Prevalence and Impact of Post-traumatic Stress Disorder Symptoms in Patients with Masticatory Muscle or Temporomandibular Joint Pain: Differences and Similarities

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Aims: *To evaluate temporomandibular disorder (TMD) patients for differences between masticatory muscle (MM) and temporomandibular joint (TMJ) pain patients in the prevalence of post-traumatic stress disorder (PTSD) symptoms and evaluate the level of psychological dysfunction and its relationship to PTSD symptoms in these patients.* ***Methods:*** *This study included 445 patients. Psychological questionnaires included the Symptom Check List-90-Revised (SCL-90-R), the Multidimensional Pain Inventory, the Pittsburgh Sleep Quality Index, and the PTSD Check List Civilian. The total sample of patients was divided into 2 major groups: the MM group (n = 242) and the TMJ group (n = 203). Each group was divided into 3 subgroups based on the presence of a stressor and severity of PTSD symptoms.* ***Results:*** *Thirty-six patients (14.9%) in the MM group and 20 patients (9.9%) in the TMJ group presented with PTSD symptomatology (*P = .112*). Significant differences were found between the MM and the TMJ group in several psychometric domains, but when the presence of PTSD symptomatology was considered, significant differences were mostly maintained in the subgroups without PTSD. MM and TMJ pain patients in the "positive PTSD" subgroups scored higher on all SCL-90-R scales (*P < .001*) than patients in the other 2 subgroups and reached levels of distress indicative of psychological dysfunction. TMJ pain patients (58.3%;* P = .008*) in the positive-PTSD subgroups were more often classified as dysfunctional. Both positive-PTSD subgrounps of the MM and TMJ groups presented with more sleep disturbance (*P < .005*) than patients in the other 2 subgroups.* ***Conclusion:*** *A somewhat elevated prevalence rate for PTSD symptomatology was found in the MM group compared to the TMJ group. Significant levels of psychological dysfunction appeared to be linked to TMD patients with PTSD symptoms.* J OROFAC PAIN 2007;21:107–119

Key words: prevalence, post-traumatic stress disorder, psychological dysfunction, sleep disturbances, temporomandibular disorders

Post-traumatic stress disorder (PTSD), an anxiety disorder that can develop following an individual's exposure to an event perceived to be life-threatening or traumatic,[1] may coexist with other psychological disorders, such as anxiety, depression, and substance abuse disorders.[2,3] In addition, PTSD has been shown to coexist with chronic pain conditions such as fibromyalgia,[4,5] headaches,[6,7] and temporomandibular disorders (TMD).[8–10]

Several studies have explored the relationship between PTSD and chronic pain.[5,11–15] For instance, Sherman et al found in a sample of fibromyalgia patients that pain level, disability, and affective distress were greater in patients reporting PTSD symptoms than in those who did not report such symptoms.[4] An additional characteristic of patients with symptoms of PTSD and chronic pain is that these patients present with difficulty in coping and adapting to their pain.[4,9]

TMD comprise a number of clinical problems involving the masticatory muscles (MM) and/or the temporomandibular joints (TMJ)[16] and also have been associated with elevated levels of depression and anxiety.[17–20] Studies comparing the 2 most common categories of TMD, MM pain and TMJ/intracapsular pain, have revealed that MM pain patients are more psychologically distressed than TMJ pain patients.[21–24] In fact, MM pain patients report elevated levels of depression, pain disability, and exposure to major life stressors compared to intracapsular pain patients.[25,26] Major life stressors in turn have been associated with high levels of pain, affective distress, and disability in TMD patients.[26] Lampe et al[27] noted that stressful life events such as childhood abuse and depression experienced by chronic pain patients had a significant impact on the occurrence of the chronic pain condition. In regard to TMD, Curran et al[19] reported that 68.9% of orofacial pain patients reported a history of physical and sexual abuse in an anonymous survey. The history of abuse was significantly correlated to depression, psychological distress and greater pain severity. There is also evidence suggesting that TMD patients suffer stressful life events prior to the onset of their symptomatology.[26,28,29] Overall, traumatic life experiences seem to interfere with the well-being of patients and may have a substantial link to the occurrence of TMD.

A persistent finding in cases of chronic pain[30–33] TMD,[34,35] and PTSD[36–38] is the dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis. Dysregulation of the HPA axis has been related to somatic complaints such as myalgia, arthralgia, and sleep disturbances in the absence of a recognized pathological condition.[39] In addition, it appears that dysregulation of the HPA axis plays an important role in the development of both chronic pain[20,40] and PTSD.[41] Alteration in the physiology of the HPA axis has also been associated with inadequate coping strategies in chronic pain patients.[40]

In accordance with previous studies in chronic pain patients with PTSD symptomatology,[4,12] TMD patients with such symptoms present with increased psychological distress, elevated levels of pain,[10] and greater disability when compared to TMD patients without PTSD symptomatology.[4,9] In the case of the 2 main categories of TMD, several lines of evidence suggest a higher prevalence of PTSD symptoms in the MM pain category compared to the TMJ pain category.[9,24,42] A recent investigation by the present authors in chronic orofacial pain patients revealed that patients who reported symptoms of PTSD were more psychologically distressed and more prone to be classified with a dysfunctional profile than patients who did not report symptoms of PTSD.[9] An additional finding of that investigation was that clinically significant levels of psychological distress were strongly linked with PTSD symptoms.

The coexistence and interaction of chronic pain/TMD and PTSD appear to be related to increased psychological distress, elevated levels of pain, and greater disability. In addition, dysregulation of the HPA axis has been associated with chronic pain,[30–33] TMD,[34,35] and PTSD.[36–38] Such characteristics may influence a patient's adaptability to disease and to treatment outcomes. Consequently, the successful management of patients with chronic pain requires assessment of comorbid psychological conditions and should address all coexisting factors.

