ORIGINAL ARTICLE

Temporomandibular dysfunction, myofascial, craniomandibular and cervical pain: effect on masticatory activity during rest and mandibular isometry

Disfunção temporomandibular, dor miofascial crâniomandibular e cervical: efeito na atividade mastigatória durante o repouso e isometria mandibular

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ABSTRACT

BACKGROUND AND OBJECTIVES: Craniomandibular and cervical symptoms interfere with mandibular stability. Determining whether these disorders influence muscle activation when chewing, it is possible to improve interventions for this population. The objective of this study was to verify the effect of the temporomandibular joint dysfunction, craniomandibular and cervical pain on the electromyographic activity of the masticatory muscles during rest and mandibular isometry.

METHODS: Fifty-five women aged between 18 and 30 years were divided into two groups: with temporomandibular dysfunction (n=28) and without temporomandibular dysfunction (n=27). The diagnosis of temporomandibular dysfunction was established using the Research Diagnostic Criteria for Temporomandibular Disorder (RDC/TMD). The RDC was also used to determine the presence of craniomandibular pain. Cervical pain was defined by physical examination. The electromyographic activity of masseter and temporalis muscles was evaluated in the rest position and mandibular isometry. The amplitude of muscle activation was represented by the root mean square values (RMS%) and normalized by maximum voluntary contraction. The Mann-Whitney U test was used to detect differences between the groups with and without temporomandibular dysfunction; with and without myofascial craniomandibular pain; and with and without cervical myofascial pain.

RESULTS: It was observed greater amplitude in the activation of masseter and right temporalis muscles in the rest position in individuals with myofascial craniomandibular pain compared to asymptomatic ($p<0.05$). There was no difference among individuals with and without cervical myofascial pain, and with and without temporomandibular dysfunction.

CONCLUSION: The presence of myofascial craniomandibular pain did not affect the masticatory activity, with greater muscle activation in mandibular rest.

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Keywords: Chewing, Electromyography, Myofascial pain, Temporomandibular dysfunction.

RESUMO

JUSTIFICATIVA E OBJETIVOS: Sintomas crâniomandibulares e cervicais interferem na estabilidade mandibular. Ao determinar se essas desordens influenciam na ativação muscular durante a mastigação é possível aprimorar intervenções para essa população. O objetivo deste estudo foi verificar o efeito da disfunção temporomandibular, dores crâniomandibular e cervical na atividade eletromiográfica dos músculos mastigatórios, durante o repouso e a isometria mandibular.

MÉTODOS: Cinquenta e cinco mulheres com idade entre 18 e 30 anos, foram divididas em grupo com disfunção temporomandibular (n=28) e sem disfunção temporomandibular (n=27). O diagnóstico de disfunção temporomandibular foi estabelecido por meio do *Research Diagnostic Criteria for Temporomandibular Disorder* (RDC/TMD). O RDC também foi utilizado para determinar a presença de dor crâniomandibular. A dor cervical foi definida por meio de um exame clínico. A atividade eletromiográfica dos músculos temporal e masseter foi avaliada durante o repouso e a isometria mandibular. A amplitude de ativação muscular foi representada por valores de raiz quadrada da média (RMS%) e normalizada pela contração voluntária máxima. O teste U de Mann-Whitney foi utilizado para detectar diferenças entre os grupos, com e sem disfunção temporomandibular; com e sem dor miofascial crâniomandibular; e com e sem dor miofascial cervical.

RESULTADOS: Observou-se maior amplitude de ativação dos músculos temporais e masseter direito durante o repouso para indivíduos com dor miofascial crâniomandibular em relação a assintomáticos ($p<0,05$). Não houve diferença entre indivíduos com e sem dor miofascial cervical e com e sem disfunção temporomandibular.

CONCLUSÃO: A presença de dor miofascial crâniomandibular exerceu efeito sobre a atividade mastigatória, com uma maior ativação muscular no repouso mandibular.

Descritores: Disfunção temporomandibular, Dor miofascial, Eletromiografia, Mastigação.

INTRODUCTION

Temporomandibular disorder (TMD) is characterized by a group of clinical conditions associated with noises and blockages in the temporomandibular joint (TMJ)[1]. The Research

Diagnostic Criteria (RDC/TMD) is composed of a set of criteria, determining the TMD's diagnosis through a variety of signs and symptoms[2]. This evaluation method can diagnose an individual with TMD through the disc and articular symptoms, or due to muscular pain's presence, and also in a mixed way, including the alteration types[3].

