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Comparison of pressure pain threshold between muscles in the contracted and relaxed state in patients with myofascial pain: a cross-sectional study

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SUMMARY

Objective. The aim of this study was to compare the Pressure Pain Threshold (PPT) of the masseter and temporal muscles in the contracted and relaxed state between patients with myofascial pain (MFP) and asymptomatic individuals.

Materials and methods. Were included 40 women divided into two groups: test group – 20 individuals with MFP; control group – 20 asymptomatic individuals. The PPT was measured using a digital algometer. First. PPT was obtained with the relaxed muscles and soon after with the contracted muscles. To compare the mean value of the PPT of each muscle between the groups the independent Student's t-test was used. To compare the means value of the PPT between contracted and relaxed musculature within each group, the Paired Student's t-test was used. All the tests were conducted with a 5% significance level.

Results. Patients in Test group presented lower mean PPT values in relation to Control group ($p<0.05$). There was an increase in the mean PPT values with contracted muscles, but this increase was not statistically significant ($p>0.05$).

Conclusion. Patients with MFP present lower PPT than asymptomatic individuals. Muscle contraction was able to increase PPT in relation to relaxed muscles, but not in a statistically significant way.

Key words: masticatory muscle, myofascial pain, pressure pain threshold.

INTRODUCTION

Temporomandibular disorders (TMDs) are a group of musculoskeletal disorders that affect the stomatognathic system (1, 2). Population studies have reported the prevalence of TMDs ranging from 11% to 50% (3, 4), incurring billions of dollars in health care annually (1, 2). The literature shows a higher prevalence of TMD in the female gender (approximately 2.4 times more), which can be explained in part by the fact that women seek treatment more than men, besides hormonal and constitutional factors related specifically with the female gender (1, 5).

Myofascial pain (MFP) associated or not with other diagnoses, represents approximately 88.7% of the TMDs (6). MFP is defined as a regional muscular pain related to muscle tenderness and referred pain, with or without limitation of mouth opening (1, 2). The most used test for MFP diagnosis is the digital palpation of the masticatory muscles, which allows to identify areas of greater sensitivity in the musculature (1, 2, 7, 8). Another method of assessing the condition of masticatory muscles is by obtaining the Pressure Pain Threshold (PPT). PPT is the point at which a patient feels that the increasing pressure exerted on an area has become unpleasant or 'painful' (9). PPT can be objectively measured through devices such as algometers (10), and it is evidenced that pressure algometry presents diagnostic efficacy in relation to TMDs symptoms (11).

Increased pain on palpation of masticatory muscles and decreased PPT are considered clinical manifestations of the MFP (12, 13). The main instruments for the TMD diagnosis. Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) and the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD), recommend that palpation should be performed with only relaxed muscles (1, 2). However, the interference of muscle contraction during the palpation examination is not yet fully understood, and this

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knowledge can influence the physical examination in cases of TMDs.

Therefore, the aim of this study was to compare the PPT of the masseter and temporal muscles in the contracted and relaxed state between patients with MFP and asymptomatic individuals. The null hypothesis to be tested is that there will be no differences of PPT between muscles in the contracted and relaxed state in patients with MFP and asymptomatic individuals.

MATERIALS AND METHODS

This cross-sectional study was approved by the Ethics Committee for the Research Involving Human Beings of the State University of Maringá. Maringá. Brazil (Number: 370.090). All patients signed a free informed consent form, and a clinical trial was conducted following the Helsinki Declaration and the recommendations of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (14).

The sample size was calculated considering a test power of 80%, a level of significance of 5% and adding 10%, for possible refusals. The result was 40 individuals.

The sample was divided into two groups:

- Test group: 20 individuals with MFP;
- Control group: 20 asymptomatic individuals.

