Published in final edited form as:

Pain. 2011 April ; 152(4): 765–771. doi:10.1016/j.pain.2010.11.007.

Influence of headache frequency on clinical signs and symptoms of TMD in subjects with temple headache and TMD pain

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Abstract

The relationship of the frequency of temple headache to signs and symptoms of temporomandibular disorders (TMD) was investigated in a subset of a larger convenience sample of community TMD cases. The study sample included: 86 painful TMD, non-headache subjects; 309 painful TMD subjects with varied frequency of temple headaches; and 149 subjects without painful TMD or headache for descriptive comparison. Painful TMD included Research Diagnostic Criteria (RDC) diagnoses of myofascial pain, TMJ arthralgia and TMJ osteoarthritis. Mild to

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The authors do not have any conflict of interest.

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moderate intensity temple headaches were classified by frequency using criteria based on the ICHD-II classification of TTH. Outcomes included TMD signs and symptoms (pain duration, pain intensity, number of painful masticatory sites on palpation, mandibular range of motion), PPTs and temple headache resulting from masticatory provocation tests. Trend analyses across the painful TMD groups showed a substantial trend for aggravation of all of the TMD signs and symptoms associated with increased frequency of the temple headaches. In addition, increased headache frequency showed significant trends associated with reduced PPTs and reported temple headache with masticatory provocation tests. In conclusion, these findings suggest that these headaches may be TMD-related, as well as a possible role for peripheral and central sensitization in TMD patients.

Keywords

temporomandibular disorders; headache; signs; symptoms; myofascial pain; TMD pain

Introduction

The International Classification of Headache Disorder, 2nd Edition (ICHD-II) has encouraged research focused on clinical characteristics of secondary headaches, such as TMD-related headaches, with the goal that “these headaches can become much more clearly defined” [17]. Several studies have reported the overlapping signs and symptoms of temporomandibular disorders (TMD) in tension-type headache (TTH) patients and TTH in TMD patients, respectively [3,10,16,39]. In patients with TTH increased headache has been found following jaw movements or clenching of the teeth [20,38]. This kind of close temporal relationship between headache and a causative disorder is one of the principle criteria for secondary headache diagnoses, including “11.7 Headache and facial pain attributed to temporomandibular joint (TMJ) disorder” [17]. This suggests that at least some of these headaches may be TMD-related.

Experimental studies in healthy subjects, have demonstrated that extensive chewing or clenching can elicit pain in the face, temples and head [1,41]. In other studies algogenic substances have been either injected or infused into the muscles to observe somatosensory changes related to muscle. Hypertonic saline infused intra-muscularly to provoke pain in healthy individuals in the masticatory and pericranial muscles was found to give similar referral patterns to those reported by TMD and TTH patients [35,36]. Similarly, hypertonic saline infused into the muscles of Chronic Tension-type Headache and TMD patients has been found to produce large overlapping referral patterns [2,42]. Taken together these studies suggest that some of the same muscles may be involved in the pathophysiology of both TTH and TMD and that the process of central sensitization and associated increased pain sensitivity may play a role in both [2,12,39].

The aims of this study were to investigate the relationship of the frequency of concurrent temple headache to: 1) signs and symptoms of a painful TMD; 2) pain sensitivity to pressure in trigeminal and non-trigeminal sites; and 3) whether clinical provocation of the masticatory system resulted in the temple headache. We hypothesized *a priori* that: 1) clinical pain characteristics of TMD would be greater in severity in subjects with more frequent temple headache; 2) generalized pain intensity would be greater in subjects with more frequent temple headache; and 3) the clinical provocation of the masticatory system would be more likely to result in their temple headache in TMD subjects with more frequent temple headache.

