Pain Catastrophizing and Pain Persistence in Temporomandibular Disorder Patients

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Aims: To describe pain catastrophizing in temporomandibular disorder (TMD) patients in relation to disability and pain persistence. **Methods:** A total of 163 TMD patients underwent a complete TMD evaluation according to the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), including the Pain Catastrophizing Scale (PCS). Patients were divided into subgroups according to their PCS, Graded Chronic Pain Scale (GCPS), and pain persistence scores. The GCPS and pain persistence subgroups were assigned as dependent variables in a stepwise multiple logistic regression model. The ability of the DC/TMD Axis II parameters and of the PCS to discriminate between patients of low and high disability (according to the GCPS) and low and high pain persistence were examined using area under the receiver operating characteristic (ROC) curve. $\alpha < .05$ was considered to reflect statistical significance. **Results:** Significant differences were found between high and low pain catastrophizing patients as to socioeconomic parameter, Axis I diagnoses, pain persistence, and Axis II evaluation. The parameters with significant discriminant ability for pain persistence were pain catastrophizing, depression, and nonspecific physical symptoms, with no significant differences between them. Depression increased the odds of high disability by 1.2, while pain catastrophizing increased the odds for high pain persistence more than 6-fold. Pain catastrophizing was not significantly associated with pain disability, and depression was not significantly associated with pain persistence. **Conclusion:** High–pain catastrophizing TMD patients were similar to patients with other chronic pain conditions, but differed from TMD patients as a group. The findings of this study support the addition of an assessment for pain catastrophizing to the DC/TMD for early identification of TMD patients who might be at higher risk for developing chronic pain. *J Oral Facial Pain Headache 2018;32:309–320. doi: 10.11607/ofph.1968*

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Pain catastrophizing is defined as "an exaggerated negative 'mental set' brought to bear during actual or anticipated painful experience."[1] Patients who catastrophize tend to focus and exaggerate the threat of pain and experience helplessness in controlling their pain.[2] Pain catastrophizing has been studied extensively in numerous acute and chronic pain conditions and has been found to be associated with psychological distress and poor prognosis[3] in a variety of pain syndromes, such as fibromyalgia and other rheumatologic diseases,[4] migraine,[5] musculoskeletal pain disorders,[6,7] endometriosis,[8] and neuropathic pain.[9] High levels of pain catastrophizing may even be a risk factor for developing chronic pain.[10] Patients who scored high on pain catastrophizing tend to report higher intensity of both acute pain[6] and chronic pain conditions[11] and show higher levels of disability.[6] Pain catastrophizing has been recognized as a barrier to healthy physical[12] and psychological[13] functioning and a key predictor for poor compliance to treatment.[14]

Compared to the wealth of studies on various pain conditions and pain catastrophizing, only a few studies have been conducted on pain catastrophizing in temporomandibular disorder (TMD) patients, partially because pain catastrophizing is not part of the Research Diagnostic

Criteria for Temporomandibular Disorders (RDC/TMD).[15] The majority of studies that have been performed have confirmed that pain catastrophizing has an effect on TMD patients.[16–20]

Recently, the RDC/TMD protocol was revised to create the Diagnostic Criteria for TMD (DC/TMD).[21] The changes implemented in the two DC/TMD axes (Axis I and Axis II) have improved the reliability and validity of both axes and offer an improved biopsychosocial model for the evaluation of TMD patients.[21] Axis II of the DC/TMD is based on several self-report factors, including measures of depression, anxiety, and nonspecific physical symptoms, by use of the Primary Care Evaluation of Mental Disorders (PRIME-MD), a well-validated instrument.[22,23] In addition, the Graded Chronic Pain Scale (GCPS) version 2.0[24] and pain persistence[24] classifications are included.

Although the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) initially recommended expanding Axis II of the RDC/TMD to include measures of catastrophizing[25] in the assessment of pain, this measure was ultimately not included in the DC/TMD.[26] With the exclusion of pain catastrophizing from the newly adopted DC/TMD, a surge in research on the association between pain catastrophizing and TMD may be less likely to occur in the future.

As noted by Michelotti et al,[27] the creation of an optimal Axis II set of instruments for the DC/TMD is an ongoing process. One of the major goals for developing optimal diagnostic criteria is to create an efficient tool that could identify at an early stage the patients who may develop a chronic pain condition, thus enabling an early intervention. This goal should be achieved by using the least number of the most efficient questionnaires, since increasing the number of questionnaires may lead to subject burden and decreased reliability due to subject fatigue.[27] The most efficient tools can only be chosen after testing them by integrating the data collected by the Axis I clinical examination and psychosocial parameters available through the DC/TMD questionnaire, which will allow a true multidimensional assessment according to the biopsychosocial model to be developed.[28]

Therefore, the aim of the present study was to describe pain catastrophizing in TMD patients in relation to disability and pain persistence scores. This analysis was performed in relation to socioeconomic data and Axes I and II of the DC/TMD.

