HHS Public Access

Author manuscript

*J Orofac Pain*. Author manuscript; available in PMC 2015 August 07.

Published in final edited form as:

*J Orofac Pain*. 2012 ; 26(2): 83–90.

# Influence of Temple Headache Frequency on Physical Functioning and Emotional Functioning in Subjects with Temporomandibular Disorder Pain

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## Abstract

**Aims—**To investigate the relationship of headache frequency with patient-reported physical functioning and emotional functioning in temporomandibular disorder (TMD) subjects with concurrent temple headache.

**Methods—**The Research Diagnostic Criteria for TMD (RDC/TMD) Validation Project identified, as a subset of 614 TMD cases and 91 controls (n = 705), 309 subjects with concurrent TMD pain diagnoses (RDC/TMD) and temple headache. The temple headaches were subdivided into infrequent, frequent, and chronic headache according to the International Classification of Headache Disorders, second edition (ICHD–II). Study variables included self-report measures of physical functioning (Jaw Function Limitation Scale [JFLS], Graded Chronic Pain Scale [GCPS], Short Form–12 [SF–12]) and emotional functioning (depression and anxiety as measured by the Symptom Checklist–90R/SCL–90R). Differences among the three headache subgroups were characterized by increasing headache frequency. The relationship between ordered headache frequency and physical as well as emotional functioning was analyzed using linear regression and trend tests for proportions.

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The authors do not have any conflicts of interest.

**Results—**Physical functioning, as assessed with the JFLS ($P < .001$), SF-12 ($P < .001$), and GCPS ($P < .001$), was significantly associated with increased headache frequency. Emotional functioning, reflected in depression and anxiety, was also associated with increased frequency of headache (both $P < .001$).

**Conclusion—**Headache frequency was substantially correlated with reduced physical functioning and emotional functioning in subjects with TMD and concurrent temple headaches. A secondary finding was that headache was precipitated by jaw activities more often in subjects with more frequent temple headaches.

## Keywords

health-related quality of life; jaw function; psychosocial status; temporomandibular disorders; tension-type headache

Temporomandibular disorders (TMD) occur in about 10% of the population, whereas the prevalence of frequent episodic tension-type headache (FETTH) ranges from 24% to 43%, and the prevalence of chronic tension-type headache (CTTH) ranges from 3% to 5%.[1–3] Several studies have demonstrated many shared signs and symptoms of tension-type headache (TTH) and TMD.[4] In studies of TMD patients, TTHs are very common[5,6] and TMD is common in studies of TTH patients.[7–11]

The International Classification of Headaches Disorders, second edition (ICHD–II) has recognized this relationship of headache and TMD with the inclusion of the secondary headache, “11.7 Headache or facial pain attributed to temporomandibular joint (TMJ) disorders,” which includes a criterion of headache associated with jaw activity.[12] The ICHD–II also made a general request for investigation of secondary headaches so that their diagnostic criteria “can be much more clearly defined.”[12] In addition, the dental literature has recently encouraged dialog between the dental and medical communities regarding these disorders.[13]

An important feature of TTH in the ICHD–II is frequency of occurrence, which is used to divide TTH into subtypes of infrequent episodic (IETTH), frequent episodic (FETTH), and chronic (CTTH) tension-type headaches.[12] IETTH has little impact on the individual, while FETTH may result in more pain-related disability and economic costs. CTTH is a serious condition with considerable impact on quality of life and disability of affected individuals.[12,14,15] Pain, depression, anxiety, psychological distress, and impaired sleep are also common in patients with TMD and have been reported to result in reduced quality of life.[16–18] Although the criteria for secondary TMD-related headache do not include subtypes of frequency as used in primary TTH, the effect of TTH frequency suggests that headache frequency should be considered in the investigation of TMD-related secondary headaches.

The Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) has suggested that six domains should be considered in the assessment of clinical trials to permit meaningful comparisons between intervention studies in chronic pain conditions such as headache.[19] Although intended for clinical trials, the use of this set of

standardized domains is also applicable to other study designs. It allows patient-centered effects to be compared across pain conditions such as TMD and headache.

