Electromyographic study of patients with masticatory muscles disorders, physiotherapeutic treatment (massage)

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Abstract
The temporomandibular joint disorder is characterized by pain and tenderness in the temporomandibular joint and in the masticatory muscles. Muscle hyperactivity can be of significant characteristic in subjects with Temporomandibular Disorders, which can be associated with pain and muscle fatigue. The aim of this study was to compare the electromyographic activity behavior of the major chewing muscles (anterior temporalis and masseter muscles) by using Parafilm material through analysis of the electromyographic signals before and after massage therapy. Sixty young adult female subjects, 17 to 27 years old, formed the total sample group. It was divided into twenty subjects with normal occlusion and no history of temporomandibular disorder, and forty subjects with signs and/or symptoms of TMD from parafunctional habits (excessively hard chewing or repeated forced mandibular opening and bruxism), which were then subdivided into twenty subjects who were submitted to physiotherapeutic treatment (massage), and twenty subjects who were not submitted to treatment. The masticatory activity was performed with the subjects comfortably sat, with the Frankfurt plane parallel to the floor. Electromyographic exams were carried out using bipolar surface differential electrodes positioned on the anterior body of the temporalis muscle and on the masseter muscles. The subjects were then instructed to bite bilaterally and simultaneously on the material. For the study of the masticatory activity the electromyographic signals were processed through rectification, linear envelope, and the coefficient of variation obtained from the procedure was comparatively analyzed. All the data collected was submitted for further analyzes of the variance. The study of the electromyographic signals of the masticatory activity in the isotonic contractions of the muscles in study was registered, stored, and analyzed by the RMS values (Root Mean Square). Moreover, the Analogue Visual Scale was utilized to assess the subject’s pain pre and post treatment. The results of this study indicated that the massage therapy decreased muscle hyperactivity, promoting better relaxation. Also, 87% of the subjects presented significant improvement of the TMD symptoms and sings. In general, this treatment is indicated as a complement of other treatment plans. The electromyographic exams are very important to analyze muscular activity; in addition, many authors agree that the common etiologic factor for TMD is the muscle hyperactivity. There is a substantial relationship between TMD and hyperactivity of the temporal muscle, and the physiotherapeutic treatment (massage) can reduce and eliminate pain and hyperactivity.

Key Words:
electromyography (emg), physiotherapy, massage, bruxism, temporomandibular disorders.
Introduction

The temporomandibular disorder (TMD), also denominated Costen Syndrome, is characterize by several signs and symptoms such as temporomandibular joint (TMJ) pain, chronic headache, articular sounds during the condylar movements, restriction of mandible movements, humming, dizziness, and also local chronic pain along with sensibility and pain on the masticatory musculature, cervical region, and shoulder girdle. The onset and intensity of these signs and symptoms may vary between the subjects.

In 1990 the American Academy of Orofacial Pain (AAOP) published the TMD classification, which is integrated with the International Headache Society medical diagnostic classification. Considering the fact that the majority of TMD classifications are not fully acknowledged as practicable, AAOP had an overall acceptance, and it is utilized nowadays as standard reference. Therefore, according to AAOP, TMD can be etiologically classified as arthrogenic, myogenic and mixed.

The etiology of the TMD is just as varied as its symptoms, considering that several factors can modify the dynamic balance of the masticatory system components.

The most common etiologic agent regarding the myogenic balance of the masticatory system components is the muscular hyperactivity. This hyperactivity can be triggered by malocclusion, associated with the hyperactivity of an isolated muscle or in different types of combinations.

One of the triggering factors related to pain and/or miofacial disorder are the mandibular parafunctions. Among these parafunctions, bruxism can be exalted. According to these authors, muscular pain, malocclusion, articular degeneration, TMJ disk disarrangements, chronic headache, masseter hypertrophy, periodontitis and teeth wearing are the most common parafunction signs and symptoms.

Several treatment options are proposed to muscular disorder. Among others, utilize the mouthguard (stabilize plate) as a therapeutic device to treat muscular disorders resulting from bruxism, with the goal of attaining relaxation of the masticatory musculature. However, only the first author utilize the stabilize mouthguard with a relaxation purpose, thus, not accomplishing the treatment. The second author recommended the mouthguard use only with the purpose of capturing EMG signals, disregarding the proposed objective of his study. This line of thinking can be seen in the majority of the researches (for example), where this stabilize mouthguard is used only as an object of study during the gathering of the EMG signals, and not as a therapeutic aid.

Although massage is a technique that has been used for many years, there are no scientific studies proving its effect, especially in TMDs. Bell describes some techniques used in massotherapy such as sliding and kneading. However, there are no researches about the effects of such techniques in the TMJ, even though they are the most applied techniques in patients with TMJ disorders.

Recently, EMG allows us to measure the efficiency and the changes in muscular activity during a certain type of treatment, becoming a useful tool in the assessment of the treatment development process. Nevertheless, the intent of this project is to assess the physiotherapeutic approach of massotherapy in myogenic TMD volunteers through the analysis of the electromyographic trace, comparing pre and post therapeutic behavior of the masseter muscle and the anterior portion of the temporal muscle during the isotonic bilateral masticatory activity.