Materials and Methods

This cross-sectional retrospective study consisted of 423 consecutive Israeli Jewish patients who were referred to the Tel Aviv University Orofacial Pain Clinic with a proposed diagnosis of TMD during 2015 to 2016. All patients were examined by four senior staff members of the Orofacial Pain Clinic who were all calibrated 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 from the study were patients younger than 18 years old (n = 52); referred due to bruxism or obstructive sleep apnea (n = 32); who did not meet the criteria to receive an Axis I diagnosis of TMD (n = 31); had a diagnosis of other orofacial pain conditions, such as neuropathic pain, rheumatoid arthritis, fibromyalgia, migraine, occlusal dysesthesia, odontogenic pain, neuromuscular disorders, burning mouth syndrome, referred otalgia from cervical source, or trigeminal autonomic cephalalgias (n = 36); or did not report pain (n = 30). Patients who did not fill out the questionnaire according to the specifications of the DC/TMD (n = 79) were not included in the final analyses (missing data as to pain catastrophizing scale/pain persistence/depression/anxiety/nonspecific physical symptoms/GCPS). This group differed significantly from the study group as to age (mean age 47.5 years ± standard deviation [SD] 17.92; $P < .001$), but there were no statistical differences between this group (n = 79) and the study group as to the male: female ratio (1:3). The final study population was 163 patients. The study was approved by the committee for conducting studies on human subjects of Tel Aviv University. All patients signed an informed consent form in which the patient agreed that their data would be used for research purposes. The authors received no funding for this research and have no conflicts of interest.

Prior to the clinical examination, all patients completed the Hebrew version of the DC/TMD questionnaire, which was translated into Hebrew and then backtranslated according to the Guidelines for Establishing Cultural Equivalency of Instruments documentation established by the international DC/TMD consortium. The Hebrew translation project of the DC/TMD was completed in January 2018. The Hebrew version of the PRIME-MD tools, including the Patient Health Questionnaire-9 (PHQ-9), Patient Health Questionnaire-15 (PHQ-15), and the Generalized Anxiety Disorder-7 (GAD-7) questionnaires incorporated into the DC/TMD, were downloaded from http://www.phqscreeners.com/select-screener. It is noteworthy that all these questionnaires are widely used in studies in Israel.[29–35]

Each patient received a full DC/TMD Axis I diagnosis and Axis II evaluation. For Axis I pain-related TMD, the prevalence of myalgia, myofascial pain with referral, arthralgia, and headache attributed to TMD were calculated separately. For intra-articular TMD, the prevalence of all four subgroups (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) were calculated as one group, and the prevalence of degenerative joint disease and subluxation were each calculated separately.

The Axis II evaluation included calculation of depression level (assessed by the Hebrew version of the PHQ-9), anxiety level (assessed by the Hebrew version of the GAD-7 questionnaire), and nonspecific physical symptoms levels (assessed by the Hebrew version of the PHQ-15 questionnaire). In addition, the Graded Chronic Pain Scale (GCPS) version 2.0[24] and pain persistence classification[24] were calculated for each patient according to the specifications of the DC/TMD. The pain persistence classification aims to assess pain persistence according to the patient's report of less/more than 90 days of pain in the last 6 months.[24] This question appears as the first question in the GCPS version 2.0 questionnaire, which is part of the DC/TMD ("On how many days in the last 6 months have you had facial pain?"). According to the pain persistence classification scoring, 1 to 89 days of pain is considered nonpersistent pain, while 90 to 180 days is considered persistent pain.[24] The pain persistence variable indicates the presence of possible chronicity. Indeed, the new classification of chronic pain of the International Classification of Diseases (ICD-11) defines chronic pain as a recurrent or persistent pain that lasts more than 3 months.[36]

To assess the level of pain catastrophizing, the Hebrew validated version[37] of the Pain Catastrophizing Scale (PCS) questionnaire was added. The PCS was developed in 1995 by Sullivan et al[38] for measuring catastrophizing level related to pain. It has been translated and validated into many languages, including Hebrew,[37] and is used worldwide. The PCS has adequate to excellent internal consistency (coefficient alphas: total score = .87; rumination = .87; magnification = .66; and helplessness = .78).[38] It is composed of 13 thoughts or feelings associated with experiencing pain, and the total score is computed by summing responses to all 13 items. Total scores can range from 0 to 52. Overall, the PCS measures three dimensions of pain catastrophizing: rumination ("I can't stop thinking about how much it hurts"), the sum of four items; magnification ("I worry that something serious may happen"), the sum of three items; and helplessness ("It's awful and I feel that it overwhelms me"), the sum of six items. A total score of 30 represents clinically relevant catastrophizing and corresponds to the 75th percentile of the distribution of pain catastrophizing scores in clinical samples of chronic pain patients. A total score of 20 to 29 corresponds to the 50th to 75th percentile of the distribution of the scores and represents a moderate risk for the development of chronicity.[39]

Therefore, patients were divided into several subgroups:

- According to their PCS scores: high pain catastrophizing (HPC): score of 30 or more; intermediate pain catastrophizing (IPC): score of 20 to 29; low pain catastrophizing (LPC): score of 19 or less
- According to their GCPS scores: high (grades 3 to 4) vs low (grades 1 to 2)
- According to their pain persistence scores: < 90 days vs ≥ 90 days

The ability of the DC/TMD Axis II parameters and of the pain catastrophizing parameters to discriminate between low and high disability (according to the GCPS) and low and high pain persistence were also examined.

