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ORIGINAL ARTICLE

Correlations between masticatory muscle activity, quality of life, and dysfunction severity in women with chronic temporomandibular disorder

Relação entre atividade elétrica mastigatória, qualidade de vida e gravidade da disfunção em mulheres com disfunção temporomandibular crônica

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ABSTRACT

BACKGROUND AND OBJECTIVES: Assessing the possible interactions between the activity of masticatory muscles and quality of life and severity of the temporomandibular disorder can help clarify how changes in muscle activity can be associated with a chronic temporomandibular disorder in women. This study aimed to investigate the correlations between masticatory electrical activity during mandibular resting, maximum voluntary contraction, the severity of the temporomandibular disorder, and quality of life in women with chronic temporomandibular disorder and to compare these parameters with healthy asymptomatic controls.
METHODS: Sixty women, 30 with temporomandibular disorder and 30 asymptomatic, participated in this case-control observational study. Diagnostic Criteria for Temporomandibular Disorder was used to identify the presence or absence of temporomandibular disorder. The SF-36 questionnaire was used to assess the quality of life in participants, and ProTMD-multi-part-II was applied to assess the severity of signs and symptoms of temporomandibular disorder.
RESULTS: During jaw clenching, the masticatory activity of the right temporal and left masseter muscles, the symmetry of the masseter muscles, and anteroposterior coefficient were significantly smaller in the temporomandibular disorder group than in the asymptomatic group. Masticatory activity at rest, signs and symptoms of chronic temporomandibular disorder, and impairment of the quality of life were correlated using Spearman coefficient (p<0.05).
CONCLUSION: Our results contribute to findings on the associations between the masticatory activity in chronic signs and symptoms of the temporomandibular disorder, impairment in quality of life, and differences in the masticatory activity during clenching in patients with temporomandibular disorder and controls.
Keywords: Chronic pain, Electromyography, Masticatory muscles, Quality of life, Temporomandibular disorder.

RESUMO

JUSTIFICATIVA E OBJETIVOS: Avaliar a possível interação entre a atividade dos músculos mastigatórios com a qualidade de vida e a gravidade da disfunção temporomandibular pode ajudar a esclarecer como as alterações na atividade muscular podem estar associadas a mulheres com disfunção temporomandibular crônica. O objetivo deste estudo foi avaliar a correlação entre atividade elétrica mastigatória durante o repouso mandibular, contração voluntária máxima, gravidade da disfunção temporomandibular e qualidade de vida em mulheres com disfunção temporomandibular crônica e comparar esses parâmetros com indivíduos assintomáticos (grupo controle).
MÉTODOS: Sessenta mulheres, 30 com disfunção temporomandibular e 30 assintomáticas, participaram deste estudo observacional caso-controle. O instrumento critérios diagnósticos para disfunções temporomandibulares foi usado para detectar a presença ou ausência de disfunção temporomandibular. O questionário SF-36 foi usado para avaliar a qualidade de vida, e o ProDTMmulti parte II foi aplicado para avaliar a gravidade dos sinais e sintomas de disfunção temporomandibular. A atividade mastigatória durante o repouso mandibular e apertamento dentário foram medidos usando eletromiografia de superfície.
RESULTADOS: Durante o apertamento dentário, a atividade do músculo masseter, temporal direito e esquerdo, simetria do masseter e coeficiente anteroposterior foram significativamente menores no grupo disfunção temporomandibular em comparação ao grupo assintomático. A atividade mastigatória em repouso, sinais e sintomas de disfunção temporomandibular crônica e os prejuízos na qualidade de vida foram correlacionados conforme determinado pelo coeficiente de Spearman (p<0,05).
CONCLUSÃO: Os presentes achados contribuem para evidenciar as associações entre atividade mastigatória em sinais e sintomas crônicos de disfunção temporomandibular, comprometimento da qualidade de vida e diferenças na atividade mastigatória durante o apertamento dentário entre disfunção temporomandibular e grupo controle.
Descritores: Dor crônica, Eletromiografia, Músculos da mastigação, Qualidade de vida, Síndrome da disfunção da articulação temporomandibular.