Given the authors' previous findings in orofacial pain patients[9,43] that the presence of PTSD symptoms may dictate elevated levels of psychological distress, it was decided to concentrate the analysis on the 2 main categories of TMD (MM and TMJ pain). The purpose of this study was to evaluate TMD patients for differences between MM pain patients and TMJ pain patients in the prevalence of PTSD symptoms. A second aim of this study was to analyze the level of psychological dysfunction and its relationship to PTSD symptoms in MM pain patients and TMJ pain patients. It was hypothesized that the prevalence of PTSD symptoms and the level of psychological distress would be higher in MM pain patients than in TMJ pain patients. In addition, given the complicated nature of PTSD symptoms, it was hypothesized that the presence of this symptomatology would influence the level of psychological dysfunction both in MM and TMJ pain patients.

Materials and Methods

This study was a retrospective analysis of psychometric and sleep disorders data obtained from

patients as part of a standard evaluation protocol during the initial visit at an orofacial pain clinic. The patient sample was selected from patients seen at the Orofacial Pain Center at the University of Kentucky College of Dentistry from 1997 to 2005. The Orofacial Pain Center is a tertiary clinic where patients with predominantly chronic pain complaints are managed. The typical distribution of chronic pain complaints diagnosed at the center is as follows: muscle pain, 40%; TMJ pain and derangements, 25%; neuropathic pains, 15%; headaches, 5%; and others, ~15%. Management services provided are conservative in nature. Eligible patients were at least 18 years of age and had reported pain duration of at least 3 months and pain intensity of at least 3 on a visual analog scale (VAS) where 0 was "no pain" and 10 was "the most extreme pain." Patients with a diagnosis of MM pain or a diagnosis of TMJ pain according to the Research Diagnostic Criteria for TMD[44] were eligible to participate in this study. Patients with a primary diagnosis of TMJ pain and a secondary diagnosis of MM pain or vice versa were not eligible. Patients with a primary or secondary diagnosis of other types of orofacial pain, such as headache or neuropathic pain, were also not eligible to participate in the study.

All patients completed an orofacial pain questionnaire and a battery of psychological questionnaires as part of the initial evaluation/examination. The psychological questionnaires included the Symptom Check List-90-Revised (SCL-90-R),[45] the Multidimensional Pain Inventory (MPI),[46] the Pittsburgh Sleep Quality Index (PSQI),[47] and the PTSD Checklist Civilian (PCL-C).[48,49] These questionnaires embrace an extensive variety of symptoms and behaviors that are important for developing a thorough treatment/management plan for chronic pain patients. Per routine protocol, all patients between the ages of 18 and 80 years consulting the clinic complete this set of measures. The questionnaires are administered by the staff upon arrival of the patient to the clinic. A brief written explanation about the purpose of each questionnaire is attached to the battery of measures, with a global sentence indicating that the overall purpose of the battery of measures is to learn more about factors influencing the patient's pain.

Psychometric Measures

For this study, data from the SCL-90-R, MPI, PSQI, and PCL-C were used. The SCL-90-R is a 90-item self-report inventory that is used to assess psychologic symptoms; it yields 9 symptom dimensions and 3 global indices of functioning. Use of the SCL-90-R revealed the presence and extent of symptoms such as somatization, obsessive-compulsive, interpersonal sensitivity, anxiety, depression, hostility, phobic anxiety, paranoid ideation, and psychoticism. Test-retest reliabilities range from r = 0.78 to 0.90 for nonpatient samples, and internal consistencies range from 0.77 to 0.90.[45]

The MPI includes 3 sections and contains 61 questions that provide data regarding pain severity, perceptions of how pain interferes with life, appraisal of the amount of support received from spouse or significant other, perceived life control, affective distress including rates of depressed mood, irritability, tension, and social and general activities. In addition, it provides a patient profile classification, which includes dysfunctional, interpersonally distressed, and adaptive coper profiles. These 3 profiles are considered the prototypic profiles. In addition, 3 other profile classifications may be given (hybrid, anomalous and unanalyzable profiles). Kerns et al[46] have demonstrated the validity of the MPI across chronic pain patients.[46] Test-retest reliabilities range from r = 0.68 to 0.86, and internal consistencies range from 0.73 to 0.90.[46]

The PSQI is an 18-item self-report measure used to appraise general sleep quality. It provides information regarding the number of hours spent in bed and asleep, sleep latency, frequency and reasons for awakening, difficulty returning to sleep after awakening, sleep efficiency, and use of sleep medication. The PSQI has demonstrated test-retest stability (r = 0.85) and internal consistency (α = 0.83) and provides valid and reliable assessment to overall sleep quality and disturbance.[47,50]

The PCL-C is a 17-item self-report measure used to assess the incidence of significant stressor(s) and prevalence of PTSD symptomatology. The items on the PCL-C correspond to the DSM-IV[1] criteria for PTSD. Before completing the 17-item measure, the patient is asked to identify any significant stressors he or she has experienced on a 15-item experience list. The list includes military combat, violent attack, being kidnapped, taken hostage, terrorist attack, torture, incarceration, natural or man-made disaster, severe automobile accident, being diagnosed with a life-threatening illness, sudden injury/serious accident, observed someone hurt or killed, learned that your child has a life-threatening illness, and "others." Subsequently, the patient is asked to identify the most significant stressor, indicate the date of occurrence, and appraise how much the most significant stressor has bothered him or her in the past month on the 17-item measure. In this segment, 17 items are

rated on a 5-point scale (1 = not at all, 2 = a little bit, 3 = moderately, 4 = quite a bit, and 5 = extremely). The PCL-C has exhibited test-retest stability (r = 0.96), good overall internal consistency (α = 0.92), and provides a valid and reliable assessment of the presence of PTSD symptoms.[49]

