Headache Attributed to Temporomandibular Disorders: Axis I and II Findings According to the Diagnostic Criteria for Temporomandibular Disorders

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Aims: To analyze Axis I and II findings of patients diagnosed as having painful temporomandibular disorder (TMD) with headache attributed to TMD (HAattrTMD) in order to assess whether HAattrTMD is associated with a specific Axis I and II profile suggestive of the central sensitization process. **Methods:** This retrospective study included 220 patients with painful TMD divided into those with (n = 60) and those without (n = 160) HAattrTMD, and the patients were compared for Axis I and II results according to the Diagnostic Criteria for TMD (DC/TMD). A *P* value < .05 was considered statistically significant. **Results:** A total of 27.3% of the patients received a diagnosis of HAattrTMD. Myofascial pain with referral was significantly more common in the HAattrTMD group (*P* < .001), while local myalgia was significantly more common in the non-HAattrTMD group (*P* < .001). Characteristic pain intensity was significantly higher in the HAattrTMD group (*P* = .003), which also showed significantly higher levels of depression (*P* = .002), nonspecific physical symptoms (*P* = .004), graded chronic pain (*P* = .008), and pain catastrophizing (*P* = .013). Nonspecific physical symptoms were positively associated with HAattrTMD (odds ratio [OR] = 1.098, 95% CI = 1.006 to 1.200, *P* = .037). Local myalgia was negatively associated with HAattrTMD (OR = .295, 95% CI = 0.098 to 0.887, *P* = .030). **Conclusions:** Painful TMD patients who report headache in the temple area and are diagnosed as having local myalgia rather than myofascial pain with referral probably do not have HAattrTMD. The diagnosis of HAattrTMD may point to a central sensitization process and possible current/future chronic TMD conditions. *J Oral Facial Pain Headache 2021;35:119–128. doi: 10.11607/ofph.2863*

Keywords: *Axis II, DC/TMD, headache attributed to TMD, local myalgia, myofascial pain with referral*

Headache is a frequent complaint in the general population, with an estimated 77% to 91.3% of people experiencing at least one episode of headache during their lifetime.[1,2] Temporomandibular disorders (TMD) comprise the second most commonly occurring musculoskeletal condition, affecting approximately 5% to 12% of the population.[3] Epidemiologic studies have shown that between 65% and 85% of people in the United States experience some symptoms of TMD during their lifetimes, with approximately 12% experiencing prolonged pain and/or disability that results in chronic symptoms.[4] Many studies have demonstrated a comorbidity between a history of headache and musculoskeletal disorders, such as cervical pain and TMD.[5–10] Epidemiologic studies have shown that TMD symptoms are more common in subjects who report primary headaches—such as episodic tension-type headache, migraine, and chronic daily headache—compared to subjects without headaches.[11] This association is bidirectional, with several studies having shown that the majority of TMD patients report headaches.[12,13] One prospective study demonstrated that the presence of TMD predicted a future appearance of headaches.[14] In addition, the onset of TMD was followed by an increased prevalence in headache frequency.[15] Several randomized controlled studies show a beneficial effect of treating the masticatory muscles on the headache complaint.[16,17]

In 2004, the International Headache Society (IHS) proposed a classification (International Classification of Headache Disorders,