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INTRODUCTION

Chronic orofacial pain is one of the most common conditions reported by patients with temporomandibular disorder (TMD)[1]. TMD is clinically characterized by soreness of the muscles of mastication and the temporomandibular joint (TMJ), restriction of mandibular mobility, and joint sounds occurring during jaw function[2].

These symptoms may be related to alterations in the masticatory motor control[3]. Although there is evidence that muscle activation is altered in patients with TMD[4-11], the relation between the duration of TMD and muscle activity remains unclear. An earlier study observed higher masticatory activity at rest in adolescents with TMD[5] and in adults with myofascial pain[12]. However, others did not find a significant difference between symptomatic and asymptomatic adults concerning the activity of the masticatory muscles during mandibular resting[11]. Lower muscle activity during clenching in patients with TMD has been observed[4,9], whereas others found no significant differences[5,11,13]. Yet, other studies have observed greater asymmetry of activity during mastication[7,8,10], clenching[7,] and an imbalance in contralateral activities during clenching[4,13] and mastication in subjects with TMD compared to asymptomatic subjects[10].

If pain is the main symptom in patients with TMD[1,14], differences in the duration of TMD in previous studies may be the reason for the inconsistent results found in the literature. Thus, we decided to investigate muscle activation in patients with chronic TMD. We expected this group to display the true effects of persistent pain on the masticatory muscles and quality of life.

Chronic pain conditions, which encompass psychological, behavioral[15], and social factors, together with physical conditions[1] can influence the functional status of the masticatory muscles and quality of life. Studies have already confirmed that patients with chronic TMD have a low quality of life[16,17]. Others have compared the amplitude of muscle activation during mandibular resting[5,11,12] and dental clenching[4,5,7,9,11,13]; however, the correlation between these parameters has not been fully explored. Understanding the potential interaction between masticatory muscle activities and the quality of life can help to elucidate how changes in muscle activity can be related to the pattern of living in patients with chronic TMD.

The first aim of this study was to investigate correlations between the amplitude of masticatory muscle activity during mandibular resting and clenching, the severity of TMD, and the quality of life of women with chronic TMD, and the second one was to compare these parameters between women with chronic TMD and individuals in a control group (CG).

METHODS

Inclusion criteria for the TMD group were as follows: diagnosis of TMD according to the Diagnostic Criteria for Temporomandibular Disorder (DC/TMD)[2] and chronic orofacial pain (>6months). The exclusion criteria for the TMD and asymptomatic groups were as follows: Angle Class II or III malocclusion, incomplete dentition, periodontal problems, use of occlusal splints within 6 months prior to the study, current orthodontic and psychotherapeutic treatment, current use of analgesics and anti-inflammatory drugs, and refusal to provide a written informed consent. The inclusion of Angle Class I malocclusion was accepted to have a uniform sample.

The sample size was calculated based on the study by Ries et al.[8]. Considering α=0.05, β=0.22, and a test power of 85%, a minimum of 29 individuals in each group was required., Thirty individuals were enrolled in each group of the study to maintain a margin of safety. Volunteers were recruited at Santa Catarina State University (Florianopolis, Brazil) by verbal and social-media invitation. They were divided into 2 groups: the TMD group (30 females aged between 18 and 44 years; mean ± SD, 27±7.77 years), in which participants had signs and symptoms of TMD, and the asymptomatic CG (30 individuals aged between 18 and 31 years; mean ± SD, 23.2±3.78 years), in which participants had no signs and symptoms of TMD.

Clinical evaluation

One trained examiner performed the clinical examination on all participants. The diagnosis of TMD was based on the DC/TMD questionnaire[2]. According to the DC/TMD, patients with TMD in this study were clinically classified as having myalgia and arthralgia. The quality of life was assessed using the Medical Outcomes Study Item Short-Form Health Survey (SF-36) questionnaire that has been translated and adapted for the Brazilian population[18]. It is an inventory with 36 questions designed for individuals aged ≥14 years and includes 8 multi-item scales. Intra- and inter-reliability values of the SF-36 were observed to be $0.4426<r<0.8468$ and $0.5542<r<0.8101$), respectively (α=0.90). The results of quality of life ranged from 0 to 100, with 0 indicating the worst quality of life and 100 indicating the greatest possible result. The severity of TMD was evaluated using the validated ProTMDmulti-part II (validated by using the Helkimo Clinical Dysfunction Index with r=0.65 according to Spearman Rank correlation)[19].