Statistical Analyses

Continuous variables were evaluated for normal distribution by using histograms and Q-Q plots. Since the continuous variables were not distributed normally, they were analyzed by using nonparametric tests and are reported as the median and interquartile range (IQR) and the mean and SD. Categorical variables are described as frequency/percentage. Pearson chi-square test and Fisher exact test were used to test the associations between categorical variables: Pearson chi-square test was used when the expected value was 5 or more in at least 80% of the cells; when this rule was not met, Fisher exact test was used. The Kruskal-Wallis test and the Mann-Whitney test were used to assess differences in continuous variables between categories. Area under the receiver operating characteristic (ROC) curve was used to evaluate the discriminant ability of the PCS and the Axis II variables. The DeLong test was used to compare areas under curves between Axis II variables. Logistic regression was used for multivariate analysis. Variables with $P < .1$ in the univariate analysis were included in the multivariate analysis. The GCPS and pain persistence subgroups were assigned as dependent variables in a stepwise multiple logistic regression model, and variables with $P < .1$ in the univariate analysis were included in the multivariate analysis. The independent variables for GCPS analysis were age, gender, pain catastrophizing, depression, anxiety, and nonspecific physical symptoms. The independent variables for pain persistence analysis were age, gender, pain catastrophizing, depression, anxiety, nonspecific physical symptoms, diagnosis of myofascial pain with referral, and diagnosis of headache attributed to TMD. All tests were two tailed. IBM

SPSS Statistics for Windows, Version 21.0 and R: a language and environment for statistical computing, version 3.2.3 were used for all statistical analyses. The threshold for statistical significance was set at $\alpha < .05$.

Results

Demographic and Socioeconomic Data in the Study Population

A total of 163 subjects were included. The male: female ratio was 1:3. The mean age was 36.1 ± 14.1 years. About half of the study population were married or living with a significant other, and half were single. The mean pain duration reported was 53.6 ± 70.4 months, and 32.5% of the patients described their pain as continuous in the last 30 days.

Axis I Characteristics

A total of 51.5% of the sample received a diagnosis of myalgia, 25.8% myofascial pain with referral, 17.9% arthralgia, 19.6% headache attributed to TMD, 30.9% intra-articular disc disorders, 18.4% degenerative joint disease, and 19% subluxation. A total of 32.5% of the patients described their pain as continuous.

Axis II Characteristics

- Depression (according to the PHQ-9): 53.4% scored normal (score of 0 to 4); 26.4% scored mild (score of 5 to 9); 12.3% scored moderate (score of 10 to 14); 8.0% scored moderately severe to severe (score of 15+: 4.9% scored moderately severe [score of 15 to 19], and 3.1% scored severe [score of 20+]); 84.6% of the patients who scored moderately severe to severe on the PHQ-9 scored high on the PCS.
- Generalized anxiety (according to the GAD-7): 67.5% scored normal (score of 0 to 4); 19.6% scored mild (score of 5 to 9); 8.0% scored moderate (score of 10 to 14); and 4.9% scored severe (score of 15+); 87.5% of the patients who scored severe on the GAD-7 scored high on the PCS.
- Nonspecific physical symptoms (according to the PHQ-15): 47.9% scored normal (score of 0 to 4); 33.1% scored mild (score of 5 to 9); 13.5% scored moderate (score of 10 to 14); and 5.5% scored severe (score of 15+); 55.6% of the patients who scored severe on the PHQ-15 scored high on the PCS.
- GCPS (version 2.0): 26.6% scored level 1; 53.9% scored level 2; 9.1% scored level 3; and 10.4% scored level 4.
- Pain persistence: 54% scored < 90 days; 46% scored ≥ 90 days.
- Pain catastrophizing: 29.4% scored 30+; 49.7% scored 19 or less on the PCS. The mean rumination score was 7.00 ± 5.28, mean magnification was 4.21 ± 3.55, and mean helplessness was 10.22 ± 7.54.

Comparisons Among Pain Catastrophizing Subgroups

Significant differences between pain catastrophizing subgroups were found for education level, with LPC patients being more educated than the other two pain catastrophizing subgroups ($P = .025$), and marital status, with LPC patients being more likely to be married or living with a significant other than the other two PCS subgroups ($P = .040$). HPC patients were significantly younger than the LPC patients ($P = .046$) (Table 1).

Regarding Axis I diagnoses, significant differences between the subgroups were found as to diagnoses of myalgia and myofascial pain with referral, with HPC patients manifesting higher prevalence of myofascial pain with referral ($P < .05$) and lower prevalence of myalgia ($P < .02$). Significant differences between the subgroups were also found as to temporal characteristics of the pain: 60.4% of HPC patients described their pain as continuous in the last 30 days compared to 27.2% of the LPC patients ($P < .001$). HPC patients differed from LPC patients as to the type of jaw activity causing facial pain, reporting significantly more pain associated with clenching, grinding, chewing gum, talking, kissing, or yawning. The HPC patients reported significantly more headaches in the temporal area in the last 30 days ($P = .023$). There were no other significant differences between the subgroups as to the rest of the Axis I diagnoses (Table 1).

Comparisons between pain catastrophizing subgroups regarding Axis II diagnoses are presented in Table 1. Significant differences between subgroups were found for all Axis II parameters, including GCPS ($P < .001$), depression ($P < .001$), anxiety ($P < .001$), and nonspecific physical symptoms ($P < .001$).

There were also significant differences between the pain-catastrophizing subgroups on pain persistence ($P < .001$); as stated above, more HPC patients than LPC patients described their pain as always present in the last 30 days ($P < .001$). No significant differences between subgroups were found as to pain duration ($P = .926$).