Study Groups

Based on their diagnoses, patients were allocated to either the MM or TMJ group of TMD. Subsequently, both groups were subcategorized, with subgroups of "no stressor," "negative PTSD," or "positive PTSD" according to the presence of a stressor and the degree of PTSD symptomatology as assessed with the PCL-C. A score of 41 on the PCL-C is considered the cutoff point for clinical significance of PTSD symptomatology.[49] The "no-stressor" subgroup comprised patients who did not report a stressor. The "negative-PTSD" subgroup comprised patients who reported at least 1 stressor on the PCL-C but did not meet criteria for PTSD symptoms (PCL-C score < 41). The "positive-PTSD" subgroup comprised patients who reported at least 1 stressor and met criteria for PTSD symptoms (PCL-C score ≥ 41).

The clinical examinations were performed by dentists with advanced training in the diagnosis of orofacial pain conditions. All examiners were trained in the Orofacial Pain Center of the University of Kentucky within the guidelines of the American Academy of Orofacial Pain.[16] As part of the Orofacial Pain Center protocol, all participants had already signed a standard patient registration/consent form upon arriving for their initial evaluation. Additionally, this study was approved by the Office of Research Integrity of the University of Kentucky.

Statistical Analysis

Initial analyses were conducted by comparing the 2 diagnostic groups (MM and TMJ). Diagnostic, demographic, MPI profile, and prevalence of PTSD symptomatology data between the 2 groups were tested using χ^2 analyses. Age, pain severity, and pain duration were tested using Student t tests. After these initial comparisons, each diagnostic group was divided into 3 subgroups depending on prevalence and intensity of PTSD symptomatology (no stressor, negative PTSD, and positive PTSD). Multivariate analysis of variance (MANOVA) was used to test differences between the 2 diagnostic groups and among the 3 subgroups with regard to data from the SCL-90-R, MPI, and PSQI. MANOVA involves techniques for assessing group differences across multiple dependent variables at the same time, based on a set of categorical independent variables, and is preferred over analysis of variance (ANOVA) when there is more than 1 dependent variable. Whereas ANOVA tests the difference in means of a single dependent variable, MANOVA tests the differences in the centroid (vector) of means of multiple interval dependents. Repeated univariate procedures can dramatically increase chance of type-1 errors, but use of MANOVA can decrease this type of error. In the current study, the potential for family-wise error due to multiple comparisons was also controlled for by using post-hoc tests and the Bonferroni correction. The Bonferroni correction is a multiple-comparison correction used when several dependent or independent statistical tests are being performed simultaneously. In order to avoid spurious positives, the Bonferroni correction lowers the α value to account for the number of comparisons being performed. In the current study, the Bonferroni correction was set to actual α = .039. Significance level for all other comparisons was set at P = .05. All statistical analyses were conducted using the Statistical Package for the Social Sciences, Release 11.0 (SPSS).

Results

Sample Size, Demographics Characteristics, Pain Variables, and Prevalence of PTSD Symptoms

The total patient sample comprised 445 adult patients (male = 42; female = 403; mean age 37.3 ± 12.9 years). The MM pain group was composed of 242 patients (male = 23; female = 219) with a mean age of 38.3 ± 12.9 years. The TMJ pain group was composed of 203 patients (male = 19; female = 184) with a mean age of 36.0 ± 12.8 years. Pain severity (VAS 0 to 10) was 6.9 ± 1.9 for the MM group and 6.4 ± 2.0 for the TMJ group. Pain duration reported by patients was 42.9 ± 55.7 months for the MM group and 46.7 ± 74.5 months for the TMJ group. There were no significant differences between the 2 groups for gender (P = .55), age (P = .069), pain duration (P = .553), and demographic characteristics (Table 1). Patients in the MM group reported significantly more severe pain than patients in the TMJ group (P = .004).

Of the entire sample, 206 patients (46% total; 48% of the MM group and 44% of the TMJ group) reported having experienced 1 or more significant traumatic stressors. Fifty-six of 445 patients (12.6%) presented with symptomatology

Table 1 Demographic Characteristics

	MM group		TMJ group			
Variable	**n**	**%**	**n**	**%**	χ^2	***P***
Gender						
Female	219	90.5	184	90.6	0.003	.959
Male	23	9.5	19	9.4		
Marital Status						
Married	142	58.7	117	57.6	3.49	.322
Single	57	23.6	51	25.1		
Divorced	32	13.2	17	8.4		
Widowed	6	2.5	2	1.0		
Missing Data	5	2.0	16	7.9		
Employment						
Full-time	117	48.3	98	48.3	6.78	.341
Part-time	28	11.6	21	10.3		
Unemployed	32	13.2	36	17.7		
Disabled	27	11.2	15	7.4		
Retired	11	4.5	8	3.9		
Student	13	5.4	6	3.0		
Missing Data	14	5.8	19	9.4		
Receiving or applying for disability	37	15.6	22	10.9	2.09	.148
Lawyer consult	18	7.8	9	4.6	1.80	.179
Smoker	64	26.9	51	25.1	0.178	.673

of PTSD. More patients in the MM group (14.9%) than in the TMJ group (9.9%) met the criteria for PTSD symptoms, but the difference was not statistically significant ($\chi^2 = 2.53$; $P = .112$).