Severity was indicated on a printed numerical scale of 0 to 10, with 0 indicating the absence of symptoms and 10 indicating the highest possible severity. The ProTMDmulti-part II quantifies the signs and symptoms of TMD according to the perception of the individual. The severity score was the sum of the scores (range, 0–360) attributed to each sign and symptom in e situations (waking up, chewing, talking, and resting). All evaluations were performed by a single trained and able examiner (first author).

Surface electromyography (EMG) assessment

The electrical impedance of the skin was reduced by cleaning the site with hydrophilic cotton soaked in 70% alcohol. The masseter and anterior temporal muscles on both sides were examined. All EMG signals were recorded using an EMG system (Miotool USB, Miotec Company, Porto Alegre, Rio Grande do Sul, Brazil). Measurements were taken with 12 bites of resolution on an analogical/digital converter board at a 2000 Hz sampling frequency and minimum common-mode rejection ratio of 110 dB. Disposable, bipolar surface electrodes (Medi-trace Kendall-LTP, Chicopee, Mansfield, Massachusetts, USA) were positioned on the surface of masticatory muscle bellies parallel to the muscle fibers with a between-electrodes center-to-center distance of 20 mm[20]. A muscle function test was performed before the electrode placement. For the temporalis anterior (vertically along the anterior margin of the muscle) and masseter (2cm above the external angle of the jaw) muscles, the electrodes were placed during dental clenching. The reference electrode was placed on the sternum. Before registering the myoelectric activity of the temporalis and masseter muscles, the examiner ensured the individuals were trained to be familiar with the procedures of acquiring the EMG data. Initially, the EMG signals were recorded during mandibular resting: individuals were asked to relax and maintain the maxillary and mandibular teeth out of contact (teeth out of occlusion) for 10 s[5]. For maximum voluntary clenching (MVC), individuals were requested to clench as hard as possible with the Parafilm (Neenah, Wisconsin, USA) folded 15 times (1.5 by 3.5cm) placed bilaterally in the molar regions[5,7,9]. Subjects were requested to maintain the same level of contraction for 5s, and they were verbally encouraged to perform at their best. For both mandibular resting position and MVC, three measurements were recorded, with a 1-min rest interval between measurements during test performances.

Surface electromyography analysis

The MATLAB software version 5.3 (The Math Works Inc., Los Angeles, California, USA) was used to process data. Bilateral electrical activities of the masseter and temporal muscles were analyzed using the root means square (RMS) of the amplitude (unit: µV). In the mandibular resting position and MVC, the most stable 250ms window of muscle activity was selected. In all analyses, data were filtered through high-pass and low-pass filters from 20 to 500Hz, and standardization was performed to allow comparisons between volunteers. For comparisons of the EMG signal between individuals, RMS values were normalized by calculating a percentage of the maximum RMS value obtained for 1 s in the three measurements of the MVC for each subject and muscle. The amplitude analysis of muscle activity was performed by calculating the RMS% in microvolts. In the normalized curve and rectified EMG signal, the symmetry index (SI%)[21] and antero-posterior coefficient (APC%) were analyzed[22].

The SI% was calculated to identify whether the left and right sides of the masseter and temporal muscles were activated during dental clenching with symmetrical muscular patterns; a symmetrical muscle pattern presented as a ratio close to 100%[21].

The APC% compared the activity between the masseter and temporal muscles; the index ranged from 0% (no synergy between the masseter and temporalis) to 100% (full synergy between the masseter and temporalis)[22].

The Human Research Ethics Committee of Santa Catarina State University approved this project under number 758.038/2014, and all volunteers provided written Free Informed Consent Term (FICT).

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences Version 20.0 for Windows. For all procedures, a significance level of 5% ($p<0.05$) with two-tailed distribution was adopted. The Kolmogorov-Smirnov test was used to verify the normality of the data. Student's t-test or the Mann-Whitney test was used to compare the parameters of EMG activity, TMD severity, and quality of life among patients with and without TMD.

