of the sternocleidomastoid, upper trapezius, and temporalis muscles.²⁵ TrPs of the sternocleidomastoid muscle, especially, have a referred pain pattern similar to that seen in cervicogenic headaches (posterior to frontal).⁸ A possible explanation for the contribution of TrPs to headache is that pain thresholds are decreased where the local tenderness is increased, represented by a segmented central sensitization or supraspinal modulation of incoming stimuli.²⁵

Table 2 Demographic, Anthropometric, Pain, and Trigger Point Sensitivity Data for the Cervicogenic and Non-Cervicogenic Headache Groups

Data	Group; no. of participants; mean (SD), SEM	
	Cervicogenic	Non-cervicogenic
Age, y	20; 36.45 (8.38), 1.87	20; 41.20 (8.21), 1.84
BMI, kg/m ²	20; 29.75 (5.97), 1.33	20; 28.04 (6.04), 1.35
Duration of headache, mo	20; 34.50 (42.54), 9.51	20; 32.55 (35.91), 8.03
NPRS (out of 10)	20; 6.95 (1.47), 0.33	20; 6.30 (1.08), 0.24
HDI		
Functional score (out of 48)	20; 31.90 (11.81), 2.64	20; 34.40 (10.04), 2.25
Emotional score (out of 52)	20; 30.30 (10.86), 2.43	20; 30.80 (12.30), 2.75
Total score (out of 100)	20; 62.20 (21.48), 4.80	20; 65.20 (21.10), 4.72
Muscle, kg/m ²		
Right upper trapezius	19; 1.58 (0.60), 0.14	19; 2.40 (1.05), 0.24
Right sternocleidomastoid	15; 1.12 (0.35), 0.09	9; 1.08 (0.38), 0.13
Right temporalis	16; 0.95 (0.27), 0.07	13; 1.20 (0.67), 0.18
Right posterior cervical	19; 1.14 (0.43), 0.10	16; 1.23 (0.46), 0.11
Left upper trapezius	20; 1.54 (0.57), 0.13	18; 2.49 (1.13), 0.27
Left sternocleidomastoid	8; 1.11 (0.24), 0.09	6; 0.98 (0.24), 0.10
Left temporalis	17; 1.07 (0.34), 0.08	15; 1.41 (0.86), 0.22
Left posterior cervical muscles	19; 1.17 (0.42), 0.10	18; 1.35 (0.56), 0.13

NPRS = numerical pain rating scale; HDI = Henry Ford Hospital Headache Disability Inventory; SEM = standard error of measurement.

Table 3 Differences in Demographic, Anthropometric, Pain, and Trigger Point Sensitivity Data between the Cervicogenic and Non-Cervicogenic Headache Groups

Data	<i>t</i>	<i>df</i>	<i>p</i> -value	Mean (SE) difference	95% CI of difference	Effect size (Cohen's <i>d</i>)
Age, y	-1.81	38.00	0.08	-4.75 (2.62)	-10.06, 0.56	0.57
BMI, kg/m ²	0.90	38.00	0.37	1.71 (1.90)	-2.13, 5.56	0.28
Duration of headache, mo	0.16	38.00	0.88	1.95 (12.45)	-23.25, 27.15	0.05
NPRS (out of 10)	1.59	38.00	0.12	0.65 (0.41)	-0.18, 1.48	0.50
HDI						
Functional score (out of 48)	-0.72	38.00	0.48	-2.50 (3.47)	-9.52, 4.52	0.23
Emotional score (out of 52)	-0.14	38.00	0.89	-0.50 (3.67)	-7.93, 6.93	0.43
Total score (out of 100)	-0.45	38.00	0.66	-3.00 (6.73)	-16.63, 10.63	0.14
Muscle, kg/m ²						
Right upper trapezius	-2.95	28.48	0.006	-0.82 (0.28)	-1.39, -0.25	0.96
Right sternocleidomastoid	0.26	22.00	0.80	0.04 (0.15)	-0.28, 0.36	0.12
Right temporalis	-1.28	15.20	0.22	-0.25 (0.20)	-0.67, 0.17	0.49
Right posterior cervical muscles	-0.54	33.00	0.59	-0.08 (0.15)	-0.39, 0.22	0.20
Left upper trapezius	-3.24	24.56	0.003	-0.96 (0.30)	-1.57, -0.35	1.06
Left sternocleidomastoid	1.05	12.00	0.31	0.14 (0.13)	-0.15, 0.42	0.54
Left temporalis	-1.44	17.91	0.17	-0.34 (0.24)	-0.84, 0.16	0.52
Left posterior cervical muscles	-1.11	35.00	0.28	-0.18 (0.16)	-0.51, 0.15	0.36