Table 1 Diagnostic Criteria of HAattrTMD According to the ICHD-3 and DC/TMD

ICHD-3[23]	DC/TMD[22]
A. Any headache[1] fulfilling criterion C. B. Clinical evidence of a painful pathologic process affecting elements of the temporomandibular joint(s), muscles of mastication, and/or associated structures on one or both sides. C. Evidence of causation demonstrated by at least two of the following: 1. The headache has developed in temporal relation to the onset of the temporomandibular disorder, or led to its discovery 2. The headache is aggravated by jaw motion, jaw function (eg, chewing), and/or jaw parafunction (eg, bruxism) 3. The headache is provoked on physical examination by temporalis muscle palpation and/or passive movement of the jaw D. Not better accounted for by another ICHD-3 diagnosis.[2] Notes 1. Usually temporally located on one or both sides. 2. There is some overlap between [11.7] Headache attributed to temporomandibular disorder (TMD) arising from muscular tension and [2] Tension-type headache. When the diagnosis of TMD is uncertain, the headache should be coded as [2] Tension-type headache or one of its types or subtypes (presumably with pericranial muscle tenderness). Comments: [11.7] Headache attributed to temporomandibular disorder (TMD) is usually most prominent in the temporal region(s), preauricular area(s) of the face, and/or masseter muscle(s). It may be unilateral, but is likely to be bilateral when the underlying pathology involves both temporomandibular regions. Pain referral to the face is common; after tooth pain, TMD is the most common cause of facial pain. Pain generators include disc displacements, joint osteoarthritis, degenerative disease and/or hypermobility, and regional myofascial pain. Diagnosis of TMD can be difficult, with some controversy regarding the relative importance of clinical and radiographic evidence. Use of the diagnostic criteria evolved by the International RDC/TMD Consortium Network and Orofacial Pain Special Interest Group is recommended.	Headache in the temple area secondary to pain-related TMD (see note) that is affected by jaw movement, function, or parafunction, and replication of this headache occurs with provocation testing of the masticatory system. History—Positive for both of the following: 1. Headache of any type in the temple, AND 2. Headache modified with jaw movement, function, or parafunction Exam—Positive for both of the following: 1. Confirmation of headache location in the area of the temporalis muscle(s), AND 2. Report of familiar headache in the temple area with at least one of the following provocation tests: A. Palpation of the temporalis muscle(s); OR B. Maximum unassisted or assisted opening, right or left lateral, or protrusive movement(s) Validity: sensitivity = 0.89, specificity = 0.87 Comment: The headache is not better accounted for by another headache diagnosis. Note: A diagnosis of pain-related TMD (eg, myalgia or TMJ arthralgia) must be present and is established using valid diagnostic criteria.

HAattrTMD = headache attributed to temporomandibular disorder; ICHD-3 = International Classification of Headache Disorders, edition 3; DC/TMD = Diagnostic Criteria for Temporomandibular Disorders.

second edition [ICHD-2]) linking secondary headache with TMD (headache or facial pain attributed to temporomandibular joint disorder).[18,19] In 2013, a beta version of the ICHD-3 classification[20] revised the diagnostic criteria for headache attributed to TMD (HAattrTMD), followed by additional revision of the diagnostic criteria published in the ICHD-3.[21] In addition, a new diagnosis of HAattrTMD was added to the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD).[22] Currently, the diagnostic criteria for HAattrTMD according to the ICHD-3 are similar to the diagnostic criteria for HAattrTMD according to the DC/TMD (Table 1). However, there are several major differences, as discussed by Conti et al.[23] These authors observed that there is no specific criterion in the DC/TMD for a temporal relationship between the signs and symptoms of TMD and headache. Another major difference is that while the DC/TMD defines the location of headache as the temple area, the ICHD-3 does not specify an anatomical location and only requires that a unilateral headache be located ipsilateral to the TMD symptoms. Another major difference, and perhaps the most critical one, is that while both of those diagnostic criteria require a painful TMD diagnosis, the mandatory criterion of association with jaw function that is listed in the DC/TMD is absent in the ICHD-3 diagnostic criteria. Therefore, according to the ICHD-3, a patient with painful TMD who developed headache in temporal relation to the onset of painful TMD and whose headache can be provoked on physical examination by temporalis muscle palpation can be diagnosed as having HAattrTMD, even without an association with jaw function/parafunction or maneuver.

TMD has been described as a self-limiting disorder in the majority of cases.[24] Patients who continue to develop chronic TMD account for approximately 85% of the total huge cost that is attributed to TMD

treatment.[25,26] The long course of TMD signs and symptoms seems to be independent of the extent of treatment that is provided over a 5-year period.[27] Thus, it was suggested that this high cost is related to unresponsiveness of these specific chronic TMD patients to traditional TMD treatment modalities.[28] Therefore, early identification of patients who are at a higher risk for developing chronic TMD may aid in developing an effective early intervention in order to reduce transference to a chronic condition. The aim of this study was to analyze the specific Axis I and Axis II findings of patients with painful TMD who had been diagnosed as having an HAattrTMD in order to assess whether HAattrTMD is associated with a specific Axis I and II profile that may suggest a central sensitization process and therefore potential chronicity of TMD.

Materials and Methods

This retrospective study initially recruited 558 consecutive patients who were seen for the first time at the Tel Aviv University Orofacial Pain Clinic from 2015 to 2018. The TMD diagnosis was established according to the official Hebrew version[29] of the DC/TMD.[22] All of the study participants were examined by senior staff members certified in the DC/TMD Training and Calibration Course at the Department of Orofacial Pain and Jaw Function at the Faculty of Odontology at Malmö University, Sweden. Excluded were 67 subjects who were younger than 18 years, 38 who did not meet the criteria to receive an Axis I diagnosis of TMD according to the DC/TMD specifications, and 142 subjects who were diagnosed as having other orofacial pain conditions. Fifty-six subjects who did not fill in the questionnaire according to the DC/TMD specifications were also excluded from the final analysis.

