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CERVICAL PARAMETERS AND MIGRAINE

Upper cervical mobility, posture and myofascial trigger points in subjects with episodic migraine: Case-control study

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KEYWORDS
Forward head posture;
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Summary *Objectives:* To evaluate the association between episodic migraines and the prevalence of myofascial trigger points (MTrPs) in the sternocleidomastoid and upper trapezius, forward head posture (FHP), neck range of motion (ROM) and cervical facet joint stiffness.
Methods: 20 physiotherapy students with episodic migraines and 20 age- and sex matched healthy controls were included in this observational case-control study. Demographics and headache status were evaluated through questionnaires. Active neck ROM, presence of MTrPs, and cervical facet joint mobility were assessed by physical examination. FHP was measured using a lateral digital photograph taken in a sitting position.
Results: No significant differences were found in neck ROM measurements and FHP between the migraine and control groups. Significant differences were found in the prevalence of cervical facet joints stiffness in Occiput-C1 ($\chi^2 = 4.444$, $p = 0.035$) and C1—C2 ($\chi^2 = 10.157$, $p = 0.001$), but not in other segments. Significant differences were found in the prevalence of active and latent MTrPs between the migraine and control subjects in the right trapezius ($\chi^2 = 11.649$, $p = 0.003$) and right sternocleidomastoid ($\chi^2 = 8.485$, $p = 0.014$).
Conclusions: Our findings support the hypothesis that the prevalence of MTrPs in neck muscles and hypomobility in the upper cervical facet joints are associated with migraines.

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Introduction

Headaches are one of the most common complaints in medical practice (Stovner et al., 2007). The International Classification of Headache Disorders (ICHD-2) (Olesen and Steiner, 2004) categorized migraines and tension headaches as major types of headaches. Migraine is a complex disorder of the central nervous system with a one year prevalence of approximately 12% (Lipton et al., 2007), and thus incurs a substantial economic burden on society (2011). It is characterized by severe, recurrent, usually unilateral pulsating headaches that are usually accompanied by nausea, vomiting, photophobia and phonophobia (Lipton et al., 2001). Typically the headache lasting from 2–72 h, and is generally aggravated by physical activity (2004). During the past few decades, major advances in the understanding of migraine pathophysiology have been made, with major attention paid to the central mechanisms of migraines, particularly to the activation of the trigeminovascular system (Edvinsson, 2001).

Simons et al. (1999) claimed that pain originating in the pericranial, neck and/or shoulder muscles may be referred to the head and experienced as a headache. In their comprehensive text, they described referred pain patterns emanating from different myofascial trigger points (MTrPs) in the head and neck muscles which might potentially contribute to certain head and neck symptoms found in migraine sufferers. MTrPs have been defined as highly localized and hyperirritable points situated in a palpable taut band of skeletal muscle fibers (Han and Harrison, 1997; Simons et al., 1999). When compressed or stretched, MTrPs may elicit local and/or referred pain or local twitch response. There is still a controversy between medical specialists regarding the diagnostic criteria for MTrPs and their existence as a pathological entity. However, there are resent developments of imaging enabling visualization of muscular tissue containing MTrPs (Sikdar et al., 2009) and myofascial tight bands (Chen et al., 2007). These studies and advances in basic research (Hsieh et al., 2011; Shah et al., 2005) provide stronger background for myofascial pain theory.

Boquet et al. (1989) found that upper cervical MTrPs were located ipsilateral to side of pain in 24 subjects presenting with strictly unilateral migraines. In most patients, MTrPs were present even during headache-free periods. Based on these findings, it seems plausible that MTrPs in head and neck muscles might be an initiating or perpetuating factor for some migraine headaches (Fernandez-de-las-Penas et al., 2006b).