Methods

Study Sample and setting

The sample for this study was drawn from subjects included in a large comprehensive study designed to validate the RDC/TMD classification system[14,34]. The larger sample included 604 TMD community and clinic cases and 91 healthy controls[14,34]. Exclusion criteria included current pregnancy, rheumatoid diseases, neurological disorders, head and neck surgery, no widespread pain, and the use of no analgesic(s) other than acetaminophen for 3 days before the exam. The study was conducted from 2003 into 2006 and was a multi-site collaboration among researchers at the University of Minnesota (UM), the University of Washington (UW), and the University at Buffalo (UB). The Institutional Ethics Review Board at each site approved the study prior to initiation of the project. Written informed consent was obtained from all subjects before participation in the study. Subjects were compensated with \$200 for their participation. For details regarding subject demographics and clinical characteristics, see Schiffman et al. 2010[34].

The subset of the larger study that was used for this study sample included: 309 subjects with an RDC/TMD pain diagnosis (myofascial pain, TMJ arthralgia, or TMJ osteoarthritis) who also experienced headache located in their temple(s) in the past year; 86 subjects with an RDC/TMD pain diagnosis and no temple headache in the past year; and 149 subjects with no RDC/TMD pain diagnosis and no temple headache in the past year. This provided a normal control group (without painful TMD or headache) for descriptive comparison and subjects with painful TMD and a range of temple headache frequency from no headache to chronic headache.

Study Design

TMD Diagnoses—The larger study design has been described previously[34]. A brief summary of the process is provided here. One criterion examiner (CE) examined each subject at the first visit. At this visit the CE: explained the purposes of the study, reviewed the subject's medical history, confirmed eligibility with the inclusion and exclusion criteria, and obtained informed consent. A panoramic radiograph was obtained and interpreted by the site radiologist to rule out dental and osseous diseases. The first CE did a complete TMD history using a questionnaire, which included characteristics of the subject's headaches, to direct a semi-structured interview. The CE then completed the clinical assessment protocol, including both the RDC/TMD exam items and additional examination items, and rendered the TMD diagnosis(es). At a second visit an identical examination was conducted by a second CE, who was “blind” to the findings of the first CE. A reference standard diagnosis for TMD for each patient was based upon the consensus of both CEs at the second visit.

All six of the CEs were expert in TMD and orofacial pain dentistry and had between 12 and 38 years of experience in research and clinical management of TMDs. Multiple inter-reliability exercises between the sites were performed to assess agreement on examination items and diagnoses. A moderate to excellent reliability was found for the CE TMD diagnoses[28].

Headache Classification—This subset of the larger RDC/TMD Validation Project sample included both subjects with no painful TMD and no temple headache (normal controls); subjects with painful TMD (as described above) and no temple headache; and those reporting the occurrence of temple headaches in the past year concurrent with one or more of the TMD pain diagnoses of arthralgia, myofascial pain and osteoarthritis[14,34]. The subjects with painful TMD without temple headaches could have headaches in other locations.

All headache subjects in this study reported headaches occurring in the temples. The ICDH-II tension-type headache criteria were used as a framework to create a frequency/severity spectrum for classification of these temple headaches in this sample. The ICDH-II Tension-type headache (TTH) criteria are based on: A. headache frequency; B. headache duration; C. headache quality; and D. absence or limited presence of migraine symptoms of nausea/vomiting, photophobia and phonophobia [17]. The resulting spectrum of headache resulted in 15 mutually exclusive headache categories in which every subject could be classified. This spectrum included categories (1) that met ICHD-II criteria for TTH; (2) that did not meet formal TTH classification due to insufficient symptoms in criteria A, B, or C; (3) that did not meet formal TTH classification due to excessive symptoms in criterion D; and (4) that were based on the migraine type features. From this spectrum, two types of headache were excluded from further analyses: those low frequency headaches with minimal criteria B and C symptoms, and those at the other end of the spectrum meeting the ICDH-II Migraine criteria. These exclusions resulted in 10 categories, which were collapsed into 3 types based on headache frequency as defined by the ICDH-II TTH criteria [17].

The three headache types reported in this study follow. Infrequent Episodic Headaches (IEHA) occurred less than 12 days/year with an episode duration of less than 7 days. Frequent Episodic Headaches (FEHA) occurred at least 10 times/year, from 1-14 days/month; 12-179 days/year; and with an episode duration of less than 7 days. Chronic Headaches (CHA) occurred at least 10 times/year; more than 15 days/month; at least 180 days/year and with an episode duration of at least 2 hours.

