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Differences in Symptoms According to the Concordance Value Between Self-Reported Pain Sites and Standardized Palpation Pain Sites in Temporomandibular Disorder Patients: Pilot Study

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Purpose: The aims were to investigate potential differences in clinical assessments among acute pain-related temporomandibular disorder (TMD) with different concordance value (CV) between number of self-reported painful site (NSP) and number of painful sites on palpation (NPP), and if it makes sense to treat them differently.

Methods: A total of 61 patients were divided into three groups according to CV: 10 patients (concordance poor [CP]), 19 patients (concordance moderate [CM]), and 32 patients (concordance high [CH]). Clinical assessments were conducted using a standardized method in diagnostic criteria for temporomandibular disorders (DC/TMD). We compared collected information including sex, diagnosis, numerical rating scale (NRS), NPP, NSP, sleep duration, DC/TMD Axis II questionnaire, and perceived stress scale among three groups.

Results: Among the clinical assessment, NRS, sleep duration, NPP, NSP, total scores of Oral Behaviors Checklist, Patient Health Questionnaire (PHQ)-15, PHQ-9 showed significant differences among 3 groups. NRS, NPP, NSP, PHQ-15, and PHQ-9 were higher in the CP group than in the CM and CH groups. Sleep duration was positively and NPP, NRS were negatively correlated with CV.

Conclusions: While previous studies suggested differences between chronic and acute TMD in DC/TMD items, our findings propose the CV might be a key factor that could predict the severity and susceptibility of acute-TMD patients. However, Additional studies are required to determine whether their long-term prognosis was similar to that of chronic pain patients and what the response to treatment was among the three groups.

Keywords: Classification; Diagnosis; Myalgia; Myofascial pain syndromes; Psychology; Temporomandibular joint disorders

INTRODUCTION

Temporomandibular disorders (TMDs) is the second most common musculoskeletal disorder after chronic low back pain [1]. Individuals presenting with TMD often seek treatment primarily to manage their pain. According to Okeson [2], acute masticatory muscle disorder (MMD) can progress to chronic status if not promptly addressed. Chronic MMD

is more complex to treat than acute MMD due to centrally mediated effects [2]. Therefore, it is crucial for clinicians to differentiate between acute and chronic disorders to provide appropriate treatment. Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) is a valuable tool for assessing various factors relevant to pain management [3]. DC/TMD comprises a dual-axis system: Axis I provides a physical diagnosis of the TMD, while Axis II screen for pain intensity, psychosocial distress, and pain-related disability aiding in triaging, treatment planning, and estimating the patient's prognosis [3-5]. DC/TMD classifies the muscular TMD disorders into three subtypes: local myalgia, myofascial pain (MFP) with spreading and MFP with referral. Local muscle soreness and myalgia are considered acute-TMD while MFP or centrally mediated myalgia, are considered chronic-TMD [2,3].

However, distinguishing between myalgia and MFP can be challenging due to the varied pain descriptors used by patients, leading to potential confusion for clinicians. Sixty-five percent of individuals with TMD report recurrent pain, with changes in intensity and nature over time, potentially leading to under or over-representation of pain quality, intensity, and impact at the time of consultation [6]. Although the duration of pain may help differentiate between acute and chronic patients, understanding their respective clinical characteristics can facilitate the diagnosis of both. Studies on TMD often compare chronic pain-related TMD patients with those experiencing acute pain. According to previous studies, factors such as pain intensity, pain always being present, jaw activities, and interference play crucial roles in the transition from acute to chronic pain-related TMD [7]. Moreover, Compared to TMD patients diagnosed with MFP with referral, TMD patients diagnosed with local myalgia scored significantly lower on measures of depression, anxiety, somatic symptoms, pain catastrophizing, perceived stress, sick days, and insomnia [4,5,8-17]. However, when evaluating patients with acute TMD with DC/TMD, there were some patients who demonstrated a notable discrepancy between their self-reported pain and the actual pain diagnosed upon palpation, despite not clearly complaining of referred pain. Therefore, we propose that a more detailed categorization of patients diagnosed with acute pain by examining which clinical assessment items differ between these patients would enable a more sensitive approach to treatment.