The Spearman correlation coefficient was used to assess the correlation between EMG activity parameters, TMD severity, and quality of life in patients with TMD. Correlation values below 0.20 indicated no association, values between 0.20 and 0.39 indicated a very low association, values between 0.40 and 0.69 indicated a moderate association, values between 0.70 and 0.89 indicated a high association, and values between 0.90 and 1.0 a very high association[23]. To quantify the magnitude of differences independent of sample size, Cohen's d was applied. As suggested by Cohen, we considered d=0.2, small; d=0.5, medium; d=0.8, large[24].

RESULTS

Groups were not significantly different regarding age (p=0.05), weight (p=0.76), and height (p=0.45). The EMG values of masticatory muscles at rest were not significantly different between groups (Table 1). During clenching, patients with TMD had a significantly lower amplitude on the right temporal and left masseter muscles

Table 1. Comparison between the means of the activation amplitude (RMS%) of right temporal (RT%), left temporal (LT%), right masseter (RM%), left masseter (LM%), and symmetry index of temporal (ST%), symmetry index of masseter (SM%), anteroposterior coefficient (APC%) during mandibular rest (resting), and dental clenching (clenching) according to the presence of temporomandibular disorder (TMD)

		Control (n = 30)			TMD (n = 30)			p-value (effect size)
		Mean	SD	CI95%	Mean	SD	CI95%	
RESTING	RT	1.46	0.67	1.20–1.71	2.60	5.07	0.71–4.50	NS (0.31)
	LT	1.18	0.57	0.97–1.40	2.32	5.08	0.42–4.22	NS (0.31)
	RM	1.18	1.05	0.78–1.57	2.65	4.78	0.86–4.43	0.082 (0.42)
	LM	1.11	0.90	0.77–1.45	2.84	5.61	0.74–4.94	NS (0.43)
	ST	85.87	9.68	82.25–89.49	81.45	9.85	77.77–85.12	0.074 (0.45)
	SM	83.38	9.32	79.89–86.86	84.18	11.46	79.90–88.46	NS (0.07)
	APC	75.74	14.13	70.46–81.01	75.02	16.42	68.89–81.15	NS (0.04)

Continue...

Table 1. Comparison between the means of the activation amplitude (RMS%) of right temporal (RT%), left temporal (LT%), right masseter (RM%), left masseter (LM%), and symmetry index of temporal (ST%), symmetry index of masseter (SM%), anteroposterior coefficient (APC%) during mandibular rest (resting), and dental clenching (clenching) according to the presence of temporomandibular disorder (TMD) – continuation

		Control (n = 30)			TMD (n = 30)			
		Mean	SD	CI95%	Mean	SD	CI95%	p-value (effect size)
CLENCHING	RT	86.80	5.92	84.59–89.01	82.32	10.03	78.57–86.07	0.040* (0.54)
	LT	85.49	7.02	82.87–88.11	83.30	8.01	80.32–86.30	NS (0.29)
	RM	84.33	8.27	81.24–87.42	81.09	14.05	75.84–86.33	NS (0.28)
	LM	85.68	7.20	82.99–88.37	80.58	12.04	76.08–85.08	0.049* (0.51)
	ST	95.82	3.14	94.64–96.99	94.01	5.37	92.01–96.02	NS (0.41)
	SM	96.16	2.58	95.19–97.12	93.04	6.45	90.64–95.45	0.049* (0.63)
	APC	90.83	2.21	90.01–91.66	88.57	4.24	86.99–90.16	0.001** (0.66)

T test for independent data; *p<0.05; **p<0.01; NS = not significant.