Comparisons Between GCPS Subgroups

The GCPS subgroups did not differ on gender, age, education level, income level, marital status, or any Axis I diagnoses (Table 2). However, significant differences between GCPS subgroups were found in all Axis II parameters: depression ($P < .001$),

Table 1 Comparisons Among Pain Catastrophizing Subgroups

	PCS subgroups			
	LPC (n = 81)	IPC (n = 34)	HPC (n = 48)	*P*
Demographic and socioeconomic data				
Male, n (%)	22 (27.2)	8 (23.5)	11 (22.9)	.840
Female, n (%)	59 (72.8)	26 (76.5)	37 (77.1)	
Age (y)				**.046**
(Mean ± SD)	38.31 (13.96)	33.26 (12.63)	34.53 (14.90)	
Median (IQR)	34.00 (28.00–47.50)	28.00 (24.75–41.50)	30.25 (25.25–35.00)	
Education, n (%)				**.025**
Elementary school	2 (2.5)	5 (15.2)	4 (8.5)	
Through High school	21 (25.9)	13 (39.4)	22 (46.8)	
Some college	10 (12.3)	5 (15.2)	4 (8.5)	
College graduate	24 (29.6)	12 (36.4)	17 (36.2)	
Professional or postgraduate level	24 (29.6)	3 (9.1)	3 (6.4)	
Income, n (%)				.133
Very low	2 (2.6)	4 (12.1)	2 (4.4)	
Low	7 (9.1)	3 (9.1)	6 (13.3)	
Average	48 (62.3)	20 (60.6)	33 (73.3)	
High/very high	20 (26)	6 (18.2)	4 (8.9)	
Marital status, n (%)				**.040**
Married	41 (50.6)	10 (29.4)	14 (29.8)	
Living as married	7 (8.6)	4 (11.8)	2 (4.3)	
Divorced	3 (3.7)	0 (0)	2 (4.3)	
Separated	0 (0)	0 (0)	1 (2.1)	
Widowed	0 (0)	0 (0)	2 (4.3)	
Never married	30 (37)	20 (58.8)	26 (55.3)	
Axis I diagnoses, n (%)				
Myalgia	45 (55.6)	22 (64.7)	17 (35.4)	**.019**
Myofascial pain with referral	17 (21)	6 (17.6)	19 (39.6)	**.031**
Arthralgia	13 (16.3)	7 (20.6)	9 (18.8)	.844
In the last 30 days, have you had any headaches that included the temple areas of your head?	39 (48.1)	19 (55.9)	35 (72.9)	**.023**
Headache attributed to TMD	12 (14.8)	8 (23.5)	12 (25)	.302
Disc displacement with reduction	22 (27.5)	11 (32.4)	8 (16.7)	.224
Disc displacement with reduction with intermittent locking	4 (5)	4 (11.8)	7 (14.6)	.154
Disc displacement without reduction with limited opening	3 (3.8)	1 (2.9)	2 (4.3)	> .999
Disc displacement without reduction without limited opening	2 (2.5)	0 (0)	1 (2.1)	> .999
Degenerative joint disease (osteoarthritis/osteoarthrosis)	13 (16)	6 (17.6)	11 (22.9)	.618
Subluxation	12 (14.8)	8 (23.5)	11 (22.9)	.396
Axis II evaluation, n (%)				
GCPS version 2.0				
Low disability (GCPS 1-2)	68 (90.7)	30 (88.2)	26 (57.8)	< .001
High disability (GCPS 3-4)	7 (9.3)	4 (11.8)	19 (42.2)	
PHQ-9 (depression), n (%)				
Normal (≤ 4)	58 (71.6)	18 (52.9)	11 (22.9)	**< .001**
Mild (5–9)	19 (23.5)	8 (23.5)	16 (33.3)	
Moderate (10–14)	3 (3.7)	7 (20.6)	10 (20.8)	
Moderately severe to severe (15+)	1 (1.2)	1 (2.9)	11 (22.9)	
GAD-7 (anxiety), n (%)				
Normal	69 (85.2)	21 (61.8)	20 (41.7)	**< .001**
Mild	10 (12.3)	9 (26.5)	13 (27.1)	
Moderate	1 (1.2)	4 (11.8)	8 (16.7)	
Severe	1 (1.2)	0 (0)	7 (14.6)	
PHQ-15 (nonspecific physical symptoms), n (%)				
Normal	52 (64.2)	14 (41.2)	12 (25)	**< .001**
Mild	19 (23.5)	12 (35.3)	23 (47.9)	
Moderate	9 (11.1)	5 (14.7)	8 (16.7)	
Severe	1 (1.2)	3 (8.8)	5 (10.4)	
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?				**< .001**
No pain	4 (4.9)	3 (8.8)	2 (4.2)	
Pain comes and goes	55 (67.9)	29 (85.3)	17 (35.4)	
Pain always present	22 (27.2)	2 (5.9)	29 (60.4)	
In the last 30 days, did the following activities change any pain in your jaw, temple, in the ear, or in front of the ear on either side?				
Chewing hard or tough food	56 (69.1)	25 (73.5)	38 (79.2)	.462
Opening your mouth, or moving your jaw forward or to the side	61 (75.3)	23 (67.6)	41 (85.4)	.158
Jaw habits such as holding teeth together, clenching/grinding teeth, or chewing gum	50 (61.7)	26 (22.4)	40 (83.3)	**.024**
Other jaw activities such as talking, kissing, or yawning	36 (44.4)	18 (20.2)	35 (72.9)	**.007**
Pain persistence classification, n (%)				
< 90 d	52 (64.2)	22 (64.7)	14 (29.2)	**< .001**
≥ 90 d	29 (35.8)	12 (35.3)	34 (70.8)	
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)	56.96 (74.05)	58.38 (78.05)	44.54 (58.06)	.926
Median (IQR)	24.00 (6.00–96.00)	24.00 (6.00–72.00)	24.00 (12.00–60.75)	

PHQ-15 = Patient Health Questionnaire-15 (nonspecific physical symptoms); PCS = Pain Catastrophizing Scale; GAD-7 = Generalized Anxiety Disorder-7; PHQ-9 = Patient Health Questionnaire-9; GCPS = Graded Chronic Pain Scale. Significant values ($P < .05$) are in bold.