Normal posture in the sagittal plane has been described as the alignment of the external auditory meatus over the acromioclavicular joint, aligned with a vertical postural line (Seaman and Troyanovich, 2000; Yip et al., 2008). Local symptoms believed to be associated with forward head posture (FHP), when the head is situated in an anterior position in relation to the postural line (Yip et al., 2008), may include decreased range of neck motion, muscle stiffness or pain, and degenerative changes in the spine. Head and neck aches and shoulder pain are common manifestations of these structural problems (Braun and Amundson, 1989). Chronic tension type headaches (Fernandez-de-Las-Penas et al., 2006a, 2007), cervicogenic headaches (Watson and Trott, 1993) and migraines (Fernandez-de-las-Penas et al., 2006b) have all been associated with a smaller cranio-vertebral angle when compared to controls.

Cervical musculoskeletal abnormalities have been traditionally linked to different types of headaches. However, to our knowledge, only one blinded controlled study found differences in MTrPs prevalence in the head and neck muscles, FHP, cervical facet joint stiffness and neck mobility between episodic migraine subjects and healthy controls (Fernandez-de-las-Penas et al., 2006b). Additional studies are essential to replicate these results in other samples in order to establish a link between the aforementioned cervical findings and episodic migraines.

Several studies found that massage (Hernandez-Reif et al., 1998; Lawler and Cameron, 2006; Noudeh et al., 2012) is effective in reduction of pain intensity and stress level in migraine patients, supporting the circumferential support for connection between cervical parameters and migraine.

We hypothesized that young, apparently healthy individuals with episodic migraines have more prevalent MTrPs in their neck muscles, more prominent FHP, restricted neck mobility and more prevalent stiff upper neck facet joints, then their peers without headaches.

Our aim was to assess the association between the prevalence of MTrPs in sternocleidomastoid and upper trapezius muscles, FHP, neck range of motion, cervical facet joint stiffness and episodic migraines.

Methods

Design

Observational case-control study with a convenience sample.

Setting

Study was conducted at May–June 2012 at Physical Therapy Department, Recanati School for Community Health Professions, Ben Gurion University of the Negev, Beer Sheva Israel.

Sample

Physical therapy students, apparently healthy (without known chronic or acute diseases) males and females, were asked to participate. 105 2nd–4th year students agreed to fill the demographic and headache questionnaire based on the ICHD-2 criteria. Forty subjects, 20 with episodic migraines with or without aura and 20 sex- and age-matched controls with no recurrent headache were volunteered to participate in the present case-control study. Each subject received an explanation as to the aims of the study and methods of data collection (questionnaires, palpation and ROM evaluation), was screening for inclusion and exclusion criteria, and signed an informed consent form. Subjects did not receive any compensation or other benefits for the participation in the study. The study was approved by the Ethics Committee of the Recanati School for Community Health Professions.

Inclusion criteria

Apparently healthy physical therapy students between the ages of 18 and 35. Case group: episodic migraine headaches (without allodynia) according to the IHS scale (<15 days a month) and at least a one year history of headaches (according to the questionnaires). Control group: no recurrent headache.

Exclusion criteria

Medication use, including pain relievers at the day of examination, neck or head injury during the last year, systemic diseases, >15 days a month of headache or a headache episode on the day of the physical examination. No one used migraine prevention medications.

Evaluation procedures

Demographic information and headache status were evaluated from data taken from the questionnaires. Neck ROM, neck posture, presence of MTrPs, and upper cervical facet joints mobility were assessed by physical examinations. Physical examinations were performed by two specially trained physical therapists (DT and IM). Assessors were blinded to subjects' headache status. Subjects had no headache at the day of evaluation.

Demographic data collection

Data relating to age, sex, stature, weight, chronic morbidity, occupation (in addition to studies) and smoking were obtained from a specially designed demographic questionnaire. Body mass index (BMI) was calculated as BMI = weight/stature^2.