In the MM group there were no significant differences among the 3 subgroups (no stressor, negative PTSD and positive PTSD) for gender ($\chi^2 = 3.658$; $P = .161$), marital status ($\chi^2 = 11.77$; $P = .067$), age (F = .922; $P = .399$), pain severity (F = .013; $P = .987$), or pain duration (F = .099; $P = .906$). Significant differences, however, were found in smoking status ($\chi^2 = 6.657$; $P = .036$), where patients in the positive-PTSD subgroup were more likely to be smokers. Additionally, patients in the positive-PTSD subgroup were more likely to be applying for or receiving disability than patients in the other 2 subgroups ($\chi^2 = 22.27$; $P < .0001$).

In the TMJ group there were no significant differences among the 3 subgroups for gender ($\chi^2 = 1.711$; $P = .425$), age (F = 1.823; $P = .165$), pain severity (F = 2.064; $P = .130$), pain duration (F = .821; $P = .442$), or smoking status ($\chi^2 = 4.162$; $P = .125$). Significant differences, however, were found for marital status; patients in the positive-PTSD subgroup were more likely to be divorced and less likely to be married than patients in the other 2 subgroups ($\chi^2 = 18.961$; $P = .004$). Additionally, patients in the positive-PTSD subgroup were more likely to be applying for or receiving disability than patients in the other 2 subgroups ($\chi^2 = 24.476$; $P < .0001$).

With respect to subgroups, there were no significant differences between positive-PTSD subgroups of the MM and TMJ groups for gender ($\chi^2 = 1.323$; $P = .250$), age (F = .230; $P = .634$), pain severity (F = .234; $P = .631$), pain duration (F = .434; $P = .513$), disability ($\chi^2 = .0145$; $P = .903$) or demographic characteristics in general ($P > .05$). There were no significant differences between the negative-PTSD subgroups of the MM and TMJ groups for gender ($\chi^2 = .026$; $P = .872$), age (F = .543; $P = .462$), pain severity (F = 3.520; $P = .063$), pain duration (F = .808; $P = .370$), disability ($\chi^2 = .053$; $P = .819$), or demographic characteristics in general ($P > .05$). There were also no significant differences between the no-stressor subgroups of the MM and TMJ groups for age (F = 2.386; $P = .124$), gender ($\chi^2 = .222$; $P = .638$), pain duration (F = .230; $P = .632$), disability ($\chi^2 = 3.472$; $P = .062$), or demographic characteristics in general ($P > .05$). A significant difference, however, was found between the no-stressor subgroups of the MM and TMJ groups for pain severity, with patients in the MM group reporting more severe pain than patients in the TMJ group (F = 7.511; $P = .007$).

Psychometric Data

SCL-90-R. Analyses of SCL-90-R data revealed higher scores on all scales for patients in the MM group as compared to patients in the TMJ group;

Table 2 Comparison of SCL-90-R Scale Scores for the MM and TMJ Groups

	MM group		TMJ group			
SCL-90-R scale	Mean	SD	Mean	SD	F	*P*
Somatization	61.8	9.0	58.0	10.1	16.371	.000*
Obsessive-compulsive	57.7	11.4	54.9	11.9	6.539	.011*
Interpersonal sensitivity	54.9	11.2	52.9	10.9	3.554	.060
Depression	57.9	10.9	54.1	10.7	13.570	.000*
Anxiety	55.9	10.9	53.3	11.3	5.891	.016*
Hostility	55.3	10.1	53.1	9.9	4.945	.027*
Phobic anxiety	50.9	9.4	50.7	9.3	0.017	.897
Paranoid ideation	51.8	10.8	49.5	10.1	5.610	.018*
Psychoticism	55.9	10.6	52.1	9.7	9.001	.003*

*Indicates statistical significance.

in most cases, the differences were statistically significant (Table 2).

In the MM group, there were significant differences among the 3 subgroups ($P < .0001$) for all 9 scales of the SCL-90-R. Post-hoc tests revealed that these differences were due to significantly higher scores on the subscales in the positive-PTSD subgroup than in the other 2 subgroups (Fig 1). The same pattern was observed for the TMJ subgroups ($P < .0001$; Fig 2) for all scales. Only patients in the positive-PTSD subgroups of both the MM and TMJ groups reached levels of distress that were indicative of psychologic dysfunction on almost all scales of the SCL-90-R (T-score ≥ 63; see Figs 1 and 2).

Considering the presence of a stressor and/or PTSD symptomatology, there were no significant differences between the positive-PTSD subgroups of the MM and TMJ groups on the SCL-90-R scales. When the negative-PTSD subgroups were compared, the MM group scored significantly higher on the somatization ($P = .011$) and depression ($P = .025$) scales of the SCL-90-R than the TMJ group. When the no-stressor subgroups were compared, the MM group scored significantly higher on somatization ($P = .001$), depression ($P = .018$), and psychoticism ($P = .020$).

MPI and MPI Profile Classification. Significant differences were found between the MM and TMJ groups on 3 of the MPI scales. The MM group had significantly higher scores on the life-interference and affective-distress scales and significantly lower scores on life control than the TMJ group (Table 3).

In the MM group, there were significant differences among the 3 subgroups for the following scales of the MPI: life control, affective distress, support, and punishing responses. Post-hoc tests revealed that the positive-PTSD subgroup had significantly lower scores on the life-control scale and significantly higher scores on the affective-distress and punishing-responses scales than the other 2 subgroups ($P < .01$). For the support scale, a significant difference was found between the no-stressor and positive-PTSD subgroup, with patients in the positive-PTSD subgroup reporting less support than patients in the no-stressor subgroup ($P = .027$).