Table 2 Comparisons Between Graded Chronic Pain Scale (GCPS) Version 2.0 Subgroups

Variables	GCPS subgroups		*P*
	GCPS 1–2 (n = 124)	GCPS 3–4 (n = 30)	
Axis I diagnoses, n (%)			
Myalgia	68 (54.8)	13 (43.3)	.257
Myofascial pain with referral	32 (25.8)	9 (30)	.641
Arthralgia	19 (15.3)	7 (23.3)	.293
Headache attributed to TMD	23 (18.5)	6 (20)	.855
Disc displacement with reduction	36 (29)	4 (13.3)	.078
Disc displacement with reduction with intermittent locking	12 (9.7)	1 (3.3)	.465
Disc displacement without reduction with limited opening	5 (4.1)	0 (0)	.584
Disc displacement without reduction without limited opening	3 (2.4)	2 (1.7)	> .999
Degenerative joint disease (osteoarthritis/osteoarthrosis)	23 (18.5)	5 (16.7)	.810
Subluxation	23 (18.5)	5 (16.7)	.810
Axis II evaluation			
PHQ-9 (depression), n (%)			
Normal (≤ 4)	75 (60.5)	6 (20)	**< .001**
Mild (5–9)	36 (29)	6 (20)	
Moderate (10–14)	10 (8.1)	9 (30)	
Moderately severe to severe (15+)	3 (2.4)	9 (30)	
GAD-7 (anxiety), n (%)			
Normal (≤ 4)	35 (85.4)	71 (61.2)	**.010**
Mild (5–9)	6 (14.6)	24 (20.7)	
Moderate (10–14)	0 (0)	13 (11.2)	
Severe (15+)	0 (0)	8 (6.9)	
PHQ-15 (nonspecific physical symptoms), n (%)			
Normal (≤ 4)	64 (51.6)	9 (30)	**< .001**
Mild (5–9)	42 (33.9)	8 (26.7)	
Moderate (10–14)	15 (12.1)	7 (23.3)	
Severe (15+)	3 (2.4)	6 (20)	
PCS			
0–19	68 (90.7)	7 (9.3)	**< .001**
30+	26 (57.8)	19 (42.2)	
Rumination			
Mean (SD)	6.06 (4.798)	11.37 (5.116)	**< .001**
Median (IQR)	5.50 (2.00–9.00)	12.50 (8.00–16.00)	
Magnification			
Mean (SD)	3.85 (3.261)	6.07 (4.234)	**.010**
Median (IQR)	3.00 (1.00–6.00)	6.50 (2.00–11.00)	
Helplessness			
Mean (SD)	8.94 (7.008)	16.27 (7.225)	**< .001**
Median (IQR)	8.00 (3.00–13.00)	19.00 (9.75–22.00)	
Pain, 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?			
No pain	8 (6.5)	1 (3.3)	**.002**
Pain comes and goes	84 (67.7)	11 (36.7)	
Pain is always present	32 (25.8)	18 (60.0)	
Pain persistence, n (%): On how many days in the last 6 months have you had facial pain?			
< 90 d	69 (55.6)	13 (43.3)	.225
≥ 90 d	55 (44.4)	17 (56.7)	
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)	50.91 (64.84)	59.33 (84.09)	.543
Median (IQR)	24.00 (8.00–72.00)	24.50 (12.00–75.00)	

PHQ-15 = Patient Health Questionnaire-15; PCS = Pain Catastrophizing Scale; GAD-7 = Generalized Anxiety Disorder-7; PHQ-9 = Patient Health Questionnaire-9. Significant values (*P* < .05) are in bold.

anxiety (*P* = .01), nonspecific physical symptoms (*P* < .001), and pain catastrophizing (*P* < .001). The two subgroups also differed significantly as to each of the pain catastrophizing components (rumination [*P* < .001], magnification [*P* = .01], and helplessness ([*P* < .001]) (Table 2).

There were no significant differences between the two GCPS subgroups on pain duration (*P* = .543) or pain persistence (*P* = .225) (Table 2). Of the high-disability patients, 60.0% described their pain as continuous compared to 25.8% of the low-disability patients (*P* = .002).