The final study population consisted of 255 TMD patients. Each patient underwent a full DC/TMD Axes I and II diagnosis. Axis I diagnoses included intra-articular disorders (disc displacement with reduction, disc displacement with reduction with intermittent locking, disc displacement without reduction with limited opening, and disc displacement without reduction without limited opening); local myalgia; myofascial pain with referral; HAattrTMD; arthralgia; degenerative joint disease; and subluxation. The instruments used to evaluate Axis II according to the specifications of the DC/TMD were depression level (Patient Health Questionnaire [PHQ]-9), anxiety level (Generalized Anxiety Disorder [GAD]-7), nonspecific physical symptom levels (PHQ-15 questionnaire), characteristic pain intensity (CPI), pain persistence (PP) classification, and the Graded Chronic Pain Scale (GCPS) version 2.0. The validated Hebrew version of the Pain Catastrophizing Scale (PCS) questionnaire, which was developed for measuring levels of catastrophizing in relation to pain,[30] was added to the DC/TMD questionnaire and assessed for each patient.

Ethical Considerations

Approval from the University Institutional Ethical Committee was obtained prior to data collection (#14134_20180327). Informed consent for the study group was waived since the data were retrieved retrospectively. However, each patient who is referred to the Orofacial and TMD Clinic routinely signs a form in which they agree that their data can be anonymously used for research purposes. This study was self-funded by the authors.

Statistical Analysis

Continuous variables were evaluated for normal distribution by means of a histogram and Q-Q plots. Since the continuous variables did not distribute normally, they were reported as median with interquartile range (IQR) and analyzed by nonparametric tests. Categorical variables were described as frequency and percentage. Pearson chi-square test and Fisher exact test were used to test the associations between categorical variables. Mann-Whitney test was used to assess differences in continuous variables between categories. Multivariable logistic regression was applied to study the associations between variables that were significantly associated with HAattrTMD in the univariate analysis. The independent variables for analysis included Axis I diagnoses (local myalgia and myofascial pain with referral), CPI, and Axis II evaluation (PHQ-9 total score, PHQ-15 total score, PCS total score, and interference score). Adjusted odds ratios (ORs) and 95% CI were reported. All tests were two-tailed. SPSS Statistics for Windows, version 25.0 (IBM) was used for all statistical analyses. A P value < .05 was considered statistically significant.

Results

Tables 2 and 3 summarize the data on demographic and pain characteristics of all patients diagnosed as having TMD (n = 255). The female: male ratio was 3:1, and the mean ± SD age was 37 ± 15.3 years. More than half of the patients (61.7%) reported noncontinuous pain during the last 30 days, and 54.4% reported headaches in the last 30 days (Table 3). The average pain intensity reported was 51 (CPI). The Axis I results showed that 49.1% were diagnosed as having local myalgia, 35.8% as having myofascial pain with referral, and 23.5% as having HAattrTMD (Table 4). The

Table 2 Demographic and Socioeconomic Data in the TMD Patients (n = 255)

Demographic and socioeconomic data	n (%)
Men	61 (23.9)
Women	194 (76.1)
Age (y)	
Mean (SD)	37.8 (15.34)
Median (IQR)	34.00 (25.00–48.00)
Education:	
1. Elementary/high school	83 (32.8)
2. Some college/college graduate	109 (43.1)
3. Professional or postgraduate level	61 (24.1)
Income:	
1. Very low, low	29 (12)
2. Average	148 (61.2)
3. High, very high	65 (26.9)
Marital status:	
1. Never married	107 (42.3)
2. Married/living as married	131 (51.8)
3. Divorced/separated	11 (4.3)
4. Widowed	4 (1.6)

IQR = interquartile range.

Table 3 Pain Characteristics Data in TMD Patients (n = 255)

Temporal characteristics	n (%)
In the last 30 days, which of the following best describes any pain in your jaw, temple, in the ear, or in front of the ear on either side?	
▪ 0: No pain	▪ 20 (8.5)
▪ 1: Pain comes and goes	▪ 145 (61.7)
▪ 2: Pain is always present	▪ 70 (29.8)
Report of headache: In the last 30 days, have you had any headaches that included the temple areas of your head?	
▪ 0: No	▪ 115 (45.6)
▪ 1: Yes	▪ 137 (54.4)
How many months ago did your pain in the jaw, temple, in the ear, or in front of the ear first begin?	
▪ Mean (SD)	▪ 54.86 (83.76)
▪ Median (IQR)	▪ 24.00 (6.00–63.00)
Characteristic Pain Intensity (1–100)	
▪ Mean (SD)	▪ 51.02 (27.58)
▪ Median (IQR)	▪ 53.73 (30.00–73.33)
Pain persistence score, d	
▪ Mean (SD)	▪ 73.44 (73.95)
▪ Median (IQR)	▪ 30 (10.00–180.00)

Data are reported as n (%) unless otherwise indicated. IQR = interquartile range.