The aims were to investigate potential differences in pain characteristics, including intensity of pain assessed by numerical rating scale (NRS), the number of self-reported painful (NSP) sites, and painful sites palpated by the clinician. Additionally, the study will examine psychosocial characteristics using the DC/TMD Axis II perceived stress scale (PSS) and sleep duration among pain-related patients, excluding those diagnoses with chronic TMD or MFP.

MATERIALS AND METHODS

1. Ethical Approval

This study was approved by the Institutional Review Board of Pusan National University Dental Hospital (IRB No. PNUDH-2023-05-011). All experimental procedures were performed in accordance with the principles of the latest revision of the Declaration of Helsinki. Upon their first visit, written informed consent was obtained in all patients.

2. Subjects

This study was conducted on 158 patients who presented to the Department of Oral Medicine, Pusan National University due to TMD problems, from January 2020 to February 2020. Participants were asked to complete DC/TMD and PSS questionnaire. The following exclusion criteria were applied: (1) patients with systemic conditions such as rheumatoid arthritis or fibromyalgia, (2) patients with MFP, (3) patients with chronic TMD who have had pain lasting for more than 3 months as defined by the IASP and DC/TMD [3,18], (4) patients with unresponsive items on the questionnaire.

All included 61 subjects were diagnosed using DC/TMD Axis I. We divided patients' diagnoses into arthralgia, myalgia (patients who did not experience pain but did report temporomandibular joint [TMJ] noise or limited jaw opening into the "other" category). They underwent a clinical assessment including age, sex, onset, NRS, sleep duration, number of NSP, and number of painful sites on palpation (NPP). Standardized palpation according to DC/TMD by two experienced orofacial pain specialists was performed on 9 sites on each side, for a total of 18 sites. The sites are 1)

superficial masseter, 2) deep masseter, 3) anterior temporalis, 4) posterior temporalis, 5) anterior digastric muscles, 6) posterior digastric muscles, 7) sternocleidomastoid muscles, 8) trapezius, and around the 9) lateral pole of the TMJ. NSP is the sum of the anatomically corresponding muscles and joint based on the self-drawn areas of DC/TMD pain drawing questionnaire.

Self-reporting instruments are including DC/TMD Axis II questionnaire: depression level (Patient Health Questionnaire [PHQ]-9), somatic symptoms level (PHQ-15), anxiety level (generalized anxiety disorder [GAD]-7), Graded Chronic Pain Scale (GCPS version 2.0), Jaw Functional Limitation Scale (JFLS), parafunction (Oral Behaviors Checklist [OBC]) and PSS questionnaire which measures about patient's perception of stress.

1) Patients grouping

The patients were grouped according to the concordance value (CV) (%) between the NSP and NPP. The formula for calculating CV was (The number of sites where the patient feels pain and palpation was positive/18 (Total palpation sites)*100). We categorized patients into three groups: concordance poor (CP), concordance moderate (CM), and concordance high (CH). Due to the kappa statistics have limited clinical applicability in pathology, we used the percentage of agreement to analyze the differences between patient and observer [19]. Grouping criteria by CV was 80% and 90% [19,20].

(1) CP: concordance score under 80%

(2) CM: concordance score between 80%-89%

(3) CH: concordance score over 90%

3. Statistical Analysis

IBM Statistical Package for the Social Sciences version (SPSS) 22.0 (IBM Corp.) was used for all statistical analyses. The chi-square test was used for analyzing the mean of each group's sex, types of pain. One-way ANOVA and Duncan post hoc test was used for knowing the distribution of NRS, age, sleep duration, NPP, NSP and total scores and each score of questionnaire items among CP, CM, CH groups. The correlation between and sleep duration, NRS, total score of OBC, PHQ-15, PHQ-9, PSS, NPP, NSP, and CV was verified by Pearson's correlation test. A multiple regression analysis a stepwise regression method was used to