Table 3 Comparisons Between Pain Persistence Subgroups

Variables	< 90 d (n = 88)	≥ 90 d (n = 75)	*P*
Axis I diagnoses, n (%)			
Myalgia	49 (55.7)	35 (46.7)	.251
Myofascial pain with referral	16 (18.2)	26 (34.7)	**.016**
Arthralgia	16 (18.4)	13 (17.3)	.861
Headache attributed to TMD	11 (12.5)	21 (28)	**.013**
Disc displacement with reduction	23 (26.4)	18 (24)	.722
Disc displacement with reduction with intermittent locking	7 (8)	8 (10.7)	.566
Disc displacement without reduction with limited opening	2 (2.3)	4 (5.3)	.418
Disc displacement without reduction without limited opening	2 (2.3)	1 (1.3)	> .999
Degenerative joint disease (osteoarthritis/osteoarthrosis)	14 (15.9)	16 (21.3)	.373
Subluxation	14 (15.9)	17 (22.7)	.273
Axis II evaluation			
GCPS version 2.0			
Low disability (1–2)	69 (84.1)	55 (76.4)	.225
High disability (3–4)	13 (15.9)	17 (23.6)	
PHQ-9 (depression), n (%)			
Normal (≤ 4)	67 (76.1)	43 (57.3)	**< .02**
Mild (5–9)	15 (17)	17 (22.7)	
Moderate (10–14)	2 (2.3)	11 (14.7)	
Severe (15+)	4 (4.5)	4 (5.3)	
GAD-7 (anxiety), n (%)			
Normal (≤ 4)	35 (85.4)	71 (61.2)	**< .01**
Mild (5–9)	6 (14.6)	24 (20.7)	
Moderate (10–14)	0 (0)	13 (11.2)	
Severe (15+)	0 (0)	8 (6.9)	
PHQ-15 (nonspecific physical symptoms), n (%)			
Normal (≤ 4)	49 (55.7)	29 (38.7)	.07
Mild (5–9)	27 (30.7)	27 (36)	
Moderate (10–14)	10 (11.4)	12 (16)	
Severe (15+)	2 (2.3)	7 (9.3)	
PCS, n (%)			
0–19	52 (64.2)	29 (35.8)	**< .001**
30+	14 (29.2)	34 (70.8)	
Rumination			
Mean (SD)	5.78 (4.827)	8.43 (5.470)	**< .005**
Median (IQR)	5.50 (1.00–9.00)	8.00 (4.00–13.00)	
Magnification			
Mean (SD)	3.58 (3.187)	4.96 (3.829)	**< .05**
Median (IQR)	3.00 (1.00–5.75)	4.00 (1.00–8.00)	
Helplessness			
Mean (SD)	7.94 (6.644)	12.89 (7.680)	**< .001**
Median (IQR)	7.00 (2.00–12.00)	13.00 (7.00–20.00)	
Pain, 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?			
No pain	6 (6.8)	3 (4.0)	**.007**
Pain comes and goes	63 (71.6)	38 (50.7)	
Pain is always present	19 (21.6)	34 (45.3)	
Pain duration: How many months ago did your pain the jaw, temple, in the ear, or in front of the ear first begin?			
Mean (SD)	42.40 (57.70)	66.75 (81.38)	**.006**
Median (IQR)	18.00 (6.00–60.00)	36.00 (12.00–96.00)	

GCPS = Graded Chronic Pain Scale; PHQ-15 = Patient Health Questionnaire-15; PCS = Pain Catastrophizing Scale; GAD-7 = Generalized Anxiety Disorder-7; PHQ-9 = Patient Health Questionnaire-9. Significant values (*P* < .05) are in bold.

Comparison Between Pain Persistence Subgroups

There were no differences between high and low pain persistence subgroups as to gender, age, education level, income level, or marital status. Regarding Axis I diagnoses, significant differences between pain persistence subgroups emerged for myofascial pain with referral (*P* = .016) and headache attributed to TMD (*P* = .013) (Table 3).

Significant differences between the pain persistence subgroups were also found for facial pain duration (*P* < .01). Of the high-persistence patients,

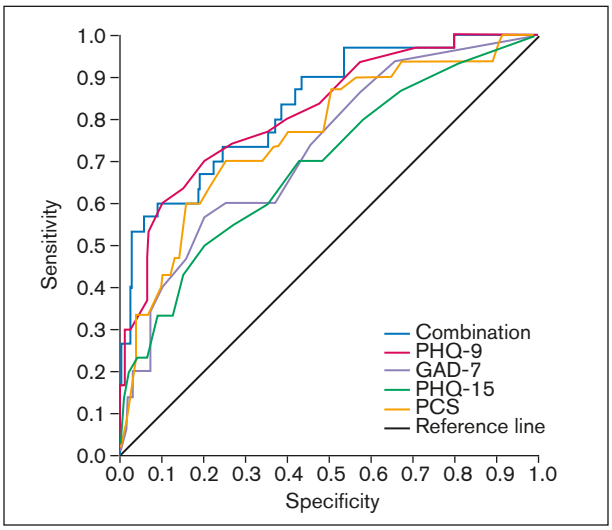

Fig 1 Graded Chronic Pain Scale (GCPS) receiver operating characteristic (ROC) curve. Combination = combination of depression, anxiety, nonspecific physical symptoms, and pain catastrophizing; PHQ-15 = Patient Health Questionnaire-15 (nonspecific physical symptoms); PCS = Pain Catastrophizing Scale (pain catastrophizing); GAD-7 = Generalized Anxiety Disorder-7 (anxiety); PHQ-9 = Patient Health Questionnaire-9 (depression).