Masticatory muscles pain and in the TMJ region is the most prevalent symptom in TMD-individuals[4]. Besides these symptoms, 60% of TMD-individuals have pain in other regions such as head and cervical[5]. The pain presence in this region is due to the connection between the cervical structures and the TMJ, which through muscles and ligaments form the complex called the craniocervical-mandibular system[6]. These structural connections have encouraged studies aiming to understand the relationship between TMD and cervical symptoms.

It is already known that individuals with craniomandibular symptoms have more frequently cervical pain than do the asymptomatics[1,7]. Another study observed the relationship between cervical postural changes and increased activation of the masseter muscle[8]. In addition, a relationship was observed between the cervical pain presence and the increased muscle sensitivity in the skull-mandibular system[9].

Factors such as increased sensitivity and pain presence are associated with proprioceptive deficits and interfere with the muscle activation pattern[10,11]. Thus, mandibular movements' dysfunctions may also be influenced by cervical symptoms in TMD-patients. These symptoms' frequency in this population suggests the presence of compensatory strategies, aiming at promoting stability for mandibular movements and maintaining the musculoskeletal system functional effectiveness[12].

This way, it is important to consider cervical and craniomandibular symptoms during masticatory muscle evaluation. These muscles' electromyographic analysis will enable to determine if these disorders influence the muscular activation pattern of symptomatic subjects, enhancing assessments and therapeutic interventions for this population.

The purpose of this study was to verify the effect of TMD, myofascial, craniomandibular and cervical pain on the electromyographic activity of the masticatory muscles during rest and mandibular isometry.

METHODS

The probabilistic and intentional sample was recruited through the research project's dissemination in universities and health centers in Florianopolis.

Volunteers were clarified about the research's objectives and signed the Free and Informed Consent Form (FICT).

Inclusion criteria were: age between 18 and 30 years old and female. Exclusion criteria were: use of functional orthodontic/orthopedic appliances, use of analgesic and anti-inflammatory drugs, systemic diseases such as arthritis and arthrosis, classified as Angle's[13] classes II and III, vestibular system's alterations, dental failures, cervical trauma history, shoulder girdle, face, and TMJ.

Sixty women were evaluated. Fifty-five participated in the study, and five were excluded due to data processing problems. Volunteers evaluated by the present study were classified according to the presence or absence of three conditions: TMD, myofascial pain in the craniomandibular region and cervical pain.

Clinical instruments

All volunteers were assessed by RDC/TMD[14] to determine TMD-presence. Volunteers who had one or more TMD diagnoses were included in the TMD group, based on the history and presence of clinical signs according to the RDC/TMD. In the group without TMD, volunteers who did not present TMD diagnoses according to RDC/TMD were included.

RDC/TMD[14] is an instrument that considers physical (axis I) and psychosocial aspects (axis II) and determines the TMD presence or absence, classifying individuals into three groups: I) Muscular diagnoses (myofascial pain with or without limited opening); II) Disc displacement (with or without reduction and with limited opening or without reduction, and without limited opening); III) Arthralgia, osteoarthritis, osteoarthrosis of TMJ. To be classified as TMD, the individual must present at least one diagnosis and may have a maximum of five diagnoses[14].

The clinical examination by muscle palpation of the RDC/TMD was also used to determine the myofascial pain presence in the craniomandibular region, regardless of the TMD diagnosis. Volunteers were classified as "myofascial craniomandibular pain present" when reporting pain in at least one muscle area during evaluation by palpation.

The cervical pain presence was detected by a clinical examination[15], consisting of the evaluation of active and passive movements, tests (dynamic-static) and cervical muscles palpation. Those volunteers who presented pain during muscle palpation and head movement were classified as "Myofascial craniomandibular pain present", according to this examination.

Based on the anteroposterior relationship's visual inspection between the mandible and the maxillary, Angle's malocclusion classification was used to evaluate the morphological aspects of dental occlusion[13].

Electromyography

Electromyography (EMG) was used to evaluate the electrical activity of the masseter (MA) and temporal (TA) muscles bilaterally, during isometry and mandibular rest. The Miotool USB (Miotec) electromyography was used with 14-bit resolution analog-to-digital converter board for an acquisition rate of 2000 Hz, minimum Common Mode Rejection Ratio of 110 dB. In order to capture the electromyographic signal, the surface electrodes of Meditrace Kendall-LTP brand, model Chicopee MA 01022 were adopted.