Table 4 Axis I Diagnoses in TMD Patients (n = 255)

Diagnosis	n (%)
Local myalgia	114 (49.1)
Myofascial pain with referral	83 (35.8)
Arthralgia	50 (19.6)
HAattrTMD	60 (23.5)
Intra-articular disorders[a]	107 (42)
Degenerative joint disease	43 (16.9)
Subluxation	31 (12.2)

HAattrTMD = headache attributed to temporomandibular disorder.

[a] Disc displacement with reduction; disc displacement with reduction with intermittent locking; disc displacement without reduction with limited opening; and disc displacement without reduction without limited opening.

Table 5 Axis II Evaluation in TMD Patients (n = 255)

Axis II domain	n (%)
GCPS, version 2.0 score	25 (9.9)
▪ 0	73 (28.9)
▪ 1	113 (44.7)
▪ 2	23 (9.1)
▪ 3	19 (7.5)
▪ 4	
Low disability (GCPS 1 or 2)	210 (83.3)
High disability (GCPS 3 or 4)	42 (16.7)
PHQ-9 (Depression)	
▪ Normal (≤ 4)	143 (56.1)
▪ Mild (5–9)	70 (27.5)
▪ Moderate (10–14)	22 (8.6)
▪ Moderately severe–severe (15+)	20 (7.8)
Generalized anxiety (GAD-7)	
▪ Normal (≤ 4)	173 (67.8)
▪ Mild (5–9)	50 (19.6)
▪ Moderate (10–14)	19 (7.5)
▪ Severe (15+)	13 (5.1)
PHQ-15 (nonspecific physical symptoms)	
▪ Normal (≤ 4)	131 (51.4)
▪ Mild (5–9)	86 (33.7)
▪ Moderate (10–14)	28 (11.0)
▪ Severe (15+)	10 (3.9)
PCS total categories	
▪ Low (0–19)	156 (61.2)
▪ Intermediate (20–29)	44 (17.3)
▪ High (30+)	55 (21.6)
Pain persistence	
▪ Low-level (≤ 89 d)	126 (60)
▪ High-level (≥ 90 d)	84 (40)

PHQ-9/15 = Patient Health Questionnaire-9/-15; GAD-7 = Generalized Anxiety Disorder-7; PCS = Pain Catastrophizing Scale.

Axis II results showed that 16.7% reported high levels of disability (score of 3 to 4), 8% reported high levels of depression, 5% reported high levels of generalized anxiety, and 4% reported high levels of nonspecific physical symptoms. Sixty percent of the patients reported persistent pain (Table 5).

At the second stage of the analysis, only painful TMD patients were included (n = 220). The patients were divided into two groups as follows: one group included 60 patients with painful TMD who were diagnosed as having headache attributed to TMD (HAattrTMD), and the other group included 160 patients with painful TMD without diagnosis of HAattrTMD (non-HAattrTMD). Tables 6 to 9 summarize the biopsychosocial comparison between these

Table 6 Demographic and Socioeconomic Characteristics in the Two Subgroups (n = 220)

	Non-HAattrTMD (n = 160)	HAattrTMD (n = 60)	*P*
Women	122 (76.3)	46 (76.7)	
Men	38 (23.8)	14 (23.3)	.948
Age, y			
Mean ± SD	40.02 ± 16.45	34.18 ± 11.73	.05
Median (IQR)	35.00 (27.00–52.00)	31.00 (25.25–38.50)	
Education:			
Elementary/high school	52 (32.7)	21 (35.6)	.492
Some college/college graduate	65 (40.9)	27 (45.8)	
Professional or postgraduate level	42 (26.4)	11 (18.6)	
Income			
Very low, low	21 (13.7)	4 (7.1)	.027
Average	99 (64.7)	30 (53.6)	
High, very high	33 (21.6)	22 (39.3)	
Marital status			
Never married	61 (38.4)	29 (48.3)	.375
Married/living as married	86 (54.1)	29 (48.3)	
Divorced/separated	8 (5.0)	2 (3.3)	
Widowed	4 (2.5)	0 (0.0)	

Data are reported as n (%) unless otherwise indicated. HAattrTMD = headache attributed to temporomandibular disorder; IQR = interquartile range.