Table 2. Comparison between the ProTMDmulti-part II according to the presence of temporomandibular disorder

	Control (n=30) Median, IQR	TMD (n=30) Median, IQR	p-value (effect size)
Muscular pain	0 (0:0)	7 (1:20)	0.001*** (1.04)
TMJ pain	0 (0:0)	5 (2:22)	0.001*** (1.36)
Neck pain	0 (0:4)	8 (1:20)	0.001*** (0.33)
Otalgia	0 (0:0)	0 (0:11)	0.001*** (0.88)
Tinnitus (buzzing)	0 (0:0)	0 (0:12)	0.001*** (0.89)
Ear fullness	0 (0:0)	0 (0:10)	0.001*** (0.81)
Tooth sensitivity	0 (0:3)	2 (0:12)	0.06 (0.74)
Joint noise	0 (0:0)	1 (0:14)	0.001*** (1.09)
Difficulty to swallow	0 (0:0)	0 (0:0)	0.02* (0.48)
Dificulty to talk	0 (0:0)	0 (0:1)	0.001*** (0.60)
Total score	3 (0:10)	46 (11:94)	0.001*** (1.21)

IQR = interquartile range; Mann-Whitney test; *p<0.05; **p<0.01; ***p<0.001; TMJ, temporomandibular joint. All values are expressed as medians (IQR).

Table 3. Comparison between the functional data according to the presence of temporomandibular disorder

	Control (n = 30) Median, IQR	TMD (n = 30) Median, IQR	p-value (effect size)
Physical functioning	95 (80:100)	95 (85:100)	0.062 (0.52)
Role limitation	100 (98:100)	100 (75:100)	NS (0.43)
Bodily pain	74 (62:84)	62 (45:74)	0.000*** (1.14)
General health	82 (67:91)	69 (72:77)	0.005** (0.77)
Vitality	60 (51:70)	62 (35:71)	NS (0.38)
Social functioning	89 (73:100)	88 (61:100)	0.049* (0.57)
Emotional role	100 (75:100)	100 (58:100)	0.022* (0.69)
Mental health	72 (68:84)	72 (52:80)	NS (0.39)

IQR = interquartile range; Mann-Whitney test; *p<0.05; **p<0.01; ***p<0.001; NS = not significant. All values are expressed as medians (IQR).

than those in the CG (p<0.05), with medium effect size (ES). Patients with TMD also exhibited greater asymmetry of the masseter muscle (p<0.05) and greater asynergy of muscle activity (APC%) between the pairs of muscles (masseter and temporal muscles; p<0.00) than those in the CG, both parameters had a medium ES. Patients with TMD had a greater negative perception of TMD, and the clinical evaluation showed low severity of signs and symptoms. The difference between the total score of the two groups presented a high ES (Table 2).

According to the SF-36 questionnaire for quality of life (Table 3), the domains bodily pain (p<0.00, [high ES]), general health (p<0.00, [medium ES]), social functioning (p<0.05, [medium ES]) and emotional role (p < 0.05, [medium ES]) scored significantly lower values in the TMD group than in the CG.

Correlation analyses

The analysis of EMG activity during mandibular resting showed that the amplitude of the right masseter had a negative, low correlation with the role limitation (i.e., physical health interferes with the activities of daily living, making it difficult to perform them) and bodily pain (assessed by the SF-36 questionnaire) (Table 4). The amplitude of the left masseter showed a negative, moderate correlation with role limitation and bodily pain (assessed by the SF-36 questionnaire). Regarding limitation and physical pain, the higher the values of the scores, the lower the EMG activities of the masseter and anterior temporalis at rest. A decrease in temporal symmetry showed a positive, moderate correlation with daily pain (SF-36). The severity of TMD had a positive, moderate correlation with the amplitude of the temporal and masseter muscles (right and left). During clenching, there was a negative, low correlation of the synergistic activity between masseter and temporalis muscles and the severity of TMD. The higher the synergistic activity between the masseter and temporalis muscles, the lower the ProTMDmulti score.

A negative, low correlation was also observed between the severity of TMD and social functioning and mental health, and a moderate correlation between the severity and emotional role. The higher the values of the items (social functioning, emotional role, and mental health), the lower the ProTMDmulti score.