Headache evaluation

All volunteers who reported recurrent (≥5 lifetime attacks) headaches up to 15 headache days per month were asked to fill out a questionnaire designed to confirm a diagnosis of episodic migraines with or without an aura. The questionnaire was an adaptation of a questionnaire that was used in an earlier study (Abu-Salameh et al., 2010) to evaluate migraine sufferers. It based on the ICHD-2 criteria (Olesen and Steiner, 2004). The final drafting of questionnaire was performed by two physical therapists, experienced in research as well as in evaluation and treatment of headaches (LK and EV) that were consulted by a board certified neurologist specializing in evaluation and treatment of headaches. It focused on headaches which had occurred during the last three months, their duration (untreated duration of 4–72 h was required), characteristics (unilateral, pulsating, moderate or severe intensity, aggravated by routine physical activity, nausea/vomiting, photophobia, or phonophobia) and accompanying features (visual and/or sensory and/or speech symptoms lasts ≥5 and <60 min). In addition to characterization, the severity of headache was evaluated using numeric pain rating scale (Krebs et al., 2007). Evaluation of each questionnaire was performed by experienced physical therapist (LK). Only individuals with headaches characterized as episodic migraines (of any side or bilateral) with or without an aura were included as cases in this study.

Neck range of motion of flexion, hyperextension, right and left side flexion, right and left rotation were evaluated by a special tool (CROM-3, Cervical Range of Motion Instrument, Performance Attainment Associates, Lindstrom, MN). The average of these three measurements was recorded for each movement. This tool is valid (Tousignant et al., 2006) and reliable in measuring cervical spine active ROM in persons with and without neck pain (Fletcher and Bandy, 2008).

FHP evaluation

A lateral digital photograph of each study subject was taken in a sitting position. FHP was measured as a craniovertebral angle (Watson and Mac Donncha, 2000; Yip et al., 2008) between a horizontal line through the spinous process of C7 and the line from the spinous process C7 through the tragus of the ear, using the UTHSCSA Image Tool free software. Previously, Raine and Twomey (1997) reported a high reliability of a similar procedure (ICC = 0.88).

MTrPs evaluation

MTrPs were identified in both upper trapezius and both sternocleidomastoids muscles according to Simons et al. (1999) and Gerwin (1995) diagnostic criteria. If the MTrP were palpated and produced local or radiated pain it was referred to as a "latent MTrP". If the MTrP were palpated and produced a headache, familiar or not, it was referred to as an "active MTrP". If no tender point was palpated in the muscle or if the tender point produced no pain, it was recorded as no-trigger.

Upper cervical facet joint mobility/stiffness was evaluated by a consensus of two experienced manipulative physical therapists (LK and EV) using a motion palpation technique. The subject lay in a supine position and each examiner independently evaluated stiffness in the right and left facet joints, blinded to the results of other evaluations or to headache status. If the results of evaluations by two assessors matched, they were recorded. If there were differences in evaluations, additional evaluation by both assessors was performed and the consensual result was recorded. The cervical spine was evaluated between Occiput/C1 and C4–C5 segments. Stiffness of the cervical spinal segment was recorded if the facet joint on either side or bilateral was found to be stiff/hypomobile. According to Humphreys (Humphreys et al., 2004), even novice clinicians have demonstrated the ability to correctly identify the presence or absence of known cervical spine inter-segmental fixations by using specific motion palpation techniques on patients with congenitally fused vertebrae. He found a sensitivity of 74% and therefore justified the

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Table 1 Demographic data of studied sample.

	Headache group ($n = 20$)	No-headache group ($n = 20$)	Comparison (p-value)
	N (%)	N (%)	
Sex (males)	2 (10%)	3 (15%)	0.633[a]
Smoking	4 (20%)	2 (10%)	0.376[a]
	Mean ± SD	Mean ± SD	
Age (years)	24.95 ± 1.79	25.65 ± 1.42	0.179[b]
BMI (kg/m^2)	21.68 ± 2.62	21.69 ± 2.08	0.995[b]
Headache frequency (days of pain during the last 3 months)	6.60 ± 5.88	–	
Average severity (numeric pain rating scale)	6.45 ± 1.50	–	

SD – standard deviation.
[a] Results of Pearson χ^2 test.
[b] Results of one way ANOVA.

clinical use of motion palpation in the diagnosis of true 'fixations' in the cervical spine (Humphreys et al., 2004).