In the TMJ group, there were significant differences among the 3 subgroups for the following scales of the MPI: interference, affective distress, punishing responses, and distracting responses. Post-hoc tests revealed that the positive-PTSD subgroup had significantly higher scores on the interference, affective-distress, and distracting-responses scales than the other 2 subgroups ($P \leq .005$). Patients in the positive-PTSD subgroup reported higher scores on the punishing-responses scale than patients in the no-stressor subgroup ($P = .004$).

Considering the presence of a stressor and/or PTSD symptomatology, there were no differences between the positive-PTSD subgroups of the MM and TMJ groups. Significant differences, however, were found between the no-stressor subgroups of the MM and TMJ groups, with patients in MM group reporting more life interference and affective distress and less life control. Patients in the negative-PTSD subgroup of the MM group also reported more life interference and less life control than those in the negative-PTSD subgroup of the TMJ group.

Approximately 55% of all patients were classified in 1 of the 3 main MPI profiles (Table 4). The 3 nonspecific profiles were not analyzed. Patients in the MM group were classified as adaptive copers significantly less often than patients in the TMJ group.

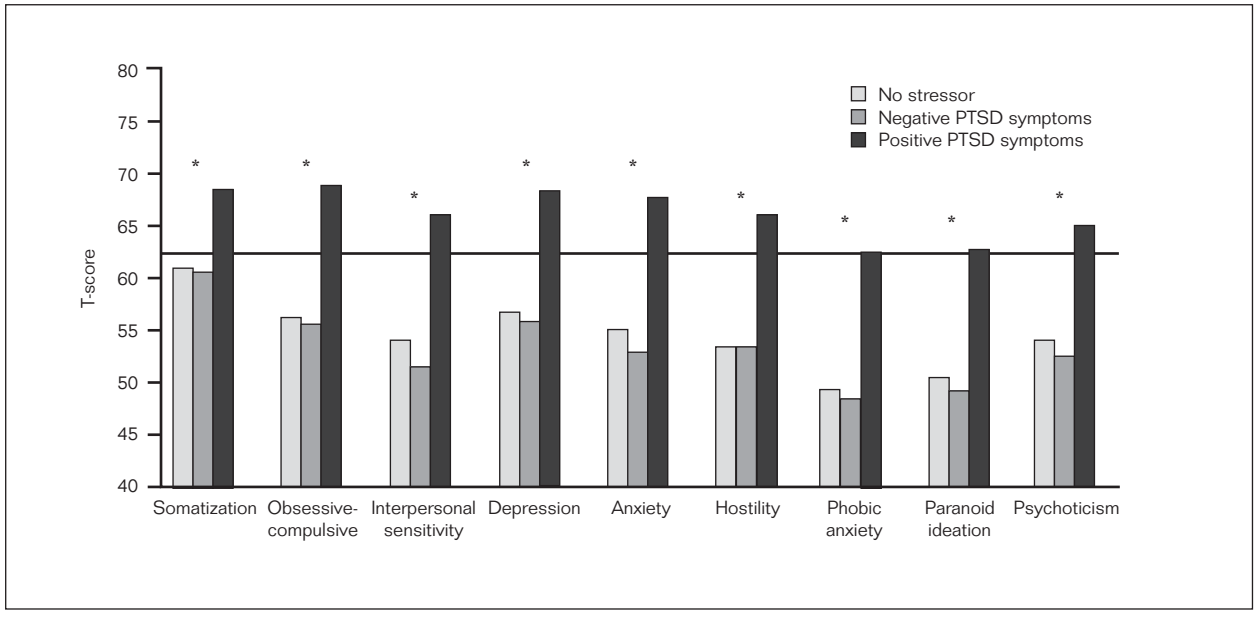

Fig 1 SCL-90-R score by PTSD status in the MM group. T-scores ≥ 63 were indicative of psychologic dysfunction. * Post-hoc comparisons indicate a significant difference between the positive-PTSD subgroup and the other 2 subgroups ($P < .001$).