Table 4. Correlation among the means of the activation amplitude (RMS%) of right temporal (RT%), left temporal (LT%), right masseter (RM%), left masseter (LM%), and symmetry of temporal (ST%), symmetry of masseter (SM%,) and anteroposterior coefficient (APC%) during mandibular rest (Resting) and dental clenching (Clenching) with ProTMD (TMD severity) and functional data for the SF-36 questionnaire (+) in patients with temporomandibular disorder (TMD)

		FF+	RL+	BP+	GH+	V+	SF+	ER+	MH+	ProTMD
RESTING	RT	-0.22	-0.22	-0.33	-0.11	-0.15	-0.19	-0.26	-0.22	0.50**
	LT	-0.25	-0.16	-0.18	-0.21	-0.12	-0.26	-0.27	-0.28	0.49**
	RM	-0.21	-0.37*	-0.40*	-0.20	-0.05	-0.14	-0.23	-0.14	0.54**
	LM	-0.08	-0.40*	-0.41*	-0.26	-0.10	-0.19	-0.17	-0.17	0.66**
	ST	-0.10	0.29	0.42*	0.05	0.29	0.31	0.15	0.25	-0.17
	SM	-0.16	-0.19	0.08	0.10	0.21	0.20	0.31	0.30	-0.16
	APC	0.11	-0.16	-0.34	0.00	-0.23	-0.01	0.12	0.13	0.07
CLENCHING	RT	0.01	-0.14	0.11	0.27	0.12	0.03	-0.05	0.08	-0.16
	LT	0.07	-0.17	-0.03	0.18	0.25	0.04	0.21	0.08	-0.10
	RM	-0.03	-0.05	-0.11	0.06	0.11	-0.12	-0.11	-0.03	-0.27
	LM	-0.12	-0.19	-0.15	0.22	0.30	-0.03	-0.05	0.09	-0.19
	ST	0.07	0.16	0.08	-0.07	0.15	-0.08	0.13	-0.06	-0.11
	SM	0.11	-0.14	-0.15	-0.16	0.16	0.06	0.15	0.15	-0.24
	APC	-0.13	-0.12	0.11	-0.27	0.09	0.08	0.26	0.10	-0.36*
ProTMD		-0.04	-0.31	-0.24	-0.21	-0.32	-0.39*	-0.40*	-0.36*	-

Spearman Correlation coefficient; Statistically significant: *p<0.05; **p<0.01; FF+ = Physical functioning; RL+ = role limitation; BP+ = bodily pain; GH+ = general health; V+ = vitality; SF+ = social functioning; ER+ = emotional role; MH+ =mental health.

DISCUSSION

All participants with TMD evaluated in this study were looking for a diagnosis due to pain in the facial region and agreed to be volunteers. All of them were referred for specialized care with dentists, physiotherapists, and speech pathologists and were free to adhere to any treatment.

The mean EMG RMS values of resting masticatory muscles were higher in patients with TMD than in those in the CG, but the difference was not significant. During clinical evaluation, reports of tenderness upon palpation in the masticatory muscles were frequent in patients with TMD, but of low intensity. Spontaneous pain at rest was not frequent in the TMD group. Changes in the resting masticatory activity in the TMD group compared to those in the CG have been found in adolescents with moderate-to-severe TMD signs in normalized EMG data[5] and adults with moderate myofascial pain and non-normalized EMG data[12]. Our findings differ from those of two previous studies regarding pain severity, TMD assessment, age, sex[5], and rest data processing methodology[12] and are, therefore, difficult to compare. The increase in the EMG activity of the masticatory muscles at rest was correlated with a low severity of signs and symptoms of TMD according to the pain perception of individuals.

Although there was no difference between the groups regarding limitation, a higher impairment of this domain was observed in the TMD group which might reflect the correlation between bodily pain, role limitation, and the increase of masticatory muscle activity during mandibular resting.

Chronic pain can contribute to more significant physical limitations, difficulties in performing daily living activities[16], impairment of oral motor functions[6,10], and progression of the disorder[25]. TMD directly affects the performance of daily living activities and interferes with the standard of living of chronic individuals. Similarly, our results show an association between an increase in the masseter muscle activity during mandibular resting with increases in generalized physical pain, as well as signs and symptoms of TMD in the craniocervical system based on clinical examination.