For this study, were evaluated consecutively 100 patient that sought treatment due to orofacial pain at the Orofacial Pain Clinic of the State University of Maringá. Clinical exams and diagnosis were performed by a single experienced examiner. In this study, only female subjects were included (aged between 20-50 years). For the Test group were included patients with only MFP, diagnosed according to RDC/TMD – Axis I (1), in the official Portuguese version. Sixty patients were excluded from the study for presented with other TMD different from MFP (such as temporomandibular joint arthralgia) or other orofacial pains (such as dental pulpitis); five patients were excluded because of the missing posterior teeth (excluding third molars), and five for the presence of occlusal interference; ten patients that were making the daily use (for more than one week) of medications such as analgesics, anti-inflammatory, muscle relaxants, anticonvulsants, opioids, benzodiazepines, antipsychotics or antidepressants were also excluded from the study. For the Control group were included consecutively 20 asymptomatic women, without any dental problem or doing any drug treatment, members of the university community, who volunteered to participate in the research. The PPT recording procedure was performed by a second examiner, who did not know which group the individual belonged to, using a digital algometer (model DDK-20. Kratos®. Cotía. São Paulo. Brazil). This algometer has a 1cm^2 flat circular-shaped tip at one end and was used to apply pressure over a masticatory muscle and measure the PPT at that muscle site. The pressure application rate was previously calibrated with a stopwatch and set at approximately 0.5 kgf/cm^2/s. Throughout the test, the individual's head was firmly supported by the operator's hand. The device used in the present study had a button that the patient was asked to press at the very beginning of a pain sensation. Therefore, the subject had full control in determining the moment when the applied pressure became painful, with no interference of the examiner. The procedure was fully explained to each patient before the examination. It was emphasized that the purpose of the study was to measure the PPT, not pain tolerance. The PPT was reached when the subject felt the pressure began to turn into pain (13).

The muscles selected were the masseter and the temporal muscles (anterior, middle and posterior), bilaterally. For each muscle, the first PPT measurement was performed in a relaxed state followed by the measurement in a contracted state. The determination of the relaxed and contracted state of the muscles were made only in a clinical way: the muscles were considered in a relaxed state when the patient was at rest, with the lips sealed, without any dental contact; the muscles were considered in a contracted state when the patient was in maximum clinical muscular contraction with maximum occlusal intercupidation. For every individual, each measurement was performed twice (with a 10-minute interval) and the average value between them was recorded.

Statistical analysis

The results were expressed as the mean values and standard deviation (±SD). To compare the mean value of the PPT of each muscle between the groups the independent Student's t-test was used. To compare the means value of the PPT between contracted and relaxed musculature within each group, the Paired Student's t-test was used. All the tests were conducted with SAS version 9.3 (SAS Institute Inc.. Cary. NC. USA), with a 5% significance level.

RESULTS

In the comparison between groups of the PPT of the relaxed and contracted muscles, the Test group patients had lower mean values in all muscles, with statistically significant differences ($p < 0.05$). In the comparison of the PPT between contracted and relaxed musculature within each group, muscle contraction was able to increase PPT in relation to relaxed muscles, but the Paired Student's t-test showed not statistically significant differences in any comparison (Tables 1 and 2).

DISCUSSION

To the best of our knowledge, this is the first study to evaluate the influence of muscle contraction on PPT in individuals with MFP and asymptomatic. The null hypothesis was partially rejected. By comparing the groups, in all muscles, patients in Test group presented significantly lower mean PPT values in relation to Control group. Muscle contraction was able to increase PPT in relation to relaxed muscles, but not in a statistically significant way.

The muscle tenderness is one of the most common symptoms of patients with TMD (1, 2). Clinical and epidemiological studies have demonstrated decreased PPT value in compromised muscle groups (15, 16). The present results support this data. All the muscles of Test group (patients with MFP) presented statistically lower values of PPT ($p < 0.05$) in relation to Control group (asymptomatic individuals). This decrease in PPT values can be explained by peripheral and central sensitization processes and disturbances in the pain modulation system that are likely to occur in these individuals (17). This sensitization makes the normal stimulus (pressure) to be interpreted as pain (13).