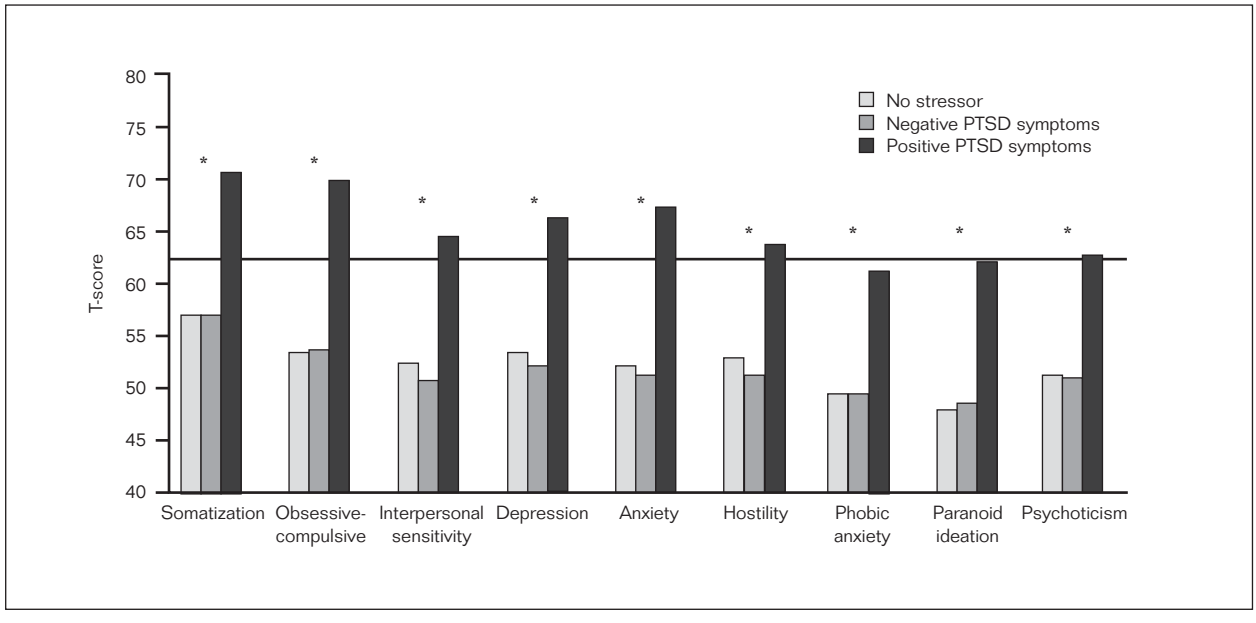

Fig 2 SCL-90-R score by PTSD status in the TMJ group. T-scores ≥ 63 were indicative of psychologic dysfunction. *Post-hoc comparisons indicate a significant difference between the positive-PTSD subgroup and the other 2 subgroups ($P < .001$).

In the TMJ group, the patients in the positive-PTSD subgroup were classified as dysfunctional significantly more often than patients in the other 2 subgroups. Patients in the no-stressor and negative-PTSD symptoms subgroups were classified as adaptive copers more often than patients in the positive-PTSD subgroup (Table 5).

Considering the presence of a stressor and/or PTSD symptomatology, there were no significant differences between the positive-PTSD or negative-PTSD subgroups of the MM and TMJ groups for the 3 MPI profile classifications. However, a significant difference was found between the no-stressor subgroups; patients in the MM group were

Table 3 Comparison of MPI Scale Scores for the MM and TMJ Groups

	MM group		TMJ group			
MPI scale	Mean	SD	Mean	SD	F	*P*
Interference	33.6	16.0	25.0	15.0	27.016	<.001*
Life control	49.4	7.9	53.0	7.3	15.798	<.001*
Affective distress	47.4	9.6	43.5	10.4	9.741	.002*
Support	47.3	11.1	47.3	10.0	0.014	.906
Punishing responses	46.5	8.6	45.0	7.1	3.236	.073
Soliciting responses	49.9	9.7	48.1	9.5	0.580	.447
Distracting responses	47.7	9.7	50.4	40.2	0.798	.372
Household chores	55.7	9.1	55.6	9.6	0.282	.596
Outdoor work	54.6	11.6	54.1	11.4	0.220	.639
Activities away from home	53.0	10.0	54.2	10.0	2.694	.102
Social activities	51.8	10.0	52.9	9.4	1.458	.228
General activity level	55.2	9.9	55.9	9.7	0.291	.590

*Indicates statistical significance.

Table 4 MPI Profile Classification for the MM and TMJ Groups

	MM group		TMJ group			
MPI profile	n	%	n	%	χ^2	*P*
Dysfunctional	46	34.8	21	24.7	2.492	.114
Interpersonally distressed	27	20.5	10	11.8	2.761	.097
Adaptive coper	59	44.7	54	63.5	7.348	.007*

*Indicates statistical significance.

Table 5 MPI Profile Classification Among the 3 Subgroups in the MM Group and in the TMJ Group

	No stressor		Negative PTSD		Positive PTSD			
MPI profile	n	%	n	%	n	%	χ^2	*P*
MM group								
Dysfunctional	25	36.8	12	27.9	9	42.9	1.616	.446
Interpersonally distressed	11	16.2	10	23.3	6	28.6	1.823	.402
Adaptive coper	32	47.1	21	48.8	6	28.6	2.661	.264
TMJ group								
Dysfunctional	7	15.2	7	25.9	7	58.3	9.543	.008*
Interpersonally distressed	6	13.0	2	7.4	2	16.7	.844	.656
Adaptive coper	33	71.7	18	66.7	3	25.0	9.141	.010*

*Indicates statistical significance.

more often classified as dysfunctional ($P = .012$) than patients in the TMJ group, and patients in the TMJ group were more often classified as adaptive copers ($P = .010$) than patients in the MM group (Table 5).

PSQI. Subjectively reported sleep problems were significantly higher for the MM group than for the TMJ group (Table 6). In the MM group, the positive-PTSD subgroup reported more sleep problems on most scales of the PSQI than the no-stressor and negative-PTSD subgroups ($P < .005$). In the TMJ group, the positive-PTSD subgroup reported more sleep problems on all PSQI scales except the "use of sleep medication" scale than patients in the no-stressor and negative-PTSD subgroups ($P < .035$).

There were no significant differences between the positive-PTSD subgroups of the MM and TMJ groups for any of the scales of the PSQI. Significant differences, however, were seen between the no-stressor subgroups of the MM and TMJ groups on all subscales except for "sleep duration" and "sleep efficiency" ($P < .02$).

Table 6 Comparison of PSQI Scale Scores for the MM and TMJ Groups

	MM group		TMJ group			
PSQI scale	Mean	SD	Mean	SD	F	*P*
Subjective sleep quality	1.6	0.8	1.3	0.8	13.228	.000*
Sleep latency	1.6	1.0	1.3	1.0	10.114	.002*
Sleep duration	1.3	1.0	1.1	1.0	5.370	.021*
Habitual sleep efficiency	1.0	1.1	0.7	1.0	6.774	.010*
Sleep disturbances	1.8	0.6	1.6	0.6	9.114	.003*
Use of sleep medication	1.4	1.4	0.9	1.2	15.359	.000*
Daytime dysfunction	1.3	0.8	1.1	0.8	6.046	.014*
PSQI total score	10.0	4.4	8.0	4.2	22.346	.000*

*Indicates statistical significance.