Table 1. Clinical characteristics of the CP, CM, CH groups

Variable	CP (n=10)	CM (n=19)	CH (n=32)	p-value	Duncan
Sex					
Male	1 (10.0)	6 (31.6)	13 (40.6)	0.201	-
Female	9 (90.0)	13 (68.4)	19 (59.4)		
Age (y)	39.5±20.1	33.5±15.8	35.8±21.6	0.793	-
Types of pain					
Myalgia	5 (50.0)	2 (10.5)	6 (18.7)	0.070	-
Arthralgia	1 (10.0)	10 (52.5)	9 (28.1)		-
Mixed	3 (30.0)	4 (21.0)	5 (15.7)		-
Others	1 (10.0)	3 (16.0)	12 (37.5)		-
Psychologic disorder				N/A	
Depression	0 (0.0)	0 (0.0)	1 (3.1)		
Sleep disorder	0 (0.0)	1 (5.3)	0 (0.0)		
Anxiety disorder	0 (0.0)	0 (0.0)	0 (0.0)		
Others	0 (0.0)	0 (0.0)	1 (3.1)		
N/S	10 (100)	18 (94.7)	30 (93.8)		
NRS	5.7±2.06	3.84±2.54	2.69±2.52	0.005**	CP>CM, CH
Sleep duration (h)	6.00±2.16	7.16±1.37	6.89±1.12	0.111	CM>CP
NPP	6.00±3.56	3.11±2.16	1.75±2.00	<0.001***	CP>CM, CH
NSP	3.70±2.95	2.21±1.62	1.38±1.88	0.008**	CP>CM, CH

CP, concordance poor; CM, concordance moderate; CH, concordance high; N/A, not applicable; N/S, normal state; NRS, numerical rating scale; NPP, number of painful sites on palpation; NSP, number of self-reported painful site.
Values are presented as number (%) or mean±standard deviation.
The data was analyzed using chi-square test and one-way ANOVA with post hoc Duncan test.
**p<0.01, ***p<0.001.

investigate the effects of NRS, sleep duration, NPP on CV. p-value <0.05 was considered statistically significant.

RESULTS

1. Clinical Characteristics Using Axis I Diagnoses of the CP, CM, CH Groups

In comparing the sex differences, 90.0% of CP group, 68.4% of CM group, and 59.4% of CH group were females, but there was no statistically significant difference in the proportion of males to females among the three groups. There was no statistically significant difference in the mean age among the three groups (Table 1). In the CP group, myalgia was the most common symptom, occurring in 50% of the cases. In the CM group, arthralgia was the most common at 52.5%. In the CH group, joint-related TMDs were the most common (37.5%), and arthralgia was following at 28.1%. There was no statistical significance in comparing the diagnoses among the group (Table 1). We investigated whether any patient had been diagnosed with psychiatric disorder. There was one patient with a sleep disorder in CM group, one patient with depression and another with psychological disorder in CH group. The mean NRS at the 1st visit of CP, CM, and CH groups were 5.70 (2.06), 3.84 (2.54), 2.69 (2.52), respectively. The NRS was statistically significantly higher in the lower CV group (p<0.01). The mean

