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Comparison of the Biopsychosocial Features of Myofascial Pain to Local Myalgia in Patients with Temporomandibular Disorders

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Purpose: This study aimed to investigate whether and how the biopsychosocial features of myofascial pain (MFP) differ from those of local myalgia (LM) in temporomandibular disorder (TMD).

Methods: Patients with TMD were retrospectively evaluated using the Diagnostic Criteria for TMD. All patients completed a series of self-administered questionnaires on pain severity and pain interference (Brief Pain Inventory, BPI), pain disability (Graded Chronic Pain Scale, GCPS), psychological distress (Symptom Check List-90-Revised, SCL-90R), pain cognition (Pain Catastrophizing Scale, PCS), and subjective sleep quality (Pittsburgh Sleep Quality Index, PSQI). Among all the TMD diagnoses, muscle pain was classified into the MFP group and LM group.

Results: This study included 917 patients with myalgia (MFP: 266, LM: 651). Significant differences were observed in the female ratio (78.9% for MFP, 60.9% for LM, $p<0.001$) and the mean pain duration (MFP: 25.3 months, LM: 15.8 months, $p=0.001$) between the two groups. Patients with MFP exhibited higher pain severity ($p=0.003$) and pain interference ($p<0.001$) of BPI than those with LM. Furthermore, the global scores of the PCS ($p<0.001$) and PSQI ($p<0.001$) were higher in the MFP group than in the LM group. The MFP group had higher global symptom index ($p=0.017$) and five subscales of the SCL-90R than the LM group. Compared with the LM group (33.4%), the greater proportion of high disability of GCPS was observed in the MFP group (44.9%) ($p<0.001$). Multiple regression analysis revealed that sex ($p=0.002$), pain duration ($p=0.019$), pain disability ($p=0.010$), and subjective sleep quality ($p=0.008$) significantly differed between the two groups.

Conclusions: The findings of this study indicated that MFP presents a higher biopsychosocial burden than LM in TMD.

keywords: Biopsychosocial; Myalgia; Myofascial pain syndromes; Pain; Temporomandibular joint disorders

INTRODUCTION

The clinical symptoms of temporomandibular disorder (TMD) can be thought of as a collection of phenotypes impacted by a variety of biopsychosocial factors, such as pain sensitivity, pain disability, sleep, and psychosocial functioning [1]. Therefore, a successful TMD management requires a deep understanding of its various clinical phenotypes based on evidence-based diagnosis and classification into homogeneous population [2].

The Research Diagnostic Criteria for TMD (RDC/TMD) and the Diagnostic Criteria for TMD (DC/TMD), a subsequent

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version of RDC/TMD, which are based on the biopsychosocial model of pain, are the most extensively used methods for TMD evaluation [3,4]. One of the significant changes in the diagnoses of TMD in the new DC/TMD is the diagnostic classification for masticatory muscle disorders. What was represented as myofascial pain (MFP), which was only one diagnosis of muscle disorders in the RDC/TMD, is now known as myalgia in the updated version. Furthermore, myalgia in the DC/TMD was given a new categorization, separating it into three subcategories: local myalgia (LM), MFP with spreading, and MFP with referral [4]. According to the definition of LM in the DC/TMD, this type of pain has a muscle origin and is exclusively felt at the palpation site [4]. The DC/TMD also changed the definition of MFP. The MFP with spreading of the DC/TMD adopted the definition of pain spreading beyond the palpation site but within the boundary of the muscle being palpated, unlike the MFP of the RDC/TMD, which describes the symptoms of pain in the jaw, temples, face, preauricular area, or inside the ear at rest or during function and the signs of evoked pain on palpation of related muscles [5]. MFP with referral is defined as pain at a point outside the area of the muscle being palpated [4]. In other words, the MFP of the RDC/TMD is different from that of the DC/TMD in that it is a broader concept for masticatory muscle pain than the latter and does not necessarily require a trigger point for spreading or referral of pain. Henceforth, the term "MFP" used in this study indicates the definition presented by DC/TMD.