Significant differences were observed between the negative-PTSD subgroups of the MM and TMJ groups on the "sleep duration" and "sleep efficiency" scales as well as in total PSQI score, with the MM group reporting more sleep-related problems than the TMJ group ($P < .02$).

Discussion

PTSD symptoms were reported by 14.9% of patients with MM pain and by 9.9% of patients with TMJ pain. Analyses of the total sample revealed an overall prevalence of 12.6% for PTSD symptoms. The findings of this study are in agreement with previous studies in orofacial pain populations.[8,9] In a recent investigation, de Leeuw et al[9] reported an overall prevalence rate of 14.7% for PTSD symptoms in orofacial pain patients. Sherman et al reported prevalence rates of 11.3% and 12.1%, respectively, for full current PTSD symptomatology and full lifetime PTSD symptomatology.[10] In accordance with previous studies,[9,42] in the present study, PTSD symptoms were more prevalent in MM pain patients compared to TMJ/intracapsular pain patients. A higher prevalence of PTSD symptoms in the MM group, although not statistically significant in the present study, is supported by several studies which also reported higher levels of psychological distress in MM pain patients than in TMJ pain patients.[21,22,24] Moreover, studies have shown that MM pain patients report more exposure to stressful life events than TMJ pain patients.[25,26]

Surprisingly, the overall prevalence rate of 12.6% of PTSD symptoms was within the range of lifetime prevalence of PTSD (1% to 14%) in the general population estimated by the DSM-IV.[1] Considering the prevalence of current PTSD symptomatology, evidence suggests a lower prevalence rate (less than 10%) of current PTSD[51–53] when compared to the lifetime prevalence rates. Given these previous studies, the prevalence of current PTSD symptomatology measured in the present study with the PCL-C can be considered moderately elevated. Nevertheless, our findings are not in agreement with previous studies in chronic pain (fibromyalgia), where elevated prevalence rates (approximately 55%) of PTSD symptoms have been reported.[4,5] Such a discrepancy could potentially be explained by individual differences among these study populations, such as differences in social support, family history, personality variables, and pre-existing mental disorders that may be involved in the development of PTSD,[1] or by methodological differences between the studies. On the other hand, the discrepancy between the authors' studies and these other 2 studies could be a reflection of an increased vulnerability for PTSD symptoms in patients with chronic widespread pain conditions when compared to patients with a more localized pain condition such as TMD. Further studies are needed to clarify whether such a relationship exists.

Previous studies have shown a relationship between the presence of PTSD symptoms and increased pain level.[4,10,12] This relationship was not supported by the present study because there were no significant differences among the PTSD subgroups of the MM and TMJ groups in regard to pain severity. In accordance with previous studies in pain populations,[4,9,10,12] the present study indicated a positive relationship between PTSD symptoms and disability. Sharp and Harvey described a model to explain the overlap of symptoms between chronic pain and PTSD, the mutual

maintenance hypothesis, whereby chronic pain and PTSD may reciprocally maintain or exacerbate the symptoms of both conditions, which may lead to disability.[54] Unfortunately, a causal relationship between PTSD and disability could not be established by the present study due to its retrospective nature; further studies are needed to determine whether such a relationship exists.

An interesting finding of this study was that only TMD patients (both of the MM group and TMJ group) with PTSD symptomatology presented with elevated levels of psychological dysfunction (T-score ≥ 63) on the SCL-90-R. Scores greater than or equal to the cutoff score of 63 are usually considered clinically significant in pain populations.[55] The present results are consistent with those of previous studies showing that clinically significant levels of psychological distress were limited to TMD patients[9] and neuropathic pain patients[43] who met criteria for PTSD symptomatology. Therefore, this study challenges the widely held concept that TMD patients are in general psychologically distressed. According to the findings of the present study, high levels of psychological dysfunction as measured on the SCL-90-R are likely to be associated with the presence of PTSD symptoms and not likely to be associated with TMD patients generally. Consequently, elevated SCL-90-R scores may indicate the presence of PTSD symptoms. This concept was further substantiated by the results of the MPI, which followed the same trend. TMD patients in the positive-PTSD subgroup presented with more life interference, affective distress, and punishing responses and less life control than TMD patients in the other subgroups. Taken together, these findings further support the necessity of PTSD screening of TMD patients.

The findings of the present study concur with other studies suggesting that MM pain patients report more psychological distress in general than TMJ pain patients.[21,22] This was supported by data from the SCL-90-R and MPI. The present results corroborated the findings of previous studies of TMD patients, which indicated that higher levels of psychological distress and life interference are found in MM patients than in TMJ pain patients.[22,24,56,57] The greater levels of life interference and affective distress in the MM group could be a consequence of the higher level of psychological distress in this group; psychological distress may interfere with a patient's coping skills. However, it was not possible to determine whether such an association existed with the present sample; further studies are needed to elucidate this matter.

There is most likely a relationship among chronic pain, PTSD, and the patient's capacity to cope with his or her pain. This is reflected in the finding that dysfunctional MPI profiles were more common than the adaptive coper profile amongst patients with PTSD symptomatology. The results of the present study are in accord with studies in which other chronic pain patients with PTSD symptomatology[4,9,58] presented more often with a dysfunctional profile than an adaptive coper profile. In addition, dysfunctional profiles may be associated with higher levels of anxiety[58] which, in turn, may exacerbate the pain condition.