Table 2. Comparison of self-report instruments among the CP, CM, CH groups

	CP (n=10)	CM (n=19)	CH (n=32)	F-value	p-value	Duncan
OBC						
Total OBC	19.1 (7.46)	14.5 (6.05)	12.31 (6.53)	4.15	0.021*	CP>CH
OBC Q.1	2.2 (1.99)	0.47 (1.07)	0.78 (1.36)	5.29	0.008**	CP>CM, CH
OBC Q.5	1.8 (1.40)	0.21 (0.63)	0.63 (1.07)	8.10	0.001**	CP>CM, CH
OBC Q.13	0.4 (0.52)	1.26 (0.93)	0.69 (0.86)	4.29	0.018*	CM>CP, CH
OBC Q.16	2.4 (1.26)	2.21 (1.32)	1.16 (1.14)	6.53	0.003**	CP, CM>CH
OBC Q.21	0.9 (0.99)	0.58 (1.12)	0.19 (0.40)	3.60	0.034*	CP>CH
GCPS version 2.0						
Total GCPS	23.8 (25.9)	9.7 (16.9)	24.5 (25.3)	2.62	0.081	-
GCPS Q.6	2.30 (2.41)	3.33 (3.09)	1.26 (1.88)	4.35	0.018*	CM>CH
GCPS Q.8	1.70 (2.06)	2.78 (3.02)	0.87 (1.65)	4.23	0.019*	CM>CH
PSS						
Total PSS	17.8 (4.71)	15.6 (5.91)	14.7 (4.66)	1.41	0.253	-
PSS Q.2	1.80 (1.40)	0.21 (0.63)	0.63 (1.07)	8.10	0.001**	CP>CM, CH
PSS Q.10	0.4 (0.52)	1.26 (0.93)	0.69 (0.86)	4.29	0.018*	CM>CP, CH
JFLS						
Total JFLS	0.53 (1.65)	0.81 (1.69)	0.67 (1.58)	0.80	0.455	-
JFLS Q.12	4.40 (3.24)	4.00 (3.43)	1.84 (2.01)	12.6	0.008**	CP, CM>CH
GAD						
Total GAD	4.50 (2.88)	3.05 (4.31)	2.19 (3.12)	1.72	0.189	-
GAD Q.3	1.30 (1.06)	0.79 (0.92)	0.53 (0.72)	3.22	0.047*	CP>CH
PHQ-15						
Total PHQ-15	8.2 (5.35)	4.58 (3.61)	3.78 (4.26)	4.12	0.021*	CP>CM, CH
PHQ-15 Q.2	1.1 (0.88)	0.58 (0.61)	0.34 (0.55)	5.61	0.006**	CP>CM, CH
PHQ-15 Q.14	1.2 (0.63)	0.58 (0.51)	0.59 (0.76)	3.50	0.037*	CP>CM, CH
PHQ-15 Q.15	1.1 (0.74)	0.37 (0.59)	0.50 (0.72)	3.96	0.024*	CP>CM,CH
PHQ-9						
Total PHQ-9	8.1 (4.7)	3.95 (4.70)	3.84 (4.90)	3.22	0.047*	CP>CM, CH
PHQ-9 Q.3	1.60 (0.97)	0.68 (1.06)	0.74 (0.93)	3.40	0.040*	CP>CM, CH

CP, concordance poor; CM, concordance moderate; CH, concordance high; OBC, Oral Behavior Checklist; GCPS, graded chronic pain scale; PSS, perceived stress scale; JFLS, jaw functional limitation scale; GAD, generalized anxiety disorder; PHQ-15, Patient Health Questionnaire-15; PHQ-9, Patient Health Questionnaire-9.
Values are presented as mean (standard deviation).
The data was analyzed using one-way ANOVA with post hoc Duncan test.
*p<0.05, **p<0.01.

NPP of CP, CM, and CH groups were 6.00 (3.56), 3.11 (2.16), and 1.75 (2.00). In addition, the mean NSP of CP group, CM group and CH group were 3.70 (2.95), 2.21 (1.62), and 1.38 (1.88). The lower CV group had a higher number of painful areas on palpation ($p<0.001$) and self-reported painful areas ($p<0.001$) (Table 1).

2. Comparison of Self-Report Instruments among the CP, CM, CH Groups

In Axis II and PSS questionnaire, the total score for OBC was significantly higher in CP group than CH group ($p<0.05$). OBC Q.1 (clench or grind teeth when asleep, based on any information you may have) and Q.5 (press, touch, or hold teeth together other than while eating) were higher in CP group than CM and CH groups ($p<0.01$). PHQ-15 and PHQ-9 were significantly higher in CP group than CM and CH groups ($p<0.05$). In PHQ-15 Q.2 (back pain), Q.14 (feeling tired or having low energy), and Q.15 (trouble sleeping) showed higher scores in CP group than CM and CH group. In PHQ-9 Q.3 (trouble falling or staying asleep, or sleeping too much) showed higher scores in CP group than CM and CH group. PSS Q.2 (in the last month, how often have you felt that you were unable to control the important things in your life?) was higher in CP group than CM and CH group (Table 2).