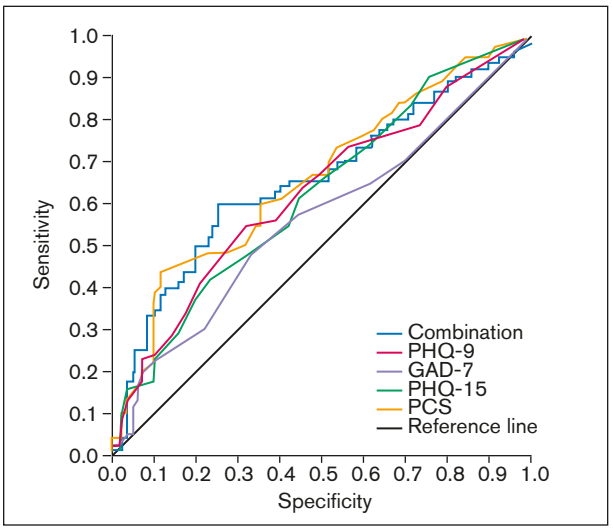

Fig 2 Pain persistence receiver operating characteristic (ROC) curve. Combination = combination of depression, anxiety, nonspecific physical symptoms, and pain catastrophizing; PHQ-15 = Patient Health Questionnaire-15 (nonspecific physical symptoms); PCS = Pain Catastrophizing Scale (pain catastrophizing); GAD-7 = Generalized Anxiety Disorder-7 (anxiety); PHQ-9 = Patient Health Questionnaire-9 (depression).

45.3% described their pain as continuous compared to 21.6% of the low-persistence patients (P = .007) (Table 3).

Significant differences between the pain persistence subgroups were found for the Axis II parameters depression (P < .02) and anxiety (P < .01), as well as pain catastrophizing (P < .001) and each of its three components (rumination [P < .005], magnification [P < .05], and helplessness [P < .001]). There were no differences between pain persistence subgroups as to nonspecific physical symptoms level (P = .07) (Table 3).

ROC Curves

This study examined the ability of pain catastrophizing and of the Axis II parameters depression, nonspecific physical symptoms, and anxiety to discriminate between patients with low and high pain disability and low and high pain persistence.

The parameters that had a significant discriminatory ability for pain disability were depression, pain catastrophizing, anxiety, and nonspecific physical symptoms (area under the ROC curve of .81, .76, .73, and .69, respectively) (Fig 1). Depression had higher discriminatory ability than nonspecific physical symptoms (area under the ROC curve of .81 compared to .69) (P < .02). There were no significant differences in discriminatory ability between the other parameters. A combination of depression, anxiety, nonspecific physical symptoms, and pain catastrophizing using logistic regression revealed an area under the ROC curve of .831 (95% confidence interval [CI] .749 to .913).

The parameters with significant discriminant ability for pain persistence were pain catastrophizing, depression, and nonspecific physical symptoms (area under the ROC curve of .66, .63, and .61, respectively), with no significant differences between them (Fig 2). Anxiety could not discriminate between pain persistence levels (area under the ROC curve of .58). Logistic regression revealed that a combination of depression, anxiety, nonspecific physical symptoms, and pain catastrophizing had an area under the ROC curve of 0.676 (95% CI 0.592 to 0.760).

Multivariate Logistic Regression Analyses

Depression was associated with pain disability (odds ratio [OR] = 1.27, 95% CI 1.07 to 1.51, P < .001); however, pain catastrophizing was not significantly associated with pain disability (OR = 2.59, 95% CI .761 to 8.816, P = .128).

Pain catastrophizing (OR = 6.71, 95% CI 1.58 to 28.41, P = .01) and myofascial pain with referral (OR = 3.74, 95% CI 1.03 to 13.57, P < .05) were associated with pain persistence; however, depression was not significantly associated with pain persistence (OR = .985, 95% CI 0.85 to 1.14, P = .838).

Sensitivity and specificity values of Axis II parameters (depression, anxiety, nonspecific physical symptoms, and pain catastrophizing levels) in identifying pain disability and pain persistence were calculated and are presented in Table 4.

Discussion

TMD are complex disorders that follow the biopsychosocial model.[40] In this study, HPC TMD patients differed in all three components of the biopsychosocial model.

Regarding the biologic component, the present study found that HPC patients suffered significantly more from myofascial pain with referral, but not from intra-articular joint disorders. Previous studies using the RDC/TMD for pain catastrophizing among TMD patients are consistent with the current results; Turner et al[16] showed that catastrophizing was not associated with relatively objective clinical examination findings (such as joint sounds), but rather with more subjective measures (such as muscle palpation pain severity). Self-reported muscle-related findings in HPC patients reported by Turner et al[16] may have paralleled the finding of significantly higher diagnosis of myofascial pain with referral in HPC patients found in the current study. These patients were more likely to report continuous pain compared to LPC patients. The same was true when comparing HPC patients to the study population group as a whole (60.4% compared to 32.5%, respectively).

Regarding the psychological component, depression and pain catastrophizing level emerged as the most significant psychological factors associated with pain persistence among TMD patients. Indeed, most of the patients who scored moderately severe to severe on the depression scale (84.6%) scored high on the PCS; however, most of the patients who scored high on pain catastrophizing (77%) scored normal to moderate on depression. While earlier studies have supported the view that pain catastrophizing is one of the symptoms of depression,[41,42] others have shown that pain catastrophizing should be viewed as a distinct entity from depression. For example, Sullivan et al[43] showed that item content overlap in questionnaires may underlie the relationship between catastrophizing and depression. Turner et al[16] showed that even after controlling for depressive symptom severity, pain catastrophizing remained significantly associated with extraoral joint and muscle palpation pain scores, pain-related activity interference, jaw activity limitations, and health care utilization. Velly et al[20] examined the effect of catastrophizing and depression on progression of disability and pain among TMD patients. They found that depression and catastrophizing contributed to the progression of chronic TMD disability and pain; however, after adjusting for levels of catastrophizing, significant effects of depression did not remain. They concluded that it is important to evaluate both catastrophizing and depression levels in the initial evaluation of TMD patients. The current findings support the view that pain catastrophizing is a distinct entity from depression. Moreover, although the two constructs may share some common features, they may provide distinct intervention targets, and this may be an important future area of research. While depression increased the odds of high pain disability by 1.2, pain catastrophizing increased the odds for high pain persistence by over 6 times. Therefore, the newly adopted pain persistence classification,[24] which includes levels of pain catastrophizing and depression, may serve as an effective combined tool for detection of subgroups of TMD patients in danger of developing chronic persistent painful TMD and disability. It is noteworthy that while assessment of disability by evaluation of GCPS scores can only be performed retroactively (in the past 30 days/6 months), the evaluation of pain catastrophizing can be performed immediately after an exposure to a noxious stimulation (situational assessment). Indeed, dispositional assessment of pain catastrophizing (recall of negative feelings related to past painful events) often fails to correlate with situational assessment of pain catastrophizing (immediately after exposure to a noxious stimulation).[44] This may explain why in the OPPERA prospective cohort study,[45] none of the subscales of the PCS were found to predict increased risk of first-onset TMD.