A potential explanation for these findings is the dysregulation of the HPA axis, which has been associated with inadequate coping strategies for life stressors.[40] Alteration in the physiology of the HPA axis may then be related to somatic complaints such as myalgia, arthralgia, and sleep disturbances in the absence of a recognized pathologic condition.[39] In addition, early life events, such as preterm birth, parental divorce, or childhood abuse may result in physiologic vulnerability, expressed as persistent sensitization of the HPA axis.[32] In fact, dysregulation of the HPA axis has also been linked to the development of both chronic pain[20,40] and PTSD and is characterized by maladaptive behavior.[41] In turn, this maladaptive behavior can be understood as a lack of inhibitory control.[59] Living systems are described as "self-organizing dynamic systems" that combine autonomic, attentional, and affective systems into a functional and structural network.[59,60] These systems are controlled by inhibitory processes that allow them the required flexibility for adequate functioning via self-regulation and adaptability when challenged with environmental demands.[59,60] Thayer and Lane described how arousal associated with anxiety represents a disinhibition of circuits that are normally under inhibitory control.[60] Thus inhibitory failure may lead to "maladaptive behavior" at multiple levels of the organism which, in turn, may prevent recovery or a return to normal functioning.

Both MM and TMJ pain patients in the positive-PTSD subgroup reported more sleep problems on most scales of the PSQI than MM and TMJ pain patients in the no-stressor and negative-PTSD subgroups. This finding is not extraordinary if the presence of PTSD symptoms is considered. Indeed, according to the DSM-IV,[1] sleep disturbances are a symptom of PTSD. Because of the limitations of the present study design, it was not possible to determine whether the sleep disturbances reported in the present study were a response to the pain experience itself or whether they were associated

with PTSD. The sleep disturbances reported in the present study may have been associated with an overlap of symptoms between chronic pain and PTSD symptoms[13,54] and in turn may exacerbate the symptomatology of both conditions. On the other hand, it also could be a response to alterations of HPA axis, a common characteristic found in chronic pain patients as well as PTSD patients.[32] The HPA axis plays an important role in maintaining alertness and modulating sleep.[61] In addition, dysregulation of the HPA axis has been associated with sleep disturbance in a number of studies.[40,62] Regardless, sleep disturbances are remarkably common in chronic pain and in PTSD. They should be addressed, as they could be a major factor in the maintenance of chronic pain and PTSD symptomatology. In agreement with previous studies, significant differences were found between patients in the MM group and patients in the TMJ group.[24,63] More sleep disturbance was found among patients in the MM group. It is unlikely that these findings would be a consequence of increased pain severity[64] or increased pain duration,[23] since in the current study no significant differences were found in pain severity or duration between the 2 groups. A possible explanation for these findings could be the alteration of the functioning of the HPA axis.

Given the coexistence of chronic pain and PTSD, appropriate management of chronic pain patients with symptoms of PTSD may require concurrent treatment of both the anxiety disorder and the pain disorder. There are only a small number of studies addressing treatment outcomes in chronic pain patients with PTSD symptoms.[65,66] Research suggests favorable treatment outcomes are obtained when the symptoms of PTSD are targeted in chronic pain patients.[66] The fact that the TMD patients with PTSD symptomatology in the present study were more often classified as having a dysfunctional profile than an adaptive coper profile may further complicate interventions in such patients. Indeed, a dysfunctional profile has been related to poor treatment outcome overall in TMD patients and to treatment failure generally.[22] Failure to recognize psychological distress has been associated with poor treatment response[67] and prematurely abandoning treatment.[68] It is likely that the multiple coexisting factors contributing to chronic pain need to be addressed in order to treat it successfully. Thus, targeting PTSD symptoms may be a key factor in managing chronic pain patients with such symptomatology. The present study was not designed to evaluate treatment outcomes; however, it does demonstrate the need for well-designed longitudinal studies to answer questions such as whether management of PTSD would change treatment outcomes for chronic pain.

As discussed, the present study has limitations due to its retrospective design. It was not possible to determine a causal relationship between chronic pain and PTSD. It was also not possible to determine causal relationships among chronic pain, PTSD, and psychological distress or among chronic pain, PTSD, and sleep disturbances. Furthermore, this study was conducted with patients who sought treatment for their TMD problem in a tertiary care center, so the results can not be generalized to TMD patients seeking care in other settings.

A strength of this study is that strict inclusion criteria were implemented in each diagnostic group (MM and TMJ); only patients with primary diagnosis or either MM pain or TMJ pain were included in order to create a more accurate sample. These inclusion criteria resulted in precisely defined MM pain and TMJ pain populations, thus decreasing the likelihood for potential errors associated with differential diagnosis.

Conclusions

The present study replicates and extends the findings of previous investigations that addressed the relationship between chronic pain and PTSD symptoms. There was a trend suggesting a higher prevalence of PTSD symptomatology in the MM group compared to the TMJ group (14.9% versus 9.9%). This difference, however, was not statistically significant; consequently, the primary hypothesis was not confirmed. It was also found that MM pain patients presented with more life interference, affective distress, and sleep disturbances and less life control than TMJ pain patients, confirming and expanding the findings of previous studies addressing the differences between MM and TMJ pain patients. However, when the presence of PTSD was considered, these differences were mostly maintained in the subgroups without PTSD symptomatology. Hence, the presence of PTSD appears to modulate not only the level of psychological distress in TMD patients and sleep disturbances but also the differences between MM and TMJ groups. Further longitudinal research is necessary to explore the relationship between chronic pain and PTSD and to devise effective multidimensional treatment.

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