3. Correlation between Clinical Factors and CV

CV was positively correlated with patients' sleep duration ($p<0.05$) and negatively correlated with NRS ($p<0.01$), total score of OBC ($p<0.01$), PHQ-15 ($p<0.05$), and NPP and NSP (all $p<0.001$, respectively) (Table 3). A multiple regression analysis a stepwise regression method was performed to investigate what variables have important effect on CV. As a result of the analysis, we found that 3 variables (NPP, sleep duration, and NRS) can account for 53.3% on the CV ($p<0.001$) (Table 4). A comparison of the β-values was conducted to determine the relative importance of the factors affecting CV and NPP (β=−0.58) had the strongest effect, followed by sleep duration (β=0.34), and NRS (β=−0.21). Over all these results suggested that the longer sleep duration, the lower NRS and NPP, the higher CV is (Table 4).

Table 3. Correlations between variables and concordance values

Physical activity	Sleep duration	NRS	NSP	NPP	Total OBC	Total PHQ-15	Total PHQ-9
r	0.277	−0.396	−0.455	−0.623	−0.341	−0.319	−0.227
p-value	0.031*	0.002**	<0.001***	<0.001***	0.007**	0.012*	0.079

NRS, numerical rating scale; NSP, number of self-reported painful site; NPP, number of painful sites on palpation; OBC, oral behavior checklist; PHQ-15, Patient Health Questionnaire-15; PHQ-9, Patient Health Questionnaire-9.
r=Pearson's correlation coefficient; p-values were obtained by Pearson's correlation.
*p<0.05, **p<0.01, ***p<0.001.

Table 4. Associations for concordance value with NPP, sleep duration, NRS by multiple linear regression analysis

	Unstandardized coefficients		Standardized coefficients	t	p-value	Collinearity statistics	
	B	SE	β			Tolerance	VIF
Constant	81.5	5.06		16.1	<0.001***		
NPP	−2.338	0.39	−0.58	−5.92	<0.001***	0.867	1.15
Sleep duration	2.618	0.71	0.34	3.68	0.001**	0.993	1.01
NRS	−0.88	0.41	−0.21	−2.15	0.036*	0.870	1.15

NPP, number of painful sites on palpation; NRS, numerical rating scale; B, regression coefficient; SE, standard error; β, standardized coefficient; VIF, variation inflation factor.
R^2=0.533, adjusted R^2=0.509; F=17.100, p<0.001, Durbin-Watson (1.834).
A stepwise regression method was utilized. A multiple regression analysis was performed.
*p<0.05, **p<0.01, ***p<0.001.

DISCUSSION

This study aimed to categorize patients diagnosed with acute TMD according to CV and determine if there are differences in physical and psychosocial factors among the groups. In regard to Axis I and Axis II pathology, CP, CM, and CH group had several significant differences in the clinical assessments. NRS, NSP, NPP, sleep duration, Total scores of OBC, PHQ-15, and PHQ-9 were statistically significant variables. The mean value of NRS at the initial visit was higher in the CP group. Several studies have demonstrated that NRS at the initial visit is associated with the persistence of TMD pain. The higher the pain intensity, the more severe the TMD pain experienced by the patient six months later [21-24]. The Garofalo et al. [11] and Epker and Gatchel [25] concluded that the characteristic pain intensity score at baseline was positively associated with the risk of acute to chronic TMD pain transition means, the NRS score at initial visit contributes to the transition from acute to chronic pain [21-24,26]. This indicates that the lower the CV, the greater the potential for conversion to chronic pain later.

In PHQ-9 questionnaire, Scores of 5, 10, 15, and 20 represent cut-points for mild, moderate, moderately severe and severe depression, respectively [27]. The CP group belonged to mild depression, while the CM and CH groups did not belong to depressive disorder. PHQ-15 scores of 5, 10, 15, represented cutoff points for low, medium, and high somatic symptom severity, respectively [28]. Q.3 of the PHQ-9 "Trouble falling or staying asleep, or sleeping too much" and Q.15 of the PHQ-15 "Trouble sleeping," were both items that were associated with sleep quality. CP group scored significantly higher than the CM and CH groups on both of these items. Additionally, sleep duration was positively correlated with CV (Table 4). Poor sleep quality has been linked to increased pain sensitivity and reduced pain threshold in TMD [9,29]. Additionally, insomnia has been identified as a risk factor for the development of chronic disease in individuals who are otherwise healthy. Among TMD patients, the association was found to be stronger in those with chronic, persistent, and radiating muscle pain, and weaker if the pain was mild or intermittent [9]. These findings indicate that the patient's sleep status is a crucial factor in the diagnosis of TMD. Even in patients with acute rather than chronic pain, those with low sleep duration and poor sleep quality are more likely to experience severe pain.