From a clinical point of view, MFP can be differentiated from LM. MFP, which develops from myofascial trigger points known as hypersensitive spots in the skeletal muscles, can have long-distance impacts on the body's motor and autonomic functions, mood, and sleep [6-10]. It is well recognized that myalgia is more prevalent than arthralgia in TMD and is affected by various psychosocial factors, including pain perception, psychological distress, and sleep quality [11-14]. However, considering few comparative studies in a sizable sample on the biopsychosocial features among the various myalgia subtypes [15], a study on the characterization and differentiation of biopsychosocial features of MFP from LM deserves to be considered.

The objectives of this study were to investigate whether and how the biopsychosocial features of MFP differ from LM in TMD. The hypothesis was that multidimensional biopsychosocial features, including pain experience, psychological distress, pain catastrophizing, and subjective sleep quality, would be different between the two clinical diagnoses.

MATERIALS AND METHODS

This cross-sectional study is a secondary analysis of existing data of our previously published primary study (IRB no. 2018-03-003). In the published study [13], the quantitative and qualitative gradients of pain experience, sleep quality, and psychological distress were investigated in 1,858 patients with four different phenotypes of TMD (Fig. 1). Additional analyses on the original dataset focused on patients with myalgia [13].

1. Subjects

This study included a total of 1,858 TMD patients aged over 18 years who sought treatment for TMD for the first time at the Orofacial Pain Clinic of Dankook University Dental Hospital in Cheonan, Korea, over a 2-year period from 2016 to 2017. Before the diagnosis, all the participants were requested to complete the questionnaires. The exclusion criteria were the same as those in our previous study [13].

The DC/TMD was used by skilled orofacial pain specialists to evaluate the patients. All TMD patients were divided into four groups (Groups 1, 2, 3, and 4) according to the DC/TMD categorization (Fig. 1). In addition, patients with muscle pain (Groups 3 and 4) were classified into the MFP group and LM group. The MFP group in the present study included patients with MFP with spreading and MFP with referral. Contrarily, the LM group included patients with myalgia with pain only at the palpation site.

2. Self-Reported Questionnaires

The self-reported questionnaires used in the present study were identical to those in our previous study [13].

1) Brief Pain Inventory (BPI)

One of the most widely used assessment tools for clinical pain evaluation is the BPI, a brief, straightforward

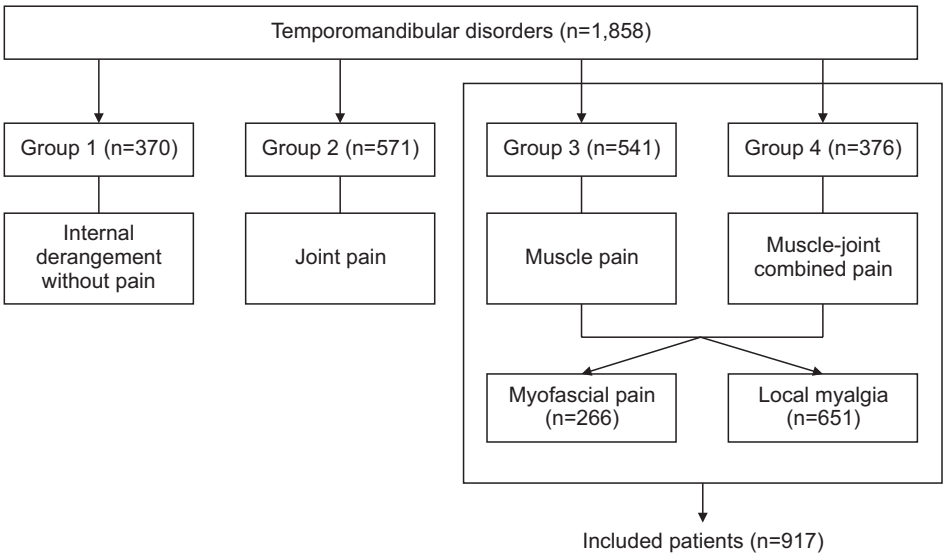

Fig. 1. Flow chart of the included patients.

questionnaire [16]. The pain intensity and interference were rated on a 0-10 scale. The four pain components, "worst," "least," "average," and "now," make up the BPI's measure of pain intensity. Seven questions make up the BPI's pain interference scale, which assesses how much pain has affected sleep, walking, job, mood, enjoyment of life, and relationships with others. The item measuring "walking ability" was replaced by "chewing ability" in relation to orofacial pain in the Korean version of the BPI [17]. The responses were based on the week preceding the BPI's completion.