In a previous study, the authors observed that subjects with painful TMD showed significant trends for increased signs and symptoms of TMD associated with patient report of increased frequency of temple headaches, suggestive of secondary TMD-related headaches.[20] The present study investigated the effects of temple headache frequency on physical functioning and emotional functioning in the same study sample. The authors hypothesized that psychological and emotional functioning would be decreased in association with increased frequency of temple headache. Therefore, the aim of this study was to investigate the relationship of headache frequency with patient-reported physical functioning and emotional functioning in TMD subjects and concurrent temple headache. A secondary objective was to assess the association between patient report of jaw activities aggravating temple headache and headache frequency.

## Materials and Methods

### Study Sample and Setting

The sample for this study was drawn from subjects included in a large comprehensive study designed to validate the Research Diagnostic Criteria for TMD (RDC/TMD) classification system.[21,22] The larger sample consisted of 705 individuals. Exclusion criteria for this sample 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 examination. The study was conducted from 2003 into 2006 and was a multisite collaboration among researchers at the University of Minnesota, the University of Washington, and the University at Buffalo. 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 $200 for their participation. For details regarding subject demographics and clinical characteristics, see Schiffman et al.[21]

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 had 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. A total of 161 subjects from the Validation Project with diagnoses of nonpainful TMD (TMJ disc displacements and osteoarthrosis) and those not meeting the headache criteria (see Headache Classification) were not included.

### Study Design

**TMD Diagnoses—**The larger study design has been described previously.[21] A brief summary 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 subject completed a questionnaire, which included ICHD–II-based items for characterizing headache, and the CE used the subject's questionnaire responses to direct a semistructured interview. The CE then completed the clinical assessment protocol, including both the RDC/TMD examination 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. Multiple interexaminer reliability exercises were performed to assess agreement on examination items and diagnoses. A moderate to excellent reliability was found for the CE TMD diagnoses.[23]

**Headache Classification—**All headache subjects in this study reported headaches occurring in the temple in either or both sides. The ICDH–II criteria for TTH were used as a framework to create a frequency/severity spectrum for classification of these temple headaches in this sample. These 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.[12] 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 and which represented probable TTH; *(3)* that did not meet formal TTH classification due to excessive symptoms in criterion D and which represented probable migraine; 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 three types based on headache frequency as defined by the ICDH-II TTH criteria.[12]

The three headache types reported in this study were as follows: Infrequent episodic headaches (IEHA) occurred less than 12 days per year with an episode duration of less than 7 days. Frequent episodic headaches (FEHA) occurred at least on 10 occasions, from 1 to 14 days per month, 12 to 179 days per year, and with an episode duration of less than 7 days. Chronic headaches (CHA) occurred more than 15 days per month, at least 180 days per 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 (nonpulsating) 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 to be the migraine type due to meeting TTH criterion C for headache quality.

## Outcome Variables

Subjects provided the following data through self-report using standardized instruments.

## Physical Functioning

**Jaw Functional Limitation Scale (JFLS)—**This scale is designed to measure how jaw function is limited during different activities. The scale includes 20 items in the domains of mastication, vertical jaw mobility, and verbal and emotional expression. The patients rate the limitation associated with each item by using a 0 to 10 numeric rating scale (NRS). “0” corresponds to no limitation and “10” to extreme limitation. Acceptable reliability and validity has been reported for the instrument.[24]

**Graded Chronic Pain Scale (GCPS).[25]—**This scale is a self-report instrument composed of seven items concerning pain intensity, interference in daily activities, and disability days to yield a 0 to IV score. Grade 0 is defined as no TMD pain. Grade I is defined as TMD pain of low intensity. Grade II is defined as high-intensity pain. Grades III and IV reflect moderate to significant pain-related psychosocial disability regardless of pain level. The GCPS has been reported to be a reliable and valid instrument.[25,26] For analytical purposes, GCPS categories were dichotomized into the presence or not of dysfunctional chronic pain (grade III or IV).

**Short Form–12 (SF–12)—**The SF–12 v2, a short version of the SF–36, is a widely used, valid, and reliable health-related quality of life (HRQoL) measure.[27,28] The SF–12 yields physical (PCS) and mental (MCS) component summary scales, transformed to have a mean of 50 and a standard deviation of 10 in the general US population. Low scores indicate poor health and high scores reflect well-being. The MCS evaluates the frequency of feelings of nervousness, depression, happiness, and calmness. The PCS measures the impact of health on limitations to any physical activity including climbing chairs, moving heavy objects, household work, and low-impact sports such as bowling or golf.