All three headache types met the criterion of mild to moderate intensity, as well as one of the additional TTHA criteria C quality characteristics: bilateral location, pressing/tightening (non-pulsating) quality, or not aggravated by routine physical activity. Some of the subjects within each of these types reported nausea, vomiting or phono- and photophobia but were not considered of migraine type due to meeting TTH criterion C for headache quality. Inclusion of these subjects was deemed appropriate as these symptoms are not exclusive to migraines and are exhibited by other chronic pain conditions [44].

Variables of Signs and Symptoms of TMD

Pain characteristics—1) Pain duration in the face, jaw, jaw joint and temple was reported in number of years and months. 2) The average pain intensity in the face, jaw, jaw joint and temple in the last month was rated on a numeric rating scale (NRS) 0 = 'no pain' to 10 = 'pain as bad as could be'.

Pressure pain threshold (PPT)—Pain pressure thresholds (kPa,) were determined with a pressure algometer (SOMEDIC Algometer®, SOMEDIC Sales AB, Sweden) [31,40]. An increasing pressure was applied at a rate of 30 kPa/s with a 1.0 cm² probe to each site. The subject terminated each measurement with a switch, which they were instructed to trigger at the pressure first perceived as painful. The average value of two measurements was used in the analysis. There was a minimum of 3 seconds between repeated pressure stimuli. The PPT was assessed bilaterally over anterior temporalis muscles; at the insertion of the masseter muscles; on the frontalis region; and at a hand site on the palm just below the palmar crease of the little finger and 1 cm medial to the lateral border of the palm.

Number of painful masticatory sites on palpation—The posterior, middle, and anterior aspect of the temporalis muscles; the origin, body, and insertion of the masseter muscles; posterior mandibular regions; submandibular regions; lateral pterygoid areas; the tendons of the temporalis muscles; and the lateral and posterior aspects of the TMJs were assessed on both sides. It should be noted that the palpation sites did not include the

sternocleidomastoid muscle, splenius or trapezius, also included in ICDH-II criteria for separation of tension-type headache with and without pericranial tenderness. This provided 20 muscle sites and 4 TMJ sites for each subject. Pain to palpation of each site was noted as present or absent by the subject. A TMD palpation composite score (number of painful sites) was established based on the sum of positive responses to 20 yes/no muscle sites and 4 yes/no TMJ sites.

Mandibular range of motion—Unassisted opening without pain, maximum unassisted opening, and maximum assisted opening (passive stretch) were each measured in mm. All measurements were made between the incisal edges of the upper and lower right central incisors.

Masticatory provocation tests—1) Clenching test: The subjects were asked to clench their teeth for 1 minute. 2). Cotton roll tests: In the two additional tests the subjects were instructed to clench their teeth on a cotton roll on the left side for 10 seconds and subsequently the right side for 10 seconds. During each of these provocation tests the subjects were asked to report if their “familiar mild to moderate temple headache” was provoked. In a similar manner static and dynamic jaw tests as described by Visscher et al. were also used in attempts to provoke the “familiar mild to moderate temple headache” [43]. Pressure was applied to the mandible during mandibular opening, closing, and protrusive movements (dynamic tests) and while the mandible was kept motionless by the subject in an open, closed, or protrusive position (static tests). The subjects were again asked if they experienced their “familiar mild to moderate headache” in the temples during the tests. The concept of “familiar pain” on clinical provocation has been previously considered in the case of TMD, as well as in other musculoskeletal pain conditions [33]. We applied this concept to temple headache in this investigation.