Statistical analysis

All statistical computations were performed using the SPSS 17.0 for Windows (SPSS, Chicago, IL, USA). Description statistics were used to characterize the study sample. To compare continuous variables between the case and control groups, one-way ANOVA was used. To compare categorical variables, the Pearson χ^2-test was used. Differences in the number of either latent or active MTrPs between both study groups were assessed with the Mann–Whitney U-test.

Results

A total of 20 subjects suffering from migraines, 2 men and 18 women, aged 20–27, and 20 healthy subjects, 3 men and 17 women, aged 23–28, were studied. No significant differences were found for gender, age, BMI, or smoking between the two groups (Table 1). No significant past or chronic morbidity (cardiovascular, oncological or rheumatologic diseases, hypertension, diabetes, or history of significant traumatic events) was reported by subjects in both groups. In migraine group, 7 subjects reported more prevalent attacks at the right side, 4 at the left side, and 9 reported bilateral pain or equal prevalence at both sides.

There were no significant differences in active neck ROM (Table 2) between the migraine and control groups. ROM of extension ($F = 0.412$, $p = 0.525$), right side flexion ($F = 0.598$, $p = 0.444$), left side flexion ($F = 3.226$, $p = 0.080$) and left rotation ($F = 0.474$, $p = 0.495$) was slightly greater in the control group; ROM in flexion ($F = 0.431$, $p = 0.516$) and right rotation ($F = 0.034$, $p = 0.854$) was greater in the migraine group. The cranio-vertebral angle was slightly smaller in the migraine group than in the healthy subjects, (more FHP than the control group), however, the difference was not statistically significant ($F = 1.375$, $p = 0.251$).

Significant differences were found in the prevalence of upper cervical spine facet joint stiffness/hypomobility (Table 3) in Occiput-C1 ($\chi^2 = 4.444$, $p = 0.035$) and C1–C2 ($\chi^2 = 10.157$, $p = 0.001$). Migraine group subjects had a higher prevalence of stiffness than their healthy peers. In segments C2–C3 ($\chi^2 = 1.905$, $p = 0.168$), and C3–C4 ($\chi^2 = 3.750$, $p = 0.053$) the differences were non-significant, but the tendency was the same.

The higher number of MTrPs was present in migraine group than in controls. The difference between groups was significant in prevalence of active ($Z = -2.146$, $p = 0.032$) and in total number (latent and active) of MTrPs ($Z = -2.673$, $p = 0.008$). Difference in prevalence of latent MTrPs was not significant ($z = -1.326$, $p = 0.185$).

We found significant differences in the prevalence of active and latent MTrPs between the migraine and control subjects (Table 4) in the right trapezius (=11.649, $p = 0.003$) and right sternocleidomastoid ($\chi^2 = 8.485$, $p = 0.014$), with a higher prevalence in the migraine group. Differences in the prevalence of MTrPs in the left trapezius ($\chi^2 = 5.804$, $p = 0.055$) and left sternocleidomastoid ($\chi^2 = 2.473$, $p = 0.290$) was also at the same direction, though non-significant.

Table 2 Differences in ROM and cranio-vertebral angle (results of one way ANOVA).

	Headache (mean ± SD)	No-headache (mean ± SD)	Comparison
Flexion	55.65 ± 13.55	53.05 ± 11.41	$F = 0.431$, $p = 0.516$
Extension	86.30 ± 11.18	89.35 ± 18.07	$F = 0.412$, $p = 0.525$
Right flexion	45.75 ± 8.23	47.70 ± 7.71	$F = 0.598$, $p = 0.444$
Left flexion	46.85 ± 6.09	50.10 ± 5.33	$F = 3.226$, $p = 0.080$
Right rotation	70.50 ± 9.87	69.95 ± 8.84	$F = 0.034$, $p = 0.854$
Left rotation	69.45 ± 9.71	71.30 ± 7.07	$F = 0.474$, $p = 0.495$
Cranio-vertebral angle	50.99 ± 7.29	53.21 ± 4.37	$F = 1.375$, $p = 0.251$

SD – standard deviation.