**Change in Temple Headache Related to Jaw Activities—**The subjects were asked if seven jaw-related activities affected their temple headache: opening your mouth or moving your jaw forward or to the side; biting into food with your front teeth; chewing hard or tough food; jaw habits such a holding teeth together, clenching/grinding teeth, or chewing gum; resting the jaw; awakening from sleep; and other jaw activities such as talking, kissing, or yawning. Response options included: temple headache got worse, temple headache did not change, or temple headache improved. For analytical purposes, responses were dichotomized into temple headache got worse or not with jaw activities.

## Emotional Functioning

**Psychological Status—**Depression was assessed with 20 items and anxiety was assessed with seven items from the Symptom Checklist–90 Revised (SCL–90R).[29] Acceptable reliability and validity has been demonstrated for these items.[30]

## Statistical Methods

To describe the relationship between the outcome variables and the ordered headache frequency in subjects with TMD, means and standard deviations are presented for continuous variables and proportions for dichotomous variables (gender, white ethnicity, college education, dysfunctional chronic pain, worse temple headache with jaw function)

along the four ordered headache frequency groups from no headache to CHA. A fifth group of subjects, no headache and no painful TMD diagnosis, was also shown to provide information about a natural extension of the ordered headache frequency from subjects with painful TMD to subjects without a painful TMD diagnosis.

To test whether trends of increasing means or proportions along the ordered headache frequency were statistically significant, a linear regression model was applied for continuous outcome variables where headache frequency was used as the linear variable, or, for dichotomous demographic variables, a trend test for proportions was performed. The trend tests were performed using the four groups of subjects with TMD pain diagnosis and varying frequency of headaches. The fifth group, subjects without TMD and without headaches, was not included in the trend analyses because this pain-free group was not an appropriate comparison for the four groups of subjects with TMD pain.

## Results

Demographic information on the sample was provided in the previous publication, but is provided in Table 1 for completeness.[20]

For the JFLS, a significant increase in scores, ie, more limitations, was seen for all the domains ($P = .040$ to $P < .001$) and for the global score ($P < .001$) with increased headache frequency (Table 2). Health-related quality of life (HRQoL) as measured with SF–12v2 decreased for the PCS and the MCS scales with increased headache frequency (Table 2). A significant increase in pain-related disability (GCPS) was seen in the groups with increased headache frequency (Table 2).

Emotional functioning measured with the SCL–90 showed a significant score increase, ie, more impaired emotional functioning, in both depression ($P < .001$) and anxiety ($P < .001$) with increased frequency of headache (Table 3).

The prevalence of self-report of temple headache aggravated by jaw-related activities increased significantly with higher frequency of headache ($P < .001$) for 52% in IEHA, 50% in FEHA, and 85% in CHA.

## Discussion

The main finding in this study was that for the domains of physical functioning and emotional functioning, a significant trend for reduced function was associated with the presence of TMD and with increased frequency of temple headache. The secondary observation was that increased percentages of those with self-reported jaw activities aggravating temple headache were also found to be significantly associated with increased frequency of headache.

### Demographics

The demographics of the study sample have been previously described, but were typical of most TMD clinical populations.[20]

## IMMPACT Recommendations

The IMMPACT consensus group recommended a core set of constructs for clinical intervention studies, and that those constructs be supplemented with measures of other constructs depending on the research question under investigation and the specific disease. The use of these constructs has also been encouraged in the case of TMD.[31,32] Therefore, in the present study, the GCPS, JFLS, and the SF-12 were included in the domain of physical functioning and the SCL-90R in the domain of emotional functioning. These instruments are commonly used in the TMD research field, and these constructs were in fact included in the original RDC/TMD as part of an Axis II assessment of TMD patients.[22]

## Physical Functioning and Disability

Chronic pain interferes with physical function and daily activities and has an impact on HRQoL. Several studies have found that TMD has an impact on HRQoL and oral HRQoL.[33,34] An increase in severity of TMD symptoms was found to be associated with reduced quality of life.[35] Physical functioning and disability are measured with generic, disease-specific, or organ-specific instruments. Generic instruments, such as the SF–12,[27,28] are used to evaluate the effects of illness or disease on different domains of overall HRQoL and can be compared across different conditions, while disease-specific instruments focus on the effects of a single disease. The disease-specific instrument is generally focused on functional impact of the diseased organ or tissue independent of the causative disease, eg, the JFLS. Both kinds of instruments have strengths and should be used together to complement each other.