For this evaluation, individuals remained seated on a chair with back support, knees at 90° and head in the Frankfurt position (parallel plane to the ground). The skin was cleaned on the electrode fixing place with 70% alcohol, and trichotomy was done, as necessary.

Electrodes' fixing on the skin surrounding the MA and TA muscles followed the SENIAM recommendations (Surface ElectroMyGraphy for the Non-Invasive Assessment of Muscles)[16]. The best electrodes positioning was determined by an isometric con-

traction reference, through dental tightening. Electrodes were bilaterally fixed on the MA (2 cm above the mandible angle), and TA (vertically, from the muscle's anterior margin)[17,18]. The reference electrode was fixed on the sternal manubrium.

A pre-protocol evaluation training was done for the participants to understand the activities execution. The electromyographic signal acquisition occurred during the following activities:

Rest: lips touching lightly with teeth out of the occlusion for three 10-second repetitions;

Isometry: with an M Parafilm bar (Neenah, Wisconsin, USA), 15 times-folded (1.5 cm x 3.5 cm), positioned bilaterally between the last dental contacts; was requested a maximum voluntary contraction, maintained for five seconds. Three attempts were made with a one-minute interval between them.

Data analysis

The MATLAB R2009a software was used for data processing. The amplitude analysis was calculated by RMS, root-mean square, in micro volts (μv). Two thousand one-second data (the second most central of each muscle) were selected. To reduce external noise, the 20Hz high-pass filter and 500Hz low-pass filter were used. The amplitude normalization of masticatory muscular activity (RMS%) was made by the RMS value percentage during one second of each muscle by isometry.

This study was approved by the Ethics and Research Committee on Human Beings of Santa Catarina›s State University-UDESC, under Report Nr. 149,333.

Statistical analysis

Descriptive statistics were used by average and standard deviation with a 95% interval. The data normality was tested by Kolmogorov-Smirnov test. The Mann-Whitney U test was used to detect differences between the groups' averages: a) with and without TMD; B) with and without myofascial craniomandibular pain; C) with and without cervical myofascial pain.

For this, the *Statistical Package* for the Social Science (SPSS) version 20.0 was used with a significance level of 5% ($p<0.05$) and two-tailed distribution.

RESULTS

Figure 1 shows the volunteers distribution (number of individuals) regarding the presence or absence of the three conditions: TMD, craniomandibular myofascial pain, and cervical pain. Individuals with craniomandibular myofascial pain exhibited greater activation amplitudes during the rest of the RT, LT and RM muscles than asymptomatic individuals ($p<0.05$). The craniomandibular pain did not affect isometry ($p>0.05$). For cervical myofascial pain, the electrical activity of the masticatory muscles during rest and isometry did not present statistical differences between groups ($p>0.05$) (Table 1).

Comparison of the average of amplitude surface EMG indexes (RMS%) during rest and isometry did not present statistical differences ($p>0.05$) between subjects with and without TMD (Table 2).

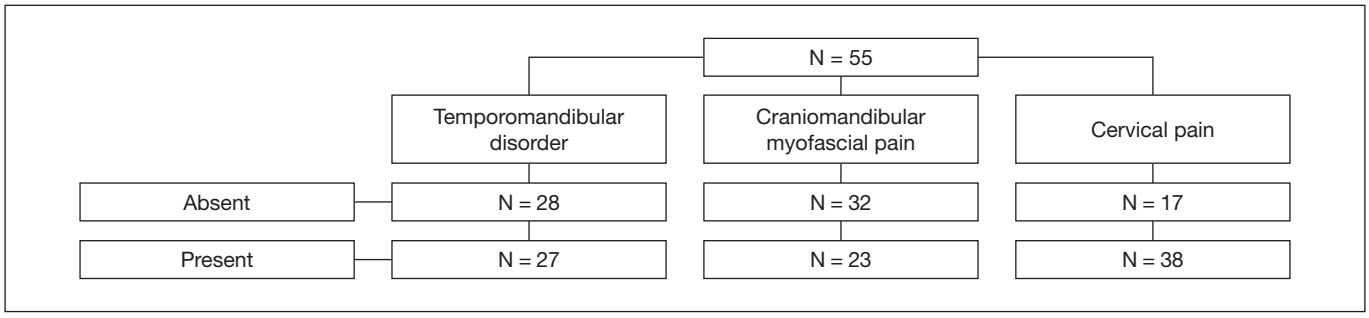

Figure 1. Volunteers' distribution regarding the presence or absence of temporomandibular disorder, craniomandibular myofascial pain and cervical pain

N = number of volunteers.