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Table 3 Differences in prevalence of upper cervical spine segmental stiffness (results of the Pearson χ^2 test).

Segment	Headache	No-headache	Comparison
Occiput-C1	4 (20%)	0 (0%)	$\chi^2 = 4.444$, $p = 0.035$
C1—C2	10 (50%)	1 (5%)	$\chi^2 = 10.157$, $p = 0.001$
C2—C3	8 (40%)	4 (20%)	$\chi^2 = 1.905$, $p = 0.168$
C3—C4	11 (55%)	5 (25%)	$\chi^2 = 3.750$, $p = 0.053$
C4—C5	5 (25%)	9 (45%)	$\chi^2 = 1.758$, $p = 0.185$

We compared the prevalence of MTrPs in each studied muscle between subjects with right vs. left side migraine using χ^2-test. No significant differences were found.

Discussion

This study was a partial replication of Fernandez-de-Las-Penas et al.'s study (Fernandez-de-las-Penas et al., 2006b). We evaluated factors associated with migraine in a generally healthy sample. The migraine group demonstrated significantly higher prevalence of active and total number of MTrPs then control group. A significantly greater number of active and latent MTrPs was found in the right sternocleidomastoid and right trapezius. MTrPs on the left side showed the same direction tendency, however, the association was not statistically significant, confirming the results of Fernandez-de-Las-Penas et al. (Fernandez-de-las-Penas et al., 2006b) who found that the total number of MTrPs in the trapezius, temporalis and sternocleidomastoid muscles were significantly greater in patients with migraines, compared to healthy controls. In view of these results, the association between prevalence of MTrPs and episodic migraine cannot be ignored.

The cross-sectional design of our study not allows evaluating the causal relationships between prevalence of MTrPs and migraine. In our opinion, three scenarios are possible: 1) MTrPs can trigger migraines, thus evaluation and consequential treatment of MTrPs should be an integral part of migraine management; 2) migraines and MTrPs have common etiological factors, i.e. chronic mental or physical tension which can cause neck MTrPs can also provoke the appearance of migraines; 3) The combination of both. These assumptions should be tested in further studies. Additional studies with follow-up design are needed to clarify the role of myofascial pain in migraine.

We could not confirm the finding of Fernandez-de-Las-Penas et al.'s (Fernandez-de-las-Penas et al., 2006b) that active MTrPs located ipsilateral to migraine headaches, most probably due to the difference in the study samples. In the study of Fernandez-de-Las-Penas et al. (Fernandez-de-las-Penas et al., 2006b) only individuals with unilateral migraine were included, that allowed the evaluation of association between side of pain and prevalence of MTrPs. In our study only almost half of the sample (9/20) reported no side preference of migraine or bilateral headache. Additionally no significant association between side of pain and prevalence of MTrPs was found in our study. In the cases of 7 subjects with right sided migraine, 4 out of the 5 individuals with active MTrPs had these on the right side.

FHP examination was conducted in a sitting position. We found non-significant ($p = 0.251$) differences in the cranio-vertebral angle between groups (i.e. a slightly smaller cranio-vertebral angle in the migraine group compared to the controls). Similarly, Zito et al. (2006) recently reported no significant differences in FHP between migraine and healthy subjects. On the other hand, Fernandez-de-Las-Penas et al. found (Fernandez-de-las-Penas et al., 2006b) a significantly smaller cranio-vertebral angle (i.e. greater FHP) in the migraine vs. control subjects. The cranio-vertebral angle in healthy individuals in Fernandez-de-Las-Penas et al.'s (Fernandez-de-las-Penas et al., 2006b) study was $52.6 \pm 7.2°$ which is very close to our ($53.2 \pm 4.4°$) and Zito et al.'s (Zito et al., 2006) ($50.3 \pm 4.6°$) findings. However, in their migraine group, the angle was much lower, $42.2 \pm 6.4°$ compared to $51.0 \pm 7.3°$ in our study and $53.3 \pm 3.9°$ in Zito et al.'s (Zito et al., 2006). It has been previously reported that prevalence of individuals with FHP increases with age (Zito et al.,

Table 4 Differences in prevalence of trigger points in trapezius and sternocleidomastoid muscles (results of the Pearson χ^2 test).