The JFLS has previously been found to discriminate between TMD patients and healthy controls as well as between TMD and patients with atypical odontalgia, a presumed intraoral neuropathic pain condition.[34,36] In the present study, the JFLS showed an increase in functional limitation of the jaw with increasing frequency of headache.

Generic instruments such as SF–12 cover a broad spectrum of domains to encompass different aspects of HRQoL. The most commonly used HRQoL instruments are the SF–36 or the shorter version SF–12 in studies of headache[14,37] and orofacial pain.[34] Several studies have found that headache has a negative impact on HRQoL and differs not only in headache patients compared to healthy controls, but also among different headache diagnoses.[37–40] Studies have also pointed out that frequency of headache is an important predictor for HRQoL in migraine patients.[41,42] Similarly, studies have found that CTTH, compared to ETTH, has a greater impact on HRQoL.[43] Studies have reported that headache patients exhibit a significant reduction in HRQoL, including physical and emotional dimensions.[14,38] This is in line with the present study where significant decreases were seen among the four groups for the two domains, the PCS–12 and the MCS–12, with increasing headache frequency.

The GCPS is a function of pain intensity and pain-related interference in functioning and has been used among adults to reflect a measure of pain-related disability. High disability on the GCPS has been reported to be more prevalent in a headache sample than in TMD samples.[11] In an epidemiological survey, it was found that 8% of ETTH and 12% of CTTH individuals

reported lost workdays due to headache.[44] In the present study, only a few individuals in the IEHA and FEHA groups reported pain-related disability, while approximately every third individual in the CHA group was affected. This suggests that pain-related disability is strongly associated with the presence of CHA.

### Emotional Functioning

Emotional functioning is often accompanied by symptoms of distress and psychiatric disorders. In epidemiological and clinical studies, an association has been reported for emotional function with both TMD[45,46] and headache.[38,47,48] A higher prevalence of anxiety was found in a headache group compared to a TMD group.[49] Similarly, a significantly higher prevalence of severe depression was seen in headache patients with coexisting TMD as compared to those headache patients without TMD.[11]

Several studies have demonstrated that the frequency of headache has an impact on emotional functioning.[14,47,50] Similar scores for depression and anxiety occur in both healthy controls and ETTH subjects.[14,51] Conversely, a higher prevalence of elevated depression and anxiety has been found in CTTH subjects.[43,47,50,52] These findings are in line with the observations in the present study regarding an increasing score of anxiety and depression with increased frequency of headache. The association of depression and anxiety with headache may be more dependent on headache frequency than on headache diagnosis.[14] It has been shown that depression may aggravate central sensitization in patients with frequent TTH, indicating a relationship between depression and TTH.[53]

### Self-reported Temple Pain Associated with Jaw-Related Activities

The IHS 2004, ICDH–II classification states: “If a new headache occurs for the first time in close temporal relation to another disorder that is a known cause of headache, this headache is coded according to the causative disorder as a secondary headache.” Studies of patients with headache from specialized headache clinics have reported increased headaches following tooth clenching.[54–57] The present study suggests that increased headache frequency is also associated with more frequent report of jaw activities precipitating temple headaches. These data suggest that these temple headaches may be associated with TMD.

### Strengths and Limitations of the Study

The major strength of the study was the consistency of the findings across measures in a large clinic-based multicenter study including well-defined and representative cases with TMD. This study has three limitations. Subjects with comorbid pain conditions and subjects with medication overuse were not included. Headache diaries were not kept before the examination in order to ensure diagnostic accuracy. Finally, a clinical neurological examination to rule out other secondary headaches was not performed. However, the strength of the findings provide a comprehensive description of the influence of frequency of headache on physical and emotional functioning in patients with TMD and concurrent temple headache. The results showed that temple headache frequency is associated with physical and emotional functioning and coincided with an increase in clinical signs and symptoms in the same population.[20]

## Conclusions

Physical and emotional functioning decreased significantly with the presence of TMD and with increased frequency of temple headache. In addition, headache precipitated by jaw activity was more common in subjects with more frequent temple headache.