Table 7 Pain Characteristics in the Two Subgroups (n = 220)

	Non-HAattrTMD (n = 160)	HAattrTMD (n = 60)	*P*
Pain duration: How many months ago did your pain in the jaw, temple, in the ear, or in front of the ear first begin?			
Mean ± SD	53.07 ± 87.21	61.61 ± 73.70	.51
Median (IQR)	18.00 (6.00–60.00)	36.00 (12.00–72.00)	
Temporal characteristics: In the last 30 days, which of the following best describes any pain in your jaw, temple, in the ear, or in front of the ear on either side?			
No pain	8 (5.1)	4 (6.8)	.02
Pain comes and goes	106 (67.9)	28 (47.5)	
Pain is always present	42 (26.9)	27 (45.8)	
In the last 30 days, have you had any headaches that included the temple areas of your head?			
No	84 (53.2)	1 (1.7)	< .001
Yes	74 (46.8)	59 (98.3)	
Characteristic Pain Intensity (1–100)			
Mean (SD)	53.41 (23.91)	63.11 (23.16)	.003
Median (IQR)	53.33 (36.66–73.33)	66.66 (53.33–80.00)	
Pain persistence: On how many days in the last 6 months have you had facial pain?			
Mean ± SD	78.71 ± 72.94	90.24 ± 76.60	.489
Median (IQR)	40.00 (15.00–180.00)	82.50 (14.75–180.00)	
Low (≤ 89 d)	79 (60.3)	27 (50.0)	.198
High (≥ 90 d)	52 (39.7)	27 (50.0)	

Data are reported as n (%) unless otherwise indicated. HAattrTMD = headache attributed to temporomandibular disorder; IQR = interquartile range.

two groups. The HAattrTMD patients were borderline significantly younger (*P* = .05) and reported a higher income level compared to the non-HAattrTMD patients (*P* = .027) (Table 6). A total of 45.8% of the HAattrTMD patients reported continuous pain compared to 26.9% of the non-HAattrTMD patients (*P* = .02). The CPI level was significantly higher in the HAattrTMD group (*P* = .003) (Table 7). There were no significant differences in pain duration between the two groups (Table 7). Among the Axis I diagnoses, myofascial pain with referral was significantly more common in the HAattrTMD group (*P* < .001), while local myalgia was significantly more common in the non-HAattrTMD group (*P* < .001; Table 8). The results of the Axis II evaluation revealed that the HAattrTMD patients had significantly higher levels of

Table 8 Axis I Diagnoses in the Two Subgroups (n = 220)

	Non-HAattrTMD (n = 160)	HAattrTMD (n = 60)	*P*
Disc displacement	54 (33.8)	26 (43.3)	.188
Osteoarthrosis	9 (5.6)	1 (1.7)	.209
Subluxation	19 (11.9)	7 (11.7)	.966
Local myalgia	99 (61.9)	15 (25.0)	< .001
Myofascial pain with referral	45 (28.1)	38 (63.3)	< .001
Arthralgia	35 (21.9)	15 (25.0)	.622
Osteoarthritis	27 (16.9)	4 (6.7)	.053

Data are reported as n (%). HAattrTMD = headache attributed to temporomandibular disorder.

depression (*P* = .002), including the total depression score (*P* < .001); nonspecific physical symptoms (*P* = .004), including the total nonspecific physical symptoms score (P < .001); GCPS (*P* = .008); interference score (*P* = .013); disability score (*P* = .024); and PCS (*P* = .013). There were no differences in generalized anxiety scores between the two groups (*P* = .153), including the total generalized anxiety scores (*P* = .06).

A multivariate logistic regression analysis was performed at the third stage of the analysis. Among independent variables for analysis (local myalgia, myofascial pain with referral, CPI, PHQ-9 total score, PHQ-15 total score, PCS total score, and interference score), nonspecific physical symptoms (PHQ-15) were positively associated with HAattrTMD (OR = 1.098, 95% CI = 1.006 to 1.200, *P* = .037), and local myalgia was negatively associated with HAattrTMD (OR = 0.295, 95% CI = 0.098 to 0.887, *P* = .030).