Statistical Methods

To describe the relationship between TMD variables of interest along the ordered headache frequency (with or without TMD), we presented means and standard deviations for continuous TMD variables across the five categories or we showed proportions of dichotomous TMD variables across the headache groups. To test whether trends of increasing means or proportions along the ordered headache frequency were statistically significant, we applied a linear regression model for continuous TMD variables where headache frequency was used as linear variable, or for dichotomous TMD variables we performed a trend test for proportions. The trend tests were performed using the four groups of subjects with TMD pain diagnosis and varying frequency of headaches, excluding the group without TMD and without headaches. For some of the trend analyses, this pain free group was not an appropriate comparison because subjects did not have a pain diagnosis. Analyses were also repeated excluding the subjects with headache other than in the temple region in the group of subject with painful TMD and no temple headache. Analyses were performed using the statistical software Stata (StataCorp. 2007. Stata Statistical Software: Release 10. College Station, TX: StataCorp LP).

Results

Demographic information on the subjects is provided in Table 1. The subjects with no painful TMD and no temple headache included 149 controls. Outcomes for this group are provided in Tables 1-6 for descriptive comparison, although since this group did not have TMD symptoms it was not included in the trend analyses. Subjects with TMD pain diagnoses and no temple headaches numbered 86. Among them were 28 subjects with headaches other than in the temple region. Subjects with painful TMD and concurrent

temple headaches included 72 subjects with infrequent episodic headache (IEHA), 172 subjects with frequent episodic headache (FEHA), and 65 subjects with chronic headache (CHA). Whereas no age trend or no trend in the proportion of college graduates was observed, gender and ethnicity changed across the ordered headache frequency. The proportion of females and subjects of Caucasian ethnicity increased with headache frequency. Trend results were similar when the 28 subjects with headaches other than in the temple region were excluded from the HA-TMD+ group.

The prevalence of both the myofascial pain and joint pain diagnoses, as well as pain intensity and duration, increased to a relevant and statistically significant degree. (Table 2). As almost all TMD pain subjects were diagnosed with both myofascial pain and arthralgia further sub-analyses of the diagnostic groups was not possible.

All other clinical variables exhibited significant increases associated with increased frequency of the concurrent temple headaches, with the single exception of maximum unassisted opening with pain. The pattern of results were consistent across several locations for the pain pressure thresholds (Table 3), for the number of painful muscle and joint palpation sites (Table 4), for 2 of 3 measures of mouth opening (Table 5), and for the subject's report of familiar headache with three jaw provocation tests (Table 6). When the trend analyses were repeated excluding the 28 subjects from the TMD+HA- group with headaches other than in the temple region, in general the trend results became stronger.

Discussion

The main finding in this study was a significant association of increased TMD pain intensity and increased frequency of clinical TMD signs with more frequent temple headaches. These findings, taken with jaw provocation of headache-like pain that also increased with headache frequency, suggest the possibility these headaches may be attributed to TMD. In addition, this study found increased sensitivity in trigeminal and non-trigeminal sites, as well as larger fields of pain (greater number of painful sites), associated with increased headache frequency. These findings suggest involvement of both peripheral and central sensitization in TMD patients.

The analyses with the subjects with headaches other than in the temples excluded from the TMD+HA- group resulted in even stronger trends. This was a result of making this group with the lowest headache frequency in essence “healthier,” i.e. less impaired, when these subjects were not included in the trend analysis.

Demographics

The age and gender distribution in this study was similar to other studies involving TMD clinic and community cases [13]. In epidemiological and clinical studies a similar pattern has been found with higher proportion of females than males with peak prevalence during the reproductive years of age [10,13,26]. This sample, specifically recruited to include an appropriate mix of TMD pain conditions necessary to test TMD diagnostic criteria [34], contained a greater proportion of subjects with joint pain than comparative population-based [13] or clinical samples [26]. However, since almost all subjects in this study also exhibited myofascial pain, the most common TMD pain condition, the results should be generalizable to other clinical and research settings.

Temple Headache

The subjects provided information regarding their mild to moderate temple headaches through a questionnaire and follow-up review with the CEs. This data was used to further characterize their headaches by frequency using criteria based on the ICHD-II TTH criteria.

The investigated mild to moderate temple headaches were thought more likely related to TMD than the existing ICHD-II “11.7 Headache and facial pain attributed to temporomandibular joint (TMJ) disorder” [17]. The existing 11.7 criteria has never been validated and include criterion for TMJ imaging and TMJ noise, specific criteria, which have been shown to have little relationship to pain [24,32].