2) Graded Chronic Pain Scale (GCPS)

The GCPS assesses the severity of chronic pain and consists of seven items on pain intensity, disability days, and interference with daily activities [18]. The GCPS is graded from 0 to IV: with each grade indicated as follows: grade 0, no pain; grade I, low intensity; grade II, high intensity; grade III, high disability; grade IV, high disability and severely limiting.

3) Pain Catastrophizing Scale (PCS)

The PCS, created by Sullivan et al. [19] in 1995, relate to how frequently participants encounter thoughts and feelings related to their pain. There are 13 items on a 5-point scale, with 0 indicating never and 4 indicating always. A total score and three subscale scores for rumination, magnification, and helplessness are produced by the PCS.

4) Symptom Check List-90-Resived (SCL-90R)

Using 90 items from the SCL-90R, the respondent's degree of psychological health was evaluated [20]. On a 5-point Likert scale (0, not at all; 4, very), the responders are asked to rate how much each of the 90 items in the survey annoyed them in the preceding 7 days. From the 90 items, the nine symptom dimensions (somatization, obsessive–compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism) and global symptom index (GSI) are evaluated.

5) Pittsburg Sleep Quality Index (PSQI)

The PSQI is a set of 19 self-reported questions that assesses a variety of sleep quality factors [21]. Seven component scores were extracted from 19 items, with each value ranging from 0 to 3. The total PSQI score, ranging from 0 to 21, was derived from the sum of these seven component scores; higher scores indicated lower sleep quality.

3. Statistical Analysis

Using Pearson's chi-square test, the influence of sex and disability level was examined for comparisons between patients with MFP and patients with LM. The impact of age, clinical pain data, sleep quality, and psychological characteristics on the two muscle groups was also examined using an independent t-test. To predict discriminating factors for MFP from LM, multiple logistic regression analysis was conducted for multiple biopsychosocial factors. For all

analyses, the significance level was fixed to 0.05. The PASW Statistics for Windows, Version 18.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

1. Included Subjects

Fig. 1 presents the flow of the included subjects in the present study. Of the 1,858 patients, Group I (internal derangement without pain) and Group 2 (joint pain only) were excluded, and patients with muscle pain were included in Group 3 (muscle pain) and Group 4 (muscle–joint combined pain). Among the 917 patients from Group 3 (n=541) and Group 4 (n=376), 651 patients (71.0%) were diagnosed with LM and 266 (29.0%) with MFP (Table 1).

2. Comparison of the Demographic Characteristics of Patients with Myofascial Pain to Patients with Local Myalgia

The patients' demographic characteristics are presented in Table 1. The sex ratios between the two groups were different. Compared with patients with LM (60.9%), those with MFP had a significantly higher proportion of female (78.9%) (p<0.001). Patients with MFP experienced pain for an average of 25.3 months, whereas those with LM reported pain for an average of 15.8 months (p=0.001). Contrary to sex and pain duration, age did not significantly differ between the two groups (p=0.247).

Table 1. Comparison of the demographic characteristics between patients with myofascial pain and those with local myalgia

Demographics	Myofascial pain	Local myalgia
Patient number	266 (29.0)	651 (71.0)
Female sex	210 (78.9)	397 (60.9)
Pearson chi-square (p-value)	27.233 (p<0.001)	
Age (y)	37.5±14.8	36.2±16.0
t-value (p-value)	1.157 (p=0.247)	
Pain duration (mo)	25.3±45.8	15.8±35.7
t-value (p-value)	3.344 (p<0.001)	

Values are presented as number (%) or mean±standard deviation.
Pearson's chi-square test was used to determine the sex difference between the two groups. Independent t-tests were used to compare the age and pain duration in the two groups.