Discussion

In the current study, 54.4% of the total study population of TMD patients (n = 255) reported headache that included the temple areas of the head (Table 3). However, only 60 (43.3%) of them were diagnosed as having HAattrTMD. Among the 220 patients with painful TMD, 27.3% were diagnosed as having HAattrTMD. HAattrTMD is a recent diagnosis; therefore, there are only limited studies on its prevalence. Svechtarov et al[31] reported a prevalence of HAattrTMD of 1%. van der Meer et al[32] reported a prevalence of HAattrTMD of 5.4% within the total TMD group and 19% among the patients with painful TMD, concluding that if approximately 10% of the population can be assumed to experience muscle-related TMD pain,[33] the prevalence of HAattrTMD

Table 9 Axis II Evaluation in the Two Subgroups (n = 220)

	Non-HAattrTMD (n = 160)	HAattrTMD (n = 60)	*P*
GCPS score, version 2.0			
▪ 0	4 (2.5)	3 (5.0)	**.008**
▪ 1	55 (34.6)	8 (13.3)	
▪ 2	74 (46.5)	33 (55.0)	
▪ 3	16 (10.1)	7 (11.7)	
▪ 4	10 (6.3)	9 (15.0)	
Low disability (GCPS 1 or 2)	132 (83.5)	44 (73.3)	.088
High disability (GCPS 3 or 4)	26 (16.5)	16 (26.7)	
Interference score[a]			
▪ Mean ± SD	23.84 ± 27.80	34.05 ± 31.01	**.013**
▪ Median (IQR)	13.33 (0.00–36.66)	30.00 (6.66–50.00)	
Disability score			
▪ 0	99 (61.9)	25 (41.7)	**.024**
▪ 1	12 (7.5)	14 (23.3)	
▪ 2	18 (11.3)	6 (10.0)	
▪ 3	18 (11.3)	5 (8.3)	
▪ 4	2 (1.3)	1 (1.7)	
▪ 5	2 (1.3)	1(1.7)	
▪ 6	9 (5.6)	8 (13.3)	
PHQ-9 (Depression)			
▪ Normal (≤ 4)	95 (59.4)	19 (31.7)	**.002**
▪ Mild (5–9)	41 (25.6)	27 (45.0)	
▪ Moderate (10–14)	11 (6.9)	9 (15.0)	
▪ Moderately severe–severe (15+)	13 (8.1)	5 (8.3)	
PHQ-9 total score			
▪ Mean ± SD	5.04 ± 5.485	6.88 ± 4.69	**< .001**
▪ Median (IQR)	3.00 (1.00–7.00)	6.00 (4.00–9.00)	
Generalized anxiety (GAD-7)			
▪ Normal (≤ 4)	107 (66.9)	35 (58.3)	.153
▪ Mild (5–9)	31 (19.4)	19 (31.7)	
▪ Moderate (10–14)	12 (7.5)	5 (8.3)	
▪ Severe (15+)	10 (6.3)	1 (1.7)	
GAD-7 total score			
▪ Mean ± SD	4.00 ± 4.92	4.35 ± 3.79	.06
▪ Median (IQR)	2.00 (0.00–5.75)	3.50 (1.00–7.00)	
PHQ-15 (nonspecific physical symptoms)			
▪ Normal (≤ 4)	89 (55.6)	17 (28.3)	**.004**
▪ Mild (5–9)	48 (30.0)	28 (46.7)	
▪ Moderate (10–14)	17 (10.6)	11 (18.3)	
▪ Severe (15+)	6 (3.8)	4 (6.7)	
PHQ-15 total score			
▪ Mean ± SD	4.75 ± 4.33	7.18 ± 4.184	**< .001**
▪ Median (IQR)	4.00 (1.00–7.00)	7.00 (4.00–9.75)	
Pain Catastrophizing Scale			
▪ Low (0–19)	104 (65.0)	26 (43.3)	**.013**
▪ Intermediate (20–29)	26 (16.3)	14 (23.3)	
▪ High (30+)	30 (18.8)	20 (33.3)	
PCS total score			
▪ Mean ± SD	16.53 ± 14.09	23.27 ± 14.27	**.001**
▪ Median (IQR)	13.00 (5.25–25.75)	21.50 (12.25–35.75)	

Data are reported as n (%) unless otherwise indicated. Significant values are shown in bold. HAattrTMD = headache attributed to temporomandibular disorder.
[a]Compute mean of items 6–8 (daily activities, social activities, work activities), and multiply by 10.

in the general population would be estimated to be 2%. However, a higher prevalence was reported by other studies, such as Vivaldi et al,[34] who reported a prevalence of 29.3% among chronic TMD patients. Schiffman et al[19] observed that 45.6% of patients with painful TMD who reported coexisting headache met the diagnostic criteria for HAattrTMD. Reviewing these studies, it appears that the prevalence of a diagnosis of HAattrTMD depends on the proportion of painful TMD among the study groups, chronic vs acute conditions, primary vs tertiary clinics, and, of course, the diagnostic criteria used both for the diagnosis of TMD and for the diagnosis of HAattrTMD (ie, the ICHD-2/3 vs the DC/TMD).