Table 4 Sensitivity and Specificity Values (%) of Axis II Parameters in Identifying Pain Disability and Pain Persistence

	Pain disability		Pain persistence	
Axis II measures	Sensitivity	Specificity	Sensitivity	Specificity
Depression	60.0	89.5	28	86.4
Anxiety	36.7	91.9	20	93.2
Nonspecific physical symptoms	43.3	85.5	25.3	86.4
Pain catastrophizing	63.3	79.0	45.3	84.1

Regarding the socioeconomic component, recent studies do not support significant associations between socioeconomic parameters such as education and income and occurrence of TMD; in another OPPERA case control study,[46] TMD occurred more frequently in older age groups, females, and in non-Hispanic whites compared to other racial/ethnic groups. No association with educational level was reported. Slade et al[47] evaluated sociodemographic predictors of TMD incidence and found that most socioeconomic measures were not significantly associated with TMD incidence, including marital status, education level, and income. These results do not coincide with the socioeconomic effects seen in other chronic pain conditions: In a 12-year longitudinal study on noncancer chronic pain patients in the United States,[48] pain scores were found

to be lower with each categorical increase in education or wealth. Respondents with no high school diploma were found to have pain scores over twice as high as respondents with a graduate degree. These disparities may be the result of using TMD as an umbrella term for heterogenous etiologies and because the majority of TMD patients do not progress to develop a chronic pain disorder.[49] In contrast, in the current study of TMD patients, HPC patients were significantly younger and less educated than LPC patients. Significant differences for marital status were noted as well. This pattern of association between high catastrophizing and socioeconomic parameters, such as education level, has also been shown in individuals with other chronic pain conditions, such as fibromyalgia,[50] rheumatoid arthritis,[51] post–total knee arthroplasty,[52] and scleroderma.[53] Thus, as far as socioeconomic parameters are concerned, HPC TMD patients resemble other patients with a chronic pain condition and not TMD patients.

Undoubtedly, complex Axis II components significantly contribute to the course, prognosis, and outcome of TMD patients, often independently of their Axis I diagnoses, especially intra-articular disorders of the temporomandibular joint. Possibly, each component of the patient's Axis II profile requires specialized intervention. Tailored interventions should consider the relative contribution of disability, depression, and pain catastrophizing levels. Patients who present with high pain catastrophizing, high depression levels, and high disability may require treatment on all aspects by using a multidisciplinary approach.[54]

A limitation of this study was that patients were divided into high and low pain persistence levels by using the dichotomous cut-off point of 90. This cut-off point was used because it is instructed by the GCPS version 2 calculation protocol.[24] It is notable that only 4.5% of the patients scored 72 to 89 on the pain persistence scale, suggesting that the 90 cut-off point probably did not bias the results. As pointed out by Benoliel et al,[55] there is no consistent definition of chronic orofacial pain. Several definitions of chronic pain exist, including pain that persists beyond normal healing time[56] or pain that lasts more than 3 to 6 months.[57] Recently, a newly suggested definition for chronic headache and orofacial pain is that they are conditions that occur on at least 50% of the days during at least 3 months.[36] This definition takes into consideration not only the total duration of pain, but also the temporal characteristics of the pain complaint, including pain persistence. However, this definition does not match the persistent classification that is used in the DC/TMD. A uniform definition for chronic orofacial pain that matches classification systems of other chronic pain conditions is essential for future research. This is especially crucial when trying to develop a set of diagnostic criteria that will apply across most chronic pain conditions, as suggested by the Analgesic, Anesthetic, and Addiction Clinical Trial Translations Innovations Opportunities and Networks (ACTTION) public-private partnership with the US Food and Drug Administration and the American Pain Society (APS) (ACTTION-APS Pain Taxonomy).[58]

Conclusions

The findings of the current study are in accordance with numerous other studies investigating other chronic pain conditions that show the predictive value of pain catastrophizing for development of chronic pain.[59–61] TMD patients with HPC differed from TMD patients as a group, but they resembled other patients with a chronic pain condition in all three dimensions of the biopsychosocial model, including the association between pain catastrophizing and pain persistence.[62,63] The present study supports the addition of an assessment of pain catastrophizing to Axis II of the DC/TMD. Assessment of pain catastrophizing could add significant information for predicting future development of chronic pain development in a specific subgroup of TMD patients. This may enable prospective studies to devise more appropriately tailored interventions for specific subgroups of TMD patients.

Acknowledgments

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