Table 2. Comparison of the biopsychosocial features between patients with myofascial pain and those with local myalgia

Biopsychosocial features	Myofascial pain	Local myalgia	t-value	p-value
BPI				
Pain severity	4.1±2.1	3.6±2.3	3.009	0.003
Pain interference	4.3±2.6	3.6±2.5	3.687	<0.001
PCS				
Magnification	4.80±3.12	3.97±3.07	3.714	<0.001
Rumination	5.96±4.64	5.13±6.19	1.978	0.048
Helplessness	8.32±6.51	6.34±5.08	4.920	<0.001
Global score	19.1±12.6	15.4±12.5	3.990	<0.001
SCL-90R				
Somatization	49.58±9.36	47.42±8.82	3.300	0.001
Obsessive - compulsive	44.45±10.54	42.89±9.81	2.139	0.033
Interpersonal sensitivity	43.72±10.32	43.33±14.09	0.418	0.676
Depression	44.48±11.20	42.79±9.54	2.303	0.021
Anxiety	45.13±9.89	44.43±21.89	0.501	0.617
Hostility	46.12±8.59	44.63±7.81	2.544	0.011
Phobic anxiety	45.77±9.69	44.98±8.31	1.234	0.217
Paranoid ideation	43.21±8.34	42.94±14.08	0.294	0.769
Psychoticism	44.19±8.57	43.01±7.68	2.053	0.040
GSI	44.70±10.42	43.05±9.27	2.346	0.017
PSQI				
Global score	9.5±3.7	8.3±3.4	4.601	<0.001

BPI, Brief Pain Inventory; PCS, Pain Catastrophizing Scale; SCL-90R, Symptom Check List-90 Revised; GSI, Global Symptom Index; PSQI, Pittsburg Sleep Quality Index.
Values are presented as mean±standard deviation.
p-values were determined using independent t-test.

3. Comparison of the Biopsychosocial Features of Patients with Myofascial Pain to Patients with Local Myalgia

As presented in Table 2, patients with MFP exhibited significantly higher pain severity (p=0.003) and pain interference (p<0.001) than those with LM. The global score (p<0.001) and the three subscales of magnification (p<0.001), rumination (p=0.048), and helplessness (p<0.001) were significantly higher in the MFP group than in the LM group. Five of the nine SCL-90R subscales, namely, somatization (p=0,001), obsessive–compulsive (p=0.033), depression (p=0.021), hostility (p=0.011), and psychoticism (p=0.040), and the GSI (p=0.017) were significantly greater in the MFP group than in the LM group. In terms of interpersonal sensitivity, anxiety, phobic anxiety, or paranoid ideation, no statistically significant difference was observed between the two groups. In addition, the MFP group had a mean PSQI score higher than that of the LM group (p<0.001). Compared with the group LM (33.4%), the MFP group (44.9%) had a substantially greater proportion of high disability (Grades III and IV) (Table 3, p<0.001).

4. Multiple Logistic Regression Analysis to Predict the Biopsychosocial Features of Myofascial Pain Distinct from Local Myalgia

To investigate the biopsychosocial features of MFP distinct from LM in patients with TMD, multiple logistic regression analysis was conducted. In the analysis, multidimensional factors, including demographic features, pain severity and pain experience from BPI, pain disability from

Table 3. Comparison of the pain disability between patients with myofascial pain and those with local myalgia

GCPS	Myofascial pain	Local myalgia	p-value (chi-square)
Low disability			
Grade I	86 (32.3)	308 (47.3)	p<0.001 (3172.1)
Grade II	47 (17.6)	125 (19.2)	
Total	133 (49.9)	433 (66.5)	
High disability			
Grade III	74 (27.8)	152 (23.3)	
Grade IV	59 (22.1)	66 (10.1)	
Total	133 (49.9)	218 (33.4)	

GCPS, Graded Chronic Pain Scale.
Values are presented as number (%).
The sum of Grades I and II indicates low disability, whereas the sum score of Grades III and IV represents high disability.
p-values were determined using Pearson's chi-square test.