In the current study, comparison between painful TMD patients with or without HAattrTMD revealed differences in both Axes I and II. Regarding Axis I, there were no significant differences between groups with regard to nonpainful diagnoses such as osteoarthrosis and intra-articular disorders. However, there were significant group differences in the diagnoses of local myalgia and myofascial pain with referral: myofascial pain with referral was significantly more common in the HAattrTMD group ($P < .001$), while local myalgia was significantly more common in the non-HAattrTMD group ($P < .001$) (Table 8). To the best of the authors' knowledge, the current study is the first to show differences in the prevalence of local myalgia in comparison to myofascial pain with referral in TMD patients with or without a diagnosis of HAattrTMD according to the DC/TMD. Previous studies have shown that patients with painful TMD with or without a HAattrTMD[34]/headache in the temple area[13] did not differ in the prevalence of myofascial pain according to the RDC/TMD. While the diagnostic criteria of local myalgia according to the DC/TMD points to a musculoskeletal type of pain, numerous studies have suggested that myofascial trigger points can act as ongoing peripheral nociceptive stimuli that can induce central sensitization.[35–38] Interestingly, regression analysis in the current study revealed a negative association between local myalgia and HAattrTMD (OR = .295). This important finding supports differentiation between the diagnosis of local myalgia and the diagnosis of myofascial pain with referral, pointing to the possibility of differences in the pathophysiology of these two muscle-related diagnoses. Therefore, the coexistence of a diagnosis of local myalgia together with a report of headache in the temple areas may suggest the need for further investigation for the source of a primary/secondary headache other than HAattrTMD. On the other hand, the finding of myofascial pain with referral and HAattrTMD may suggest a central sensitization process occurring after ongoing peripheral nociceptive input. This clinical observation is particularly important due to the great similarity between HAattrTMD and tension-type headache, which has similar characteristics of pain location and intensity.[21,39] van der Meer et al[32] showed a 25% to 50% overlap between patients diagnosed as having both tension-type headaches and HAattrTMD, and those authors concluded that HAattrTMD may be mistakenly diagnosed as tension-type headache. This overlap between HAattrTMD and tension-type headache is addressed in the ICHD-3 diagnostic criteria for HAattrTMD[21] (Table 1), noting that when a diagnosis of TMD is uncertain, the chosen diagnosis should be tension-type headache and not HAattrTMD. Conti et al[23] discussed the challenge of differentiating between HAattrTMD and tension-type headache and recommend a multidisciplinary approach by an orofacial pain specialist and neurologist. It should be borne in mind that the differential diagnosis for tension-type headache includes other secondary headaches, such as transient ischemic attack or stroke, chronic subdural hematoma, giant cell arteritis, intracranial neoplasm, and more, as well as other primary headaches, such as new daily persistent headache, bilateral hemicrania continua, and others.[40] Therefore, recognition of red flags for headache[41] and neurologic consultations are crucial in selected cases of TMD patients who present with a complaint of headache, especially those who are diagnosed as having local myalgia according to the DC/TMD.

These considerations raise the question: could a HAattrTMD represent a clinical finding that may suggest possible central sensitization? Vivaldi et al[34] showed that patients with chronic TMD who had a coexisting HAattrTMD showed significantly more numerous painful sites (fibromyalgia, back pain, gastrointestinal pain, and other headaches). These findings point to the coexistence of several central sensitivity syndromes[42] together with the HAattrTMD. Hara et al[43] examined the temporal association between TMD-related symptoms and headache during TMD treatment for patients who fulfilled the diagnostic criteria for HAattrTMD according to the DC/TMD and ICHD-3 beta. Following TMD treatment, the frequency and intensity of the reporting of headaches decreased significantly in parallel with significantly increased improvements in facial pain intensity, maximum unassisted opening, and pressure pain threshold (PPT). Those authors also observed the elevation of PPT both in masticatory muscles and in brachioradialis and trapezius muscles after physical therapy. Anderson et al[13] showed that TMD patients who sustained an increased frequency of headache in the temple area showed increased severity of TMD pain, greater spread of pain, and increased sensitivity in trigeminal and nontrigeminal sites, all of which suggest a role for both peripheral and central sensitization. Similar results were obtained in the current study: the

CPI was significantly higher in the HAattrTMD group, and most of the patients in the HAattrTMD group reported persistent pain during the preceding 30 days (P = .02). Similarly higher pain intensity was also reported by Vivaldi et al[34] among patients with painful TMD who were diagnosed as having HAattrTMD compared to TMD patients without that diagnosis.