In both groups, muscle contraction increased mean PPT values in all muscles. Although this increase was not statistically significant (Tables 1 and 2), all PPT values of the contracted muscles of Test group were higher than the cutoff values (with 90.8% specificity) to distinguish between individuals with and without MFP (13). In the present study, with the contracted musculature. PPT in Test group was 1.909 Kgf/cm^2 and 2.181 Kgf/cm2 for the masseter (left and right side, respectively) and the cutoff value is 1.5 Kgf/cm^2 (13); for the anterior temporalis were found the values of 2.516 Kgf/cm^2 and 2.491 Kgf/cm^2 (left and right sides, respectively), being the cutoff value of 2.47 Kgf/cm^2 (13); for the middle temporalis were found the values of 2.846 Kgf/cm^2 and 2.853 Kgf/cm^2 (left and right sides, respectively), being the cutoff value of 2.75 Kgf/cm^2 (13); for the posterior temporalis were found the values of 2.827 Kgf/cm^2 and 2.869 Kgf/cm^2 (left and right sides, respectively), being the cutoff value of 2.77 Kgf/cm^2 (13). These results suggest that, clinically, performing the palpation examination with the contracted musculature may contribute to false-negative MFP diagnoses.

Increased PPT with contracted muscles may be explained by the mechanism of muscle contraction. As the motor neuron triggers the action potential in the nerve endings present in the muscle fibers, there is acetylcholine secretion. This process initiates the depolarization of these fibers, followed by the sliding of myosin and actin filaments, causing the muscular contraction process. This muscular contraction increases the resistance of the muscle fibers, raising the threshold of nociception of the mechanoreceptors present in the muscles motor plates (18). This mechanism may justify the need for greater pressure to activate the nociception threshold of the mechanoreceptors when the muscles are contracted. Future studies may help clarify the relationship between muscle physiology and PPT.

The present study evaluated only women to eliminate sexual variability. Women show significantly

Table 1. Comparison of means and standard deviations (±SD) of PPT Values (Kgf/cm^2) between Masticatory Muscles in the relaxed and contracted state in Test group.

Side	Muscles	PPT of relaxed muscles	PPT of contracted muscles	p
Left	Masseter	1.406±0.548	1.909±0.651	0.081
	Anterior Temporalis	1.612±0.776	2.516±0.595	0.069
	Middle Temporalis	2.107±0.861	2.846±0.605	0.131
	Posterior Temporalis	2.372±0.834	2.827±1.011	0.162
Right	Masseter	1.434±0.643	2.181±0.967	0.072
	Anterior Temporalis	2.142±0.799	2.491±0.987	0.133
	Middle Temporalis	2.576±1.058	2.853±0.896	0.197
	Posterior Temporalis	2.514±0.985	2.869±0.861	0.201

PPT – Pressure Pain Threshold.

Table 2. Comparison of means and standard deviations (±SD) of PPT Values (Kgf/cm^2) between Masticatory Muscles in the relaxed and contracted state in Control group.

Side	Muscles	PPT of relaxed muscles	PPT of contracted muscles	p
Left	Masseter	2.187±0.853	2.859±0.974	0.122
	Anterior Temporalis	2.966±1.044	3.559±1.142	0.099
	Middle Temporalis	3.536±1.266	3.891±1.316	0.147
	Posterior Temporalis	3.663±1.299	3.951±1.192	0.151
Right	Masseter	2.234±0.766	2.747±0.791	0.101
	Anterior Temporalis	3.108±0.967	3.465±1.187	0.221
	Middle Temporalis	3.410±1.106	3.475±0.937	0.428
	Posterior Temporalis	3.426±1.118	3.677±0.942	0.364

PPT – Pressure Pain Threshold.

lower PPT values than men (19). Hormonal, constitutional, psychological and social factors are possible explanations for this (20). Differences in muscles are also important, since type I fibers are more prevalent in the skeletal muscles of women than in men, which could lead to greater muscle sensitivity (20, 21).

All the results should be analyzed with caution, since this study presents the limitation of being monocentric, with restricted population. In addition, only women were included, which made impossible comparisons between genders. Another important point is that no electromyography was performed to evaluate the activity or tonicity of the muscles. As the present study aimed to understand the influence of muscle contraction in a clinical examination, the determination of the contraction state of the muscles was made only in a clinical way. Further researches, with larger samples, are suggested to improve the knowledge regarding the involvement of muscle contraction in the examination of other TMD conditions such as arthralgia.

CONCLUSION

In view of the results and the limitations of the present study, it can be concluded that patients with MFP present significantly lower PPT than asymptomatic individuals. Muscle contraction was able to increase PPT in relation to relaxed muscles, but not in a statistically significant way.

STATEMENT OF CONFLICTS OF INTEREST

The authors state no conflict of interest.

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