Table 1. Comparison between the averages of activation amplitude for right and left temporal muscles, right and left masseter muscles, during rest and isometry according to the myofascial pain presence in the craniomandibular region and the cervical region

	AAM%	Average	SD	CI	Average	SD	CI	p value
			Absent (n=23)			Present (n=32)		
Craniomandibular myofascial pain								
Rest	RT	2.39	1.30	1.98 - 2.81	3.20	1.28	2.49 - 3.91	0.02
	LT	2.44	1.19	2.06 - 2.82	3.15	1.29	2.44 - 3.86	0.03
	RM	1.82	0.72	1.59 - 2.05	2.73	1.55	1.87 - 3.59	0.03
	LM	1.52	1.10	1.17 - 1.87	1.50	0.63	1.16 - 1.86	NS
Isometry	RT	88.00	9.71	84.85 - 91.14	85.95	10.12	80.35 - 91.55	NS
	LT	89.73	4.13	88.39 - 91.07	88.76	5.82	85.54 - 91.98	NS
	RM	85.55	9.33	82.52 - 88.57	86.08	6.65	82.39 - 89.77	NS
	LM	85.36	7.79	82.83 - 87.88	84.40	7.95	79.99 - 88.80	NS

Continue...

Table 1. Comparison between the averages of activation amplitude for right and left temporal muscles, right and left masseter muscles, during rest and isometry according to the myofascial pain presence in the craniomandibular region and the cervical region – continuation

	AAM%	Average	SD	CI	Average	SD	CI	p value
			Absent (n=23)			Present (n=32)		
Cervical myofascial pain								
Rest	RT	2.64	1.49	2.15 - 3.13	2.55	0.91	2.08 - 3.02	NS
	LT	2.61	1.27	2.19 - 3.03	2.69	1.21	2.07 - 3.31	NS
	RM	2.05	1.14	1.67 - 2.42	2.12	0.95	1.63 - 2.61	NS
	LM	1.55	1.12	1.18 - 1.92	1.45	0.61	1.14 - 1.76	NS
Isometry	RT	88.08	7.84	85.47 - 90.69	86.01	13.22	79.21 - 92.81	NS
	LT	89.72	4.63	88.17 - 91.26	88.90	4.71	86.48 - 91.32	NS
	RM	85.84	9.34	82.73 - 88.95	85.38	7.02	81.77 - 88.99	NS
	LM	85.30	8.52	82.46 - 88.14	84.64	6.04	81.53 - 87.75	NS

AAM = activation amplitude; RT = right temporal muscle; LT = left temporal; RM = right masseter; LM = left masseter; NS = not significant; SD = standard deviation; CI = confidence interval; Mann-Whitney U test.

Table 2. Comparison between the averages of activation amplitude for right and left temporal muscles, right and left masseter muscles (AAM%), during rest and isometry according to the temporomandibular disorder presence

	AAM%	Without TMD (n=27)			With TMD (n=28)			
		Average	SD	CI	Average	SD	CI	p value
Rest	RT	4.26	1.74	2.03 - 3.14	4.57	1.92	2.14 - 3.14	NS
	LT	2.63	1.35	2.09 - 3.17	2.64	1.16	2.19 - 3.09	NS
	RM	1.82	0.78	1.51 - 2.13	2.31	1.28	1.81 - 2.80	NS
	LM	1.68	1.28	1.17 - 2.19	1.36	0.57	1.14 - 1.58	NS
Isometry	RT	87.12	11.36	82.63 - 91.62	87.73	8.08	84.54 - 90.93	NS
	LT	88.87	3.85	87.34 - 90.39	90.05	5.29	87.96 - 92.15	NS
	RM	83.67	10.17	79.64 - 87.69	87.72	6.26	85.24 - 90.20	NS
	LM	84.62	8.59	81.22 - 88.02	85.56	6.99	82.79 - 88.33	NS

AAM = activation amplitude; RT = right temporal muscle; LT = left temporal; RM = right masseter; LM = left masseter; NS = not significant; SD = standard deviation; CI = confidence interval; Mann-Whitney U test.