Pressure pain threshold

In this study, the PPTs for the trigeminal sites were lower for subjects with painful TMD than control subjects. There was also a significant trend for lower PPTs of trigeminally-innervated sites with increased frequency of the concurrent temple headaches (Table 3). These findings coincide with other studies investigating a TMD clientele [29,30,40,42]. In addition a significant difference was seen in PPT at the non-trigeminal site in the hand indicating a generalized hyperalgesia compared with controls, an observation made in other investigations of TTH [4,7,8,37]. Svensson et al. have also reported lower PPTs in both masseter and anterior tibialis sites in TMD subjects as compared to controls [42].

Number of painful masticatory sites on palpation

The most clinically relevant method to evaluate tenderness in the pericranial tissue including masticatory system is manual palpation. The sites that were examined were based on a standardized protocol RDC/TMD, which has been shown to exhibit good reliability[28]. It should again be noted that the RDC/TMD protocol does not include the same 7 pairs of pericranial muscle sites included in the IHS classification for TTH [17]. Our study found an overall increased pain sensitivity in total numbers of painful sites in those subjects with temple headaches. This is in line with studies where increased pericranial muscle tenderness has been found in both patients with episodic and chronic TTH [5,19,21,25]. These findings suggest possible central sensitization and may involve supraspinal neurons [6].

Mandibular range of motion

Measurement of the jaw opening is a very reliable outcome measure [15,23]. In population-based, as well as clinical studies, a reduced opening capacity has been demonstrated in TMD patients relative to healthy controls [15,27]. In our study a significant trend for 2 of the 3 jaw opening measurements was found with increased frequency of concurrent temple headache. Maximum unassisted opening with pain was substantially greater for the control group than the TMD groups. Although the trend across the TMD groups did not reach significance, this finding is in agreement with another study where a significant difference was found in jaw opening between TMD patients and patients with daily headache [22]. It also has been reported that approximately 50% of patients with recurrent headache report pain when they were asked to open their mouth as wide as possible [38]. In our study both unassisted opening without pain and maximum assisted opening with pain exhibited significant trends for reduced measurements associated with increased frequency of the concurrent temple headaches.

Provocation tests of the jaw

In the ICDH-II classification it is stated that “when pre-existing TTH is made worse in close temporal relation to another disorder that is a known cause of the headache”, consideration should be given to classifying it as a secondary headache [17]. Several studies in healthy individuals as well as in TMD patients have demonstrated increased pain after experimental clenching tests [9,11]. Another study indicated that individuals who engage in deliberate, low-level tooth contacts report greater pain than those instructed to relax their masticatory muscles [16]. In studies of patients with TTH from specialized headache clinics high frequencies of reported tooth clenching have been observed [20,21,25]. Two studies have

demonstrated that experimental tooth clenching can provoke pain in subjects with migraine and tension-type headache respectively as compared with controls [18,20].

Our study demonstrated a significant trend for a report of “familiar headache pain” provoked by teeth clenching associated with the increased frequency of temple headache. We observed clenching-provoked “familiar headache pain” in 19.2% of the subjects with FEHA and 27.7% for those with CHA. These figures are lower than those reported by Jensen et al., 1996 with clenching producing headaches in 69% of their subjects with a tension-type headache diagnosis [20]. This difference is likely related to the duration of the clenching during the clinical provocation test. In our study the subjects clenched at maximum for one minute, as opposed to the 30 minutes at 10% of maximum EMG clench used by Jensen and Olesen. The other provocation tests, unilateral cotton roll biting and static and dynamic masticatory testing, also exhibited an increased trend for reported “familiar headache pain” associated with increased frequency of temple headaches. These findings further suggest that these are TMD-related secondary headaches.

Strengths and limitations of the study

The study has several strengths. It is a large clinic based multicenter study and included well-defined and representative cases with TMD. Patients with co-morbid pain conditions and subjects with medication overuse were not included as these could influence the presentation of TMD. The clinical measures were all tested for reliability and repeated calibrations of examiners were performed to establish as reliable diagnoses as possible. The major strength of the study is the consistency of findings across measures.