## 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, awarded to Thomas List.

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**Table 1**

Trend Analysis of Subject 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) | | | | | |
| Age (y) | 37.6 (13.4) | 37.8 (15.1) | 34.7 (12.9) | 35.1 (11.8) | 41.5 (13.7) | .311 |
| | % (n) | | | | | |
| Gender (F) | 66.4 (99) | 79.1 (68) | 91.7 (66) | 89.5 (154) | 87.7 (57) | .088 |
| Ethnicity (white) | 87.3 (130) | 90.7 (78) | 87.3 (62) | 94.2 (162) | 98.5 (64) | .027 |
| Education (college graduate) | 83.2 (124) | 82.6 (71) | 91.7 (66) | 85.5 (147) | 75.0 (48) | .252 |

*Subjects without painful TMD and without headache are shown for comparison. Temple headache (HA) present (+) or absent (−), and TMD pain diagnosis present (+) or absent (−).

**Table 2**

Trend Analysis of Jaw Disability (JFLS), Health-Related Quality of Life (SF–12), and Pain-Related Disability (GCPS) Across Four Groups of Subjects with Painful TMD and Increasing Headache Frequency*

| Variable | HA− TMD− | HA− TMD+ | IEHA TMD+ | FEHA TMD+ | CHA TMD+ | *P* value for trend across TMD+ groups |
|---|---|---|---|---|---|---|
| | Mean (SD) | | | | | |
| JFLS: Mastication (0–60 units) | 1.0 (4.0) | 13.1 (9.7) | 13.1 (9.7) | 14.5 (11.0) | 18.2 (10.9) | .005 |
| JFLS: Vertical jaw mobility (0–40 units) | 0.6 (3.2) | 10.5 (8.6) | 10.7 (7.8) | 11.1 (8.0) | 13.8 (9.1) | .040 |
| JFL: Verbal/emotional expression (0–100 units) | 0.3 (2.0) | 5.5 (10.7) | 6.4 (9.0) | 6.8 (9.9) | 16.9 (18.7) | < .001 |
| JFL: Global score (0–80 units) | 1.0 (3.9) | 12.0 (8.7) | 13.3 (8.8) | 13.9 (10.0) | 19.5 (13.1) | < .001 |
| SF–12v2: PCS (0–100 unit) | 52.0 (4.0) | 51.2 (4.5) | 50.2 (4.3) | 48.9 (5.4) | 47.5 (6.6) | < .001 |
| SF–12v2: MCS (0–100 units) | 55.4 (8.0) | 55.1 (8.1) | 50.3 (11.2) | 50.5 (9.8) | 46.5 (12.7) | < .001 |
| | | | % (n) | | | |
| GCPS: Grade III/IV | 0.0 (0) | 2.4 (2) | 9.7 (7) | 12.2 (21) | 34.4 (22) | < .001 |

*Subjects without painful TMD and without headache are shown for comparison. HA present (+) or absent (−), and TMD pain diagnosis present (+) or absent (−).

**Table 3**

Trend Analysis of Depression and Anxiety (SCL–90R) Across Four Groups of Subjects with Painful TMD and Increasing Headache Frequency*

| Variable | HA− TMD− | HA− TMD+ | IHA TMD+ | FHD TMD+ | CHD TMD+ | *P* value for trend across TMD+ groups |
|---|---|---|---|---|---|---|
| | Mean (SD) | | | | | |
| SCL–90R: Depression (0–4 units) | 0.27 (0.30) | 0.38 (0.40) | 0.47 (0.41) | 0.55 (0.50) | 0.88 (0.72) | < .001 |
| SCL–90R: Anxiety (0–4 units) | 0.10 (0.18) | 0.21 (0.28) | 0.32 (0.48) | 0.32 (0.45) | 0.70 (0.78) | < .001 |

* Subjects without painful TMD and without headache are shown for comparison. HA present (+) or absent (−), and TMD pain diagnosis present (+) or absent (−).