The OBC total score was significantly higher in the CP group than in the CH group. All three groups belong to low parafunction, but the lower the concordance, the higher the total OBC score [3]. Van der Meulen et al. [30] found that OBC scores were significantly associated with pain intensity and stress, depression, somatization ,and anxiety. Since OBC score was correlated negatively with CV (Table 4), it is worth noting that if patients have high OBC scores, they may also have high scores on other psychologic factors and chronic pain symptoms. Furthermore, although not statistically significant, total PSS and GAD increased as the CV decreased. Previous studies have revealed that individuals diagnosed with acute TMD scored significantly lower levels of depression, anxiety, somatic symptoms, pain catastrophizing, perceived stress, the number of sick days, and insomnia compared to those diagnosed with chronic TMD [5,12,31]. Additionally, Wright et al. [32] also found that among patients with acute TMD, those with a high conversion rate to chronic pain had higher levels of depression, GAD, somatization, and more self-reported pain than those with a low conversion rate. The trends seen in chronic patients in previous studies were also seen in patients with lower CV in our study. It provides the possibility of acute pain-related TMD patients with lower CV exhibit the clinical characteristics of chronic pain-related TMD patients.

In the multiple linear regression model, the variable NPP, Sleep duration, and NRS had the highest impact on CV of acute-TMD patients (Table 4). Previous studies indicate the intensity and location of pain and poor sleep quality in the MFP are more pronounced than in myalgia [5,8-13,15,26,33]. Our study suggests that patients with lower CV in acute-TMD patients have symptoms that are more characteristic of chronic patients than acute patients. Therefore, patients with less sleep duration, high intensity and location of pain should be approached similarly to how chronic patients are treated, rather than simply being labeled as myalgia.

This study has several limitations. First, given the small sample size, it is challenging to assert that the study results accurately represent each group, potentially leading

to imbalances in statistical power. Therefore, employing larger and similarly sized samples is necessary to enhance the validity and reliability of the findings across all groups. Second, since our study was retrospective, clinical assessments conducted by two orofacial pain specialists were utilized, and inter-rater reliability was not evaluated. Third, as the study was a retrospective case-control study, it was unable to assess subsequent treatment responses or long-term treatment outcomes for the patients. However, we speculate that the relationship between CV and progression to chronic pain will be more evident in future studies that address these limitations, given the results of our pilot study.

In conclusion, our study suggests that with lower CV-TMD patients' physical and psychiatric diagnoses especially in OBC, PHQ-9, PHQ-15, and sleep duration, the pain intensity was similar to those of chronic pain patients. Further studies are needed to determine whether their long-term prognosis of patients with lower CV actually leads to chronic pain related TMD, and whether are less likely to respond to treatment as chronic patients.

CONFLICTS OF INTEREST

Soo-Min Ok and Hye-Min Ju serve on the editorial board of the *Journal of Oral Medicine and Pain*. But they have no role in the decision to publish this article. Except for that, no potential conflict of interest relevant to this article was reported.

DATA AVAILABILITY STATEMENT

The datasets used in this study are available from the corresponding author upon reasonable request.

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AUTHOR CONTRIBUTIONS

Conceptualization: HMJ, JWJ. Data curation: SYC, SHJ, SMO. Formal analysis: HMJ. Funding acquisition: HMJ. Investigation: HMJ. Methodology: HMJ. Project administration: HMJ. Resources: YWA. Software: JWJ. Supervision: HMJ. Validation: JWJ. Visualization: JWJ. Writing - original draft: JWJ. Writing - review & editing: HMJ. All authors have read and agreed to the published version of the manuscript.

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