Limitations of the study were that headache diaries were not kept before examination and after clinical tests. Also, the examiner conducting the clinical tests was not blinded to the headache diagnosis, although the diagnosis was made following the examination. In addition, a neurological examination was not performed, and the subjects were not examined in a randomized order. Finally, this study was cross-sectional so it was not possible to determine a causal relationship.

Conclusions

The main findings of this study were that TMD patients with increased frequency of headache occurring in the temple(s) exhibited increased severity of TMD pain characteristics, spread of pain, as well as increased sensitivity in trigeminal and non – trigeminal sites. Together these findings suggest that these headaches may be TMD-related, and suggests a role for both peripheral and central sensitization in TMD patients.

Acknowledgments

The authors thank the following personnel of the RDC/TMD Validation Project: at the University of Minnesota, Mansur Ahmad, Quentin Anderson, Mary Haugan, Amanda Jackson, Wenjun Kang, Pat Lenten, John Look, Wei Pan, and Feng Tai; at the University at Buffalo, Leslie Garfinkel, Yoly Gonzalez, Patricia Jahn, Krishnan Kartha, Sharon Michalovic, and Theresa Speers; and, at the University of Washington, Lars Hollender, Kimberly Huggins, Lloyd Mancl, Julike Sage, Kathy Scott, Jeff Sherman, and Earl Sommers. This research was supported by grant no. U01 DE013331 from the NIH/NIDCR. The completion of this manuscript was also facilitated by the Lasby Visiting Professorship at the School of Dentistry, University of Minnesota, USA, awarded to Thomas List.

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Table 1

Trend analyses of demographics across four groups of subjects with painful TMD and increasing temple headache frequency.

Variable	HA- TMD- N=149	HA- TMD+ N=86	IEHA TMD+ N=72	FEHA TMD+ N=172	CHA TMD+ N=65	P-value for trend across TMD+ groups
Mean (SD) or % (N)						
Age [years]	37.6 (13.4)	37.8 (15.1)	34.7 (12.9)	35.1 (11.8)	41.5 (13.7)	0.311
Gender - Females	66.4 (99)	79.1 (68)	91.7 (66)	89.5 (154)	87.7 (57)	0.088
Ethnicity - White	87.3 (130)	90.7 (78)	87.3 (62)	94.2 (162)	98.5 (64)	0.027
Education- College graduate	83.2 (124)	82.6 (71)	91.7 (66)	85.5 (147)	75.0 (48)	0.252

Temple headache (HA) present (+) or absent (-), and Temporomandibular disorder pain diagnosis (TMD) present (+) or absent (-). Infrequent episodic headache (IEHA), frequent episodic headache (FEHA) and chronic headache (CHA).

Table 2

Trend analyses of specific TMD pain diagnoses, pain duration and intensity across four groups of subjects with painful TMD and increasing temple headache frequency.

Variable	HA-TMD- N=149	HA-TMD+ N=86	IEHA-TMD+ N=72	FEHA-TMD+ N=172	CHA-TMD+ N=65	P-value for trend across TMD+ groups
Mean (SD) or % (N)						
Presence of myofascial pain	-	96.5 (83)	100.0 (72)	100.0 (172)	100.0 (65)	0.008
Presence of joint pain diagnosis	-	79.1 (68)	90.3 (65)	89.0 (153)	93.9 (61)	0.008
Pain Duration [years]	-	6.9 (8.1)	8.8 (8.8)	9.1 (8.7)	9.5 (9.0)	0.046
Average Pain Intensity [0-10]	-	4.4 (2.3)	5.0 (2.3)	4.8 (2.0)	6.1 (2.1)	<0.001

Temple headache (HA) present (+) or absent (-), and Temporomandibular disorder pain diagnosis (TMD) present (+) or absent (-). Infrequent episodic headache (IEHA), frequent episodic headache (FEHA) and chronic headache (CHA).

Trend analyses of pain pressure thresholds (kPa) by site across four groups of subjects with painful TMD and increasing temple headache frequency.