Table 4. Multiple logistic regression analysis to predict the biopsychosocial features of myofascial pain distinct from local myalgia

Biopsychosocial features	df	Exp (B)	95% CI	p-value
Demographics				
Sex	1	0.575	0.406-0.816	0.002[a]
Age	1	0.998	0.988-1.007	0.654
Pain duration	1	0.996	0.992-0.999	0.019[a]
BPI				
Pain severity	1	1.005	0.909-1.112	0.915
Pain interference	1	1.008	0.917-1.108	0.862
PCS				
Global score	1	0.994	0.980-1.009	0.447
SCL-90R				
GSI	1	1.003	0.986-1.021	0.740
PSQI				
Global score	1	0.940	0.898-0.984	0.008[a]
GCPS				
Pain disability	3			0.010[a]
Dummy 1		2.605	1.479-4.588	0.001
Dummy 2		2.028	1.184-3.475	0.010
Dummy 3		1.609	1.002-2.585	0.049
Constant	1	3.675		0.011

BPI, Brief Pain Inventory; PCS, Pain Catastrophizing Scale; SCL-90R, Symptom Check List-90 Revised; PSQI, Pittsburg Sleep Quality Index; GCPS, Graded Chronic Pain Scale; GSI, Global Symptom Index.
[a]The values are significantly different (p<0.05).
p-values were determined using multiple logistic regression analysis. Hosmer-Lemeshow test: X^2=10.641; df=8; p-value=0.223.

GCPS, subjective sleep quality from PSQI, catastrophizing from PCS, and psychological distress from SCL-90R, were input as independent variables for the dependent factor of binary diagnosis (MFP and LM) (Table 4). Among multiple biopsychosocial factors, sex (p=0.002), pain duration (p=0.019), pain disability (p=0.010), and subjective sleep quality (p=0.008) significantly differed between the two groups. In the multiple logistic regression analysis, no statistically significant differences were observed in age (p=0.654), pain experience from pain severity (p=0.915) and pain interference (p=0.862), pain catastrophizing (p=0.447), and psychological distress from SCL-90R (p=0.740). The model fitness was checked using the Hosmer–Lemeshow goodness-of-fit statistic (p-value=0.223).

DISCUSSION

This study explored and compared the various biopsychosocial characteristics between patients with MFP and patients with LM in a sample of 917 TMD patients with myalgia. Patients with MFP exhibited distinct features from those with LM in various biopsychosocial aspects. Particularly, these differences were more prominent in sex, pain duration, pain disability, and subjective sleep quality.

Females in the MFP group had significantly higher prevalence than those in the LM group in this study. The significant impact of sex on TMD pain has been demonstrated with more than twice the risk factor for female [22]. The pain threshold of female is typically lower than that of male [23-25], and it has been reported that sex hormones play a significant role in the change of nociceptive pain sensitivity [26]. In general, female sex is more vulnerable to pain catastrophizing, depression, and anxiety with high disability than male sex [27,28]. These unique sex differences in pain experience and psychological distress support the female dominance in the MFP group in this study.

Although the etiology of MFP is controversial, it is currently acknowledged as a complex interaction between peripheral nociception and central sensitization [8]. Considering the pathophysiologic feature of central sensitization of MFP [29], it is conceivable that patients with MFP experience the pain for a longer period of time, with greater intensity and interference and higher pain disability than those with LM. The central sensitization of MFP may have a more pronounced effect on the "sensory" dimension (severity) and "reactive" dimension of pain (interference with daily function) than LM. The persistence, amplification, and spread of pain due to central sensitization may play a significant role in high pain intensity in patients with MFP [30-33].

The present study found that the subjective sleep quality was lower in patients with MFP than in those with LM. A recent systemic review on the association between sleep and TMD reported that poor subjective sleep quality increases the odds ratio of TMD prevalence more than four times and suggested that sleep plays a significant role in TMD pain [34]. There are many studies on the sleep quality of patients with chronic pain, including MFP [35-38].