NPRS = numerical pain rating scale; HDI = Henry Ford Hospital Headache Disability Inventory.

The presence of TrPs is often associated with muscle tightness—that is, increased muscle tone.¹⁵ Jull and colleagues²⁶ investigated upper cervical muscle tightness in 15 cervicogenic headache patients and 15 asymptomatic controls. They found that resistance to passive muscle stretch was significantly increased in the upper trapezius muscles in the cervicogenic group, but not in any of the other muscles tested—namely, levator scapulae, scalenes (anterior, middle, and posterior divisions), and the short upper cervical extensors. It should be noted, however,

that those researchers included a control group consisting of asymptomatic participants, whereas we compared participants with cervicogenic and non-cervicogenic headaches. The findings from the Jull and colleagues²⁶ study clearly link to the findings from ours because that study found that, among patients with cervicogenic headache, the only muscle identified with increased resistance to stretch was the upper trapezius muscle, and our study found that was the only muscle with increased sensitivity in TrPs.²⁶

Response patterns across the HDI questionnaire items were found to be similar between the cervicogenic and non-cervicogenic participants. Although the prevalence of cervicogenic headaches is considerably lower than that of tension-type headaches and migraines, patients with cervicogenic headaches have a substantial quality-of-life burden that is comparable to that of patients with migraines and tension-type headaches.²⁷ Even though, in our study, the non-cervicogenic group did not have migraines or tension-type headaches specifically, the results from the self-perceived disability portion of the HDI showed that the quality-of-life burden of the cervicogenic group was as debilitating as that of the non-cervicogenic group. The similarity in the level of disability in the two comparison groups can be considered a strength of our study because differences could have acted as a confounding factor.

Awareness of the increased sensitivity of TrPs in the upper trapezius muscles of patients with cervicogenic headache will encourage clinicians to give special attention to this muscle during their assessment. Treatment modalities aimed at decreasing TrP sensitivity should also be emphasized because TrP sensitivity is known to be reduced by soft tissue massage and²² dry needling,²⁸ among other modalities.

A limitation of this study is that the factors contributing to the development of TrPs, such as postures assumed during vocational and recreational activities, as well as physical activity levels, were not investigated. The tightness in the upper trapezius muscles found in patients with cervicogenic headache can be accredited to the forward head posture (upper-crossed syndrome) commonly seen in these patients.²⁵ Postural adaptations may play a role in developing TrPs in the upper trapezius muscles associated with cervicogenic headaches.

CONCLUSION

This study's findings suggest that the sensitivity (PPT) of TrPs in the upper trapezius muscle may be used as a factor to differentiate between cervicogenic and non-cervicogenic headaches. Both the cervicogenic and the non-cervicogenic groups showed a similar level of disability, which, in people who are working, may have economic implications for both employer and employee. Demographic and anthropometric data, and the duration and intensity of symptoms, in both cervicogenic and non-cervicogenic groups revealed similar results, and women predominated in both groups. More research is needed to compare the sensitivity of TrPs in specific muscles among different types of headache. The causes of TrPs in the upper trapezius muscle, as well as the relationship between upper trapezius TrPs and the frequency and duration of cervicogenic headaches, need to be further investigated.

KEY MESSAGES

What is already known on this topic

Myofascial trigger points (TrPs) are present in patients experiencing headaches, and they contribute to the pain and disability associated with the presence of headache.

What this study adds

Myofascial TrPs in the upper trapezius muscle are more sensitive in patients experiencing cervicogenic headache than in those experiencing non-cervicogenic headache.

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