Table 3

Variable	HA-TMD-	HA-TMD+	IEHA TMD+	FEHA TMD+	CHA TMD+	<i>P-value for trend across TMD+ groups</i>
	N=149	N=86	N=72	N=172	N=65	
	<i>Mean (SD)</i>					
M. Masseter	193 (64)	149 (52)	136 (52)	130 (42)	133 (52)	0.010
M. Temporalis	228 (77)	188 (61)	168 (66)	161 (56)	158 (59)	0.001
M. Frontalis	262 (94)	217 (71)	200 (69)	193 (58)	189 (69)	0.003
Hand	201 (68)	161 (52)	149 (61)	141 (51)	137 (49)	0.002

Temple headache (HA) present (+) or absent (-), and Temporomandibular disorder pain diagnosis (TMD) present (+) or absent (-). Infrequent episodic headache (IEHA), frequent episodic headache (FEHA) and chronic headache (CHA).

Trend analyses of the number of painful muscle and joint sites to palpation across four groups of subjects with painful TMD and increasing temple headache frequency.

Table 4

Variable	HA-TMD- N=149	HA-TMD+ N=86	IEHA-TMD+ N=72	FEHA-TMD+ N=172	CHA-TMD+ N=65	P-value for trend across TMD+ groups
	Mean (SD)					
No of painful sites [0-24]	0.7 (1.8)	6.5 (4.9)	9.9 (5.8)	10.5 (5.9)	12.5 (6.1)	<0.001
No of painful muscle sites [0-20]	0.7 (1.6)	5.6 (4.3)	8.6 (5.2)	9.3 (5.2)	11.0 (5.2)	<0.001
No of painful TMJ sites [0-4]	0.0 (0.3)	0.9 (1.0)	1.3 (1.0)	1.2 (1.1)	1.5 (1.2)	0.001

Temple headache (HA) present (+) or absent (-), and Temporomandibular disorder pain diagnosis (TMD) present (+) or absent (-). Infrequent episodic headache (IEHA), frequent episodic headache (FEHA) and chronic headache (CHA).

Trend analyses of interincisal measurement of jaw opening across four groups of subjects with painful TMD and increasing temple headache frequency.

Table 5

Variable	HA- TMD- N=149	HA- TMD+ N=86	IEHA+ TMD+ N=72	FEHA+ TMD+ N=172	CHA+ TMD+ N=65	P-value for trend across TMD+ groups
	Mean (SD)					
Unassisted opening without pain (mm)	52 (7)	39 (11)	37 (9)	37 (10)	33 (11)	0.004
Max. unassisted opening with pain (mm)	54 (7)	47 (10)	47 (8)	47 (11)	43 (10)	0.065
Max. assisted opening with pain (mm)	56 (7)	50 (9)	50 (7)	50 (10)	48 (10)	0.288

Temple headache (HA) present (+) or absent (-), and Temporomandibular disorder pain diagnosis (TMD) present (+) or absent (-). Infrequent episodic headache (IEHA), frequent episodic headache (FEHA) and chronic headache (CHA).

Table 6

Trend analyses of clinical jaw provocation tests resulting in familiar mild to moderate headache across four groups of subjects with painful TMD and increasing temple headache frequency.

Variable	HA- TMD- N=149	HA- TMD+ N=86	IEHA TMD+ N=72	FEHA TMD+ N=172	CHA TMD+ N=65	<i>P-value for trend across TMD+ groups</i>
	% (N)					
Familiar HA with clenching	-	1.2 (1)	12.5 (9)	19.2 (33)	27.7 (18)	<0.001
Familiar HA with biting on a cotton roll	-	0.0 (0)	9.7 (7)	11.6 (20)	18.5 (12)	<0.001
Familiar HA with static or dynamic test	-	3.5 (3)	8.3 (6)	18.6 (32)	33.9 (22)	<0.001

Temple headache (HA) present (+) or absent (-), and Temporomandibular disorder pain diagnosis (TMD) present (+) or absent (-). Infrequent episodic headache (IEHA), frequent episodic headache (FEHA) and chronic headache (CHA).