Prominent poor sleep quality in patients with chronic TMD pain has been extensively described in the form of comorbidities of chronic pain, including high pain disability, elevated depression, and anxiety [14,39,40]. Although chronic pain and high psychological distress is relevant to sleep quality, the myofascial trigger point, a unique pathophysiological feature of the MFP, should also be considered in the relationship between pain and sleep. Although the results are still controversial [41-43], there is a study of the positive relationship between the presence of an active myofascial trigger point and sleep disturbance [41]. The dose–response relationship between the number of active myofascial trigger points and poor sleep quality was also reported [42]. Considering the possible reciprocal vicious cycle between the presence of myofascial trigger points and sleep, the treatment strategy should be focused on not only relieving trigger points but also improving the sleep quality of patients with MFP.

The present study found that the global score and three subscales of pain catastrophizing were significantly higher in the MFP group than in the LM group. This result indicates that patients with MFP seem to be more focused on pain, more exaggerated, and more unlikely to be able to effectively manage pain conditions than patients with LM. High pain catastrophizing can cause chronicity by repeating a vicious circle in which the pain disability of patient with MFP may be sustained and exacerbated.

Pain catastrophizing can be dependent on the degree of

pain chronicity [44-46]. The higher pain catastrophizing in patients with MFP than in patients with LM may be attributed to the longer pain duration of the MFP group in the present study. This result indicates that patients with MFP might be more vulnerable to catastrophizing cognition due to pain chronicity and high disability. Therefore, recognition of catastrophizing level and intervention for psychological support are essential for long-term coping strategy in patients with chronic MFP. The present study also found that psychological distress evaluated using the SCL-90R was higher in the MFP group than in the LM group. The elevated psychological distress in patients with MFP can be considered associated with the intensification and spreading of pain due to central sensitization, pain chronicity, and comorbid conditions [47,48].

Among multiple biopsychosocial features of MFP that are different from LM, the outcome of the multiple logistic regression analysis of the present study highlighted the particular importance of sex, pain duration, pain disability and sleep quality as critical features of MFP.

These results indicate that MFP is a clinically distinct entity in terms of multidimensional biopsychosocial aspects from LM due to central sensitization and thus the treatment for MFP should be considered in a different way from LM. The findings of this study should be interpreted in the context of several limitations. First, when evaluating the homogeneity of the included participants, it should be considered that myalgia extracted from the group with muscle–joint combined pain may have the comorbid Axis I diagnosis (e.g., arthralgia, osteoarthritis) apart from myalgia. Therefore, caution is required when interpreting that the pain of patients with MFP and LM can be inhomogeneous. Although the present study included myalgia extracted from the group with muscle–joint combined pain, further research is required to verify whether the same outcomes will be obtained from the subgroups of myalgia without joint pain.

As another consideration in the present study, the MFP was not classified into pain with and without the presence of referred pain. It is generally established that two conditions are quite different in presenting pain experience, pain disability, sleep quality, and mood [41,43]. Further study comparing MFP with and without referral would give more insights into the underlying mechanism of MFP.

Despite the methodological shortcomings, the strengths of this study deserve to be acknowledged. Unlike a recent study that compared the Axes I and II of the DC/TMD in patients with LM and MFP [15], the present study compared the biopsychosocial features of the LM group with those of the MFP group using the extended Axis II spectrum, including pain catastrophizing and sleep quality. To the best of the authors' knowledge, this is considered to be the first to compare pain cognition and sleep quality between the LM and MFP groups in TMD. Compared with the well-known clinical characteristics of subgroups of myalgia, studies exploring the biopsychosocial features of MFP and LM are uncommon. Taking this into account, the findings of the present study will be useful in understanding the biopsychosocial differences between the two subgroups of myalgia.

In conclusion, in this cross-sectional study, there were distinct biopsychosocial features between patients with MFP and those with LM. The MFP group presented a higher biopsychosocial burden than that with LM. This study would contribute to a better understanding of the Axis II component of patients with MFP, which brings us one step closer to developing tailored diagnosis and management based on biopsychosocial phenotypes.

CONFLICT OF INTEREST

Hye-Kyoung Kim has been the Editor-in-Chief of the Journal of Oral Medicine and Pain since April 1, 2022. Mee-Eun Kim serves as an editor 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.

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