Emotional aspects, such as high levels of stress and psychophysiological arousal, can also cause changes in the EMG activity of the jaw muscles[26]. Psychological stress causes a permanent activation of the descending motor pathways in individuals with pain[27] that generates an involuntary motor response involving the muscles of the face in individuals with somatic complaints but not for asymptomatic individuals[26]. Psychological variables are also related to the onset and chronicity of TMD[15]. The increased impairment of affective aspects can also be related to, or influenced by, the higher masticatory activity at rest in the TMD group than in the CG. The pain-model adaptation explains that these changes in muscle activity are related to biological and psychosocial factors regulated by the central nervous system and are unique to each individual[3].

With respect to the quality of life (SF-36), there was a significant influence of bodily pain in the TMD group on negative results for general health, social functioning, and emotional role compared to the CG. The impairment of general health indicates that patients with TMD have a negative perception of health and poor expectations. The presence of chronic disorder and constant pain causes reduced physical function leading to the impression of no improvement in health in the TMD group. In addition, correlations of TMD severity with social functioning, mental health (low correlation), and emotional role (moderate correlation) were observed. Social functions are linked to the emotional state, indicating that affective problems interfere with work and activities of daily living[18].

The TMD group displayed significantly less masticatory activity during mandibular clenching compared to the CG, as was observed in other studies[4,9,28]. Pain in the masticatory muscles was the main symptom reported in the TMD group. This result can be attributed to the low functional efficiency of the masticatory muscles in the TMD group combined with the decreased activity, causing a decreased ability to perform muscle contraction[28,29]. This, therefore, acts as a predisposing factor to the disorder when motor pain and maladaptation are present[25].

The TMD group had less precision of activity in recruiting the masticatory muscles during clenching along with reduced symmetry of the masseter and less synergy between the masseter and temporalis muscle. The APC% was correlated with the severity of TMD. This finding may be an indicator of mandibular positioning by the temporal muscles and load generation effort by the masseter activity[30], suggesting that the incoordination in muscle activity during MVC is due to the subject attempting to stabilize the jaw.

These motor maladaptations in the masticatory activity in individuals with pain can lead to a modified motor response that involves the same or other groups of muscles[3,25]. Adaptations in muscle activity can be numerous in chronic individuals because what defines the worsening of the disease is ongoing pain. The effect of pain on the motor activity also depends on the interaction of biopsychosocial variables that are involved in the painful experience, along with anatomical characteristics and the sensory-motor system of the individual[3]. Studies have interpreted the adaptations of EMG activity as a compensatory mechanism to prevent further damage to and recovery of the muscle function[3,25]. However, these masticatory motor control changes have a negative impact on the worsening of the disorder[10], causing more pain in the orofacial[8] and cervical[7] regions.

The TMD group displayed low severity of signs and symptoms, and neck pain was the most severe symptom detected by clinical evaluation. TMJ pain and masticatory muscle pain are symptoms expected in patients with TMD as identified by the DC/TMD[2]. Therefore, we suggest that pain in the cervical region, in addition to the usual TMD signs, should also be investigated by professionals working with this disorder. Pain, as well as its severity of TMD, are aspects that require further study and improvement in treatments.

Our findings refer to a group of low severity signs and symptoms in the temporomandibular system and should be interpreted with caution. The higher intensity of neck pain was an unexpected finding. Therefore, signs of the disorder, duration, and intensity of neck pain were not controlled, and neither the possible effects on masticatory activity. Assessment of muscle function, while the subject is experiencing a painful crisis, is difficult because chronic pain is ongoing. Additionally, moderate or severe signs and symptoms of TMD, as well as the function of the cervical spine, should be assessed in future studies to verify the impact of clinical conditions and the muscle activity in chronic TMD.

CONCLUSION

The main results showed that the impairments in quality of life, such as limitations in physical aspects and generalized bodily pain are negatively associated with the increase in masseter muscle activity during mandibular resting. Additionally, the severity of signs and symptoms of TMD contribute to changes in the activity of masticatory muscles at rest in TMD patients. Although the domains of quality of life were not associated with masticatory activity during clenching, the TMD group showed decreased contractile activities of masticatory muscles and impairments in the quality of life compared to the CG.

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