Muscle	Trigger point	Headache	No-headache	Comparison
Right trapezius	Active	9 (45%)	0 (0%)	$\chi^2 = 11.649$, $p = 0.003$
	Latent	7 (35%)	12 (60%)	
	No-triggers	4 (20%)	8 (40%)	
Left trapezius	Active	5 (25%)	0 (%)	$\chi^2 = 5.804$, $p = 0.055$
	Latent	6 (30%)	7 (35%)	
	No-triggers	9 (45%)	13 (65%)	
Right sternocleidomastoid	Active	1 (5%)	0 (0%)	$\chi^2 = 8.485$, $p = 0.014$
	Latent	6 (30%)	0 (0%)	
	No-triggers	13 (65%)	20 (100%)	
Left sternocleidomastoid	Active	2 (10%)	0 (0%)	$\chi^2 = 2.473$, $p = 0.290$
	Latent	3 (15%)	2 (10%)	
	No-triggers	15 (75%)	18 (90%)	

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2006), therefore, it is possible that the differences between the three studies can be explained by the older age of the subjects in Fernandez-de-Las-Penas et al.'s (Fernandez-de-las-Penas et al., 2006b) study (30.0 ± 10.0) vs. 24.9 ± 1.8 in our study and 22.9 ± 3.5 in Zito et al.'s study (Zito et al., 2006). The clinical significance of FHP in different types of headaches, including migraines, should be further tested.

In our study, there was no significant difference in cervical ROM between the migraine and control subjects. Our findings are in agreement with those of (Zwart, 1997; Zito et al., 2006; Amiri et al., 2007), who likewise found similar neck ROM in migraines (or non-cervicogenic headaches) and non-headache control groups. In contrast, Fernandez-de-las-Penas et al. (2006a, b) found that the total ROM in flexion/extension was significantly reduced in the migraine group compared with the controls.

Finally, we found a significantly greater number of subjects in the migraine group with Occiput-C1 and C1–C2 stiffness/hypomobility than the control group. In support of our findings, a recent study (Watson and Drummond, 2012) found that head pain referral during palpation of the upper cervical facet joints was significantly more prevalent in the migraine group than the healthy controls. In addition, three pre-post studies found that the greater occipital nerve (the primary branch of the second cervical root) blocks were effective in relieving migraine symptoms (Afridi et al., 2006; Ashkenazi and Young, 2005; Cook et al., 2006). These findings are in contrast to Zito et al. (Zito et al., 2006) who found a high incidence of pain associated with joint hypomobility in the cervicogenic headache group, while the incidence of joint hypomobility in the control and migraine groups was relatively low. In our study, the number of subjects with C2–C5 stiffness was not significantly different between the two groups.

Study limitations

Firstly, migraine headaches were evaluated through a questionnaire, not directly diagnosed by a neurologist, which could cause misclassification of the headache. However, we believe that since the headache evaluation questionnaire was built in accordance with accepted criteria and reviewed by a neurologist and a physical therapist experienced in headache management, the possibility of misclassification was low.

Secondly, due to the cross-sectional design of the study, we were unable to establish a causal relationship between MTrPs and migraines. A follow-up designed study with a greater number of subjects would need to be performed to establish this relationship.

Conclusions

Our findings support the hypothesis that prevalence of MTrPs in neck muscles is associated with migraines. The association between MTrPs in head and neck muscles and migraines should still be confirmed in larger studies. A strong association was found between migraines and hypomobility in the facet joints in the upper cervical spine. On the other hand, a significant limitation in ROM and a smaller cranio-vertebral angle, i.e. greater FHP, was not found, as predicted in the migraine group. We believe that therapeutic approaches for migraines based on MTrP management and mobilization of upper cervical facet joints should be designed and evaluated.

Disclosures

There are no potential conflicts of interest relevant to this article.

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