As for the Axis II evaluation, the HAattrTMD group had significantly higher levels of depression (P = .002), including total depression score (P < .001); nonspecific physical symptoms (P = .004), including total nonspecific physical symptoms score (P < .001); GCPS (P = .008); interference score (P = .013); and disability score (P = .024). There were no differences in the generalized anxiety scores between the two groups (P = .153), including the total generalized anxiety score (P = .06). However, significant group differences were found in pain catastrophizing levels. The regression analysis showed that among the Axis II variables, nonspecific physical symptoms (PHQ-15) were associated with HAattrTMD (OR = 1.098, 95% CI = 1.006 to 1.200, P = .037), which again points to central sensitization syndromes, given the fact that high PHQ-15 scores imply other bodily complaints, such as gastrointestinal complaints, back pain, headache, and chest pain. Taken together, the HAattrTMD patients exhibited both Axis I and Axis II characteristics suggestive of central sensitization with significant Axis II components. Over the years, numerous studies have consistently shown that patients with chronic TMD scored higher on psychologic questionnaires aimed at assessing levels of depression, anxiety, and nonspecific physical symptoms.[44–48] Adhering to the biopsychosocial model, several groups have attempted to develop a model that could predict which patients would continue to develop chronic TMD. Garofalo et al[49] reported that Axis I, group 1 (muscle disorders) according to the RDC/TMD, CPI, Axis II GCPS, nonspecific physical symptoms, and gender emerged as significant risk factors for chronic TMD condition. Epker et al[28] showed that subjects in the chronic group reported significantly greater pain and impairment, as measured by the GCPS, depression, nonspecific physical symptoms, and nonchronic pain intensity, compared to subjects in the nonchronic group, and that they showed a more dysfunctional coping profile. Logistic regression analysis in that study demonstrated that the CPI and the presence of a muscle disorder accurately classified 91% of the subjects who went on to develop chronic TMD. Those authors concluded that certain combinations of variables are better able to predict a chronic TMD condition than any one variable alone. In the current study, these same combinations of Axis I myofascial pain with referral, nonspecific physical symptoms, and higher pain intensity emerged as the hallmark of patients who are diagnosed as having HAattrTMD. The diagnosis of HAattrTMD in and of itself may therefore serve as a key for suspecting future or current chronic TMD.

Conclusions

The findings of this study demonstrate that the diagnosis of HAattrTMD in a TMD patient may point to a central sensitization process and to a significant Axis II component. This may lead to the decision to choose a treatment aimed at addressing central sensitization for the purpose of reducing the risk for the development of a chronic TMD condition. A patient with a painful TMD who reports a headache in the temple area and is diagnosed as having local myalgia most likely does not have HAattrTMD and should undergo further investigation of the primary/secondary headache by means of a multidisciplinary approach. An effort should be made to unify the diagnostic criteria of HAattrTMD (ICHD-3 and DC/TMD) in future diagnostic criteria updates. It is the authors' opinion that the DC/TMD includes more precise diagnostic criteria for HAattrTMD by requiring assessment of the association between headache and jaw function. Future versions of the DC/TMD should provide more detailed information on pain characteristics and location, as well as intensity of the HAattrTMD. Prospective studies are warranted in order to examine whether a diagnosis of HAattrTMD may point to a current or future chronic TMD condition.

Highlights

- The diagnosis of HAattrTMD in a painful TMD patient may point to a central sensitization process and to a significant Axis II component with a possible current/future chronic TMD condition.
- A TMD pain patient who reports headache in the temple area and is diagnosed as having local myalgia rather than myofascial pain with referral most likely does not have HAattrTMD and should undergo further investigation by means of a multidisciplinary approach in order to rule out other primary/secondary headache(s).
- It is the present authors' opinion that the DC/TMD includes more precise diagnostic criteria for HAattrTMD compared to the ICHD-3. An effort should be made to unify the diagnostic criteria of HAattrTMD (ICHD-3 and DC/TMD) and to enable retrieval of information as to the pain characteristics of HAattrTMD in future diagnostic criteria updates.

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All authors listed have contributed sufficiently to the project to be included as authors. All authors gave final approval and agree to be accountable for all aspects of the work.The author contributions are as follows:

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