DISCUSSION

This study evaluated the electric activity behavior of the masticatory musculature during rest and mandibular isometry in women with and without TMD, seeking to understand the effect of the craniomandibular myofascial pain and mandibular pain on the activity of these individuals' masticatory muscles. The main result showed that the activation of RT, LT and RM muscles at rest is greater in the presence of craniomandibular myofascial pain than in the absence of this symptom, independent of the TMD diagnosis.

As during rest the mandible is in a position of involuntary suspension resulting from the masticatory muscles' relaxation, the electromyographic activity expected is minimal[19,20]. However, in this study, individuals with craniomandibular myofascial pain presented greater electrical activation amplitude of the masticatory muscles during rest than those asymptomatic ones, a result found by Bodéré et al.[21]. As to the TMD presence, there was no difference between the groups. It was considered that the greater activation amplitude of the masticatory muscles during rest in subjects of the TMD group, compared to the control group found in other studies[22,23] was due to methodological differences. The severity degree of TMD and the inclusion in the non-TMD group of individuals who presented craniomandibular myofascial pain may have influenced the results. Individuals with moderate to severe intensity of TMD showed greater activation during rest compared to those with mild pain or from control group[23]. The present study included subjects with mild, moderate and severe TMD in the same group. The inclusion of individuals with mild TMD may have reduced the differences between this group and the control.

Despite the presence of TMD, the presence of craniomandibular myofascial pain in the control group may have increased the activation of the masticatory muscles during rest. The exclusion in the control group of any dysfunction sign or symptom was considered in another study[22]. When some disturbance interferes with the stomatognathic system functioning, the organism uses several adaptive processes to maintain the efficiency of the functions that involve its structures[24]. It is likely that by means of sensory and motor interactions, the presence of myofascial pain in this region modifies the generation of a resting action potential, changing the activation pattern of the craniomandibular muscles[22]. In TMD's study, it is necessary that the control group does not present any dysfunction sign and symptom.

The muscle activation amplitude did not differ in the isometry between the groups with and without myofascial pain and with and without TMD. The same result was observed by Rodrigues-Bigaton et al.[22] and Lauriti et al.[23], indicating that both the presence and intensity of pain in TMD subjects did not influence the electrical activity of the masticatory muscles.

However, other studies have found less electrical activity during the maximal voluntary contraction of the masticatory muscles in subjects with TMJ disorders[25], or with arthrogenetic and psychogenic TMD, but not myogenic TMJ[26]. In this study, the DTM group consisted of individuals with one or more RDC/TMD diagnosis. Most individuals with TMD presented pain only due to muscle palpation[14]. Spontaneous pain (active pain) at rest, which is characteristic in myofascial pain because of muscle tension and contracture[27], was not frequent among subjects in the TMD group. And some of the individuals with TMD classified according to RDC/TMD as group II (disc displacement) showed no signs of joint and muscular pain. As pain is an important modifier of muscle function[26,28,29], it is probable that the absence of the symptom or its location may also have contributed to the similarity in the amplitude parameters during mandibular isometry between the groups with and without TMD.

Due to the anatomical and neurophysiological connection between the craniomandibular structures and the cervical[6], the initial hypothesis was that pain in this region could influence the masticatory muscles' activity. However, no significant difference was observed in the isometry or at rest of the masticatory muscles between the groups. Corroborating these results, Svensson et al.[30] verified through an experimental study that cervical pain is not associated with changes in the electromyographic activity of the mandibular muscles. Nevertheless, it has been shown that masticatory dysfunction seems to be more associated with chronic cervical pain, lasting at least three months[31].

As the presence of pain may alter the functional balance and the masticatory action effectiveness[32], the results of this study reinforce the importance of considering craniomandibular myofascial pain during the evaluation and treatment of TMD-patients. The information obtained through this research provides subsidies for research protocols that identify more specific aspects of the pain influence on the masticatory muscles' activity, contributing to the clinical intervention of these subjects.

CONCLUSION

Cervical pain and TMD did not affect masticatory electrical activity at rest or in isometry. At rest, there was a greater masticatory muscles activation amplitude in the presence of craniomandibular myofascial pain. Thus, craniomandibular myofascial pain seems to interfere in the physiological behavior of the masticatory muscles when the mandible is at rest and should be investigated in the evaluation and intervention of TMD-individuals. The importance of the symptoms absence in the TMD study control groups is emphasized.

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