Material and Methods

Subjects

Primarily, a questionnaire was submitted to three hundred and fifty two volunteers (310 women and 42 men) aged 17 to 27 years old. All the volunteers attended the University of Mogi of Cruzes (UMC) physical therapy course. Moreover, a selection was made according to the inclusion and exclusion criteria, which will be further described, and 84 volunteers were selected.

All of them were submitted to the EMG assessment, assembling a standard sample group, which excluded 24 volunteers. The 60 remaining volunteers, all women, were divided in three groups.

Group 1: 20 young women with normo-occlusion (class I - Angle) and no history of temporomandibular disorder, regarding the inclusion criterion. They were submitted to the EMG exams, but not to the physiotherapeutic treatment.

Group 2: 20 young women with signs and/or symptoms of myogenic TMD related to bruxism or clenching, also regarded to the inclusion criterion. They were submitted to both EMG exams and massotherapy.

Group 3: 20 young women with signals and/or symptoms of myogenic TMD related to bruxism or clenching, respecting the inclusion criterion. They were submitted to EMG exams, but not to the massage therapy.

Criterion of Inclusion

The sample group was subdivided in 3 groups of 20 volunteers. The first group was made of female volunteers without TMD signs and/or symptoms, with normo-occlusion (class I – Angle), normal electromiographic pattern of the masticatory muscles, and they were also asked to assume...
A questionnaire to select the volunteers presenting or not presenting temporoamandibular disorders.

After accomplishing the first steps of the research the group submitted to treatment, which included twenty subjects with muscular dysfunction, underwent 15 physiotherapeutic sessions for 30 minutes each, five times a week, using only the muscular relaxation technique through sliding and kneading massage therapy.

The sliding and kneading massage techniques were applied to the studied muscles with an orthopedic lotion (Ortocream,
The Analogue Visual Scale\textsuperscript{17-18} was used and the sample group was divided according to the classification of the pre-selected groups.

In this research, the Analogue Visual Scale (AVS) was composed of a 10 centimeter horizontal line (without marks), presenting in its left end a painless information, and in its right end, the information regarding the worst pain ever. The volunteers were instructed to trace a vertical line above the horizontal scale line (without tracing over it), indicating in which point of the straight line the pain was. This procedure was performed with the same pen for all the volunteers. This assessment was taken after the first electromyographic exam, and immediately after the second exam for both groups, so the subjects would not see their first trace, and consequently be influenced by it.

Placement of the Electrodes
The skin above the muscles in study was cleaned with a cotton soaked in alcohol to reduce the electrical resistance of the skin. The electrodes were placed following the longitudinal lining and parallel to the direction of the muscle fibers, after a maximum intercuspation.

Electromyograph
To register the electromyographic signals, the channel was calibrated allowing a gain of 2000, with a cut frequency of 10Hz in the high passing filter, and 500Hz in the low passing filter attained through an analogical filter, Butterworth, with two terminals (poles) which presented an acquiring frequency of 1000Hz.

All the analogical signals were amplified and prepared to be digitized in conditioned modules of signals (MCS 1000V2. Lynx) with 16 analogical entries.

The volunteers were placed comfortably on a chair, with their back supported in the Frankfurt plane, parallel to the floor. Their eyes were oriented forward (as looking to the infinite), feet on the floor, and arms supported on the inferior limbs.

The muscles to be worked with more intensity in this study were the muscles with higher EMG activity, along with a higher sensibility in the clinical assessment; therefore, each subject had her own individuality respected.

After finishing 15 sessions, the EMG data gathering protocol was repeated with all the patients participating in the research, which consisted in the 20 subjects who reported TMD and were not submitted to treatment, 20 subjects of the control group who were not submitted to therapeutic intervention as well, and the other 20 subjects who underwent treatment.

Visual Analogue Scales (VAS)
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The data collected in this study demonstrated that the massage therapy technique applied on the Group 2, a significant result of decreased EMG activity of all the muscles in study was collected, as seen in Graphic 1 and 2, and in Figure 1.

Analogical Visual Scale (VAS)
The results (Graphic 2) point out the difference (p=0,0026) between the AVS scores, which was taken before and after the treatment (analyzed by the ANOVA statistical test). There was a significant decrease in pain on the miogenic TMD subjects after they were submitted to the massage therapy treatment.

Discussion
The data collected in this study demonstrated that the massage therapy (sliding and kneading techniques) was efficient in decreasing the electrical activity of the hyperactive studied muscles, due to the bruxism.

Even though it is not possible to draw a comparison with the literature that deals with the effect of massage therapy in patients with bruxism due to the fact that there is no literature registers of this protocol, the results collected are in agreement with the classic literature concerning the massotherapy\textsuperscript{14-15,20}, which supports the theory of promotion of increased blood and lymphatic circulation, favoring a muscular relaxation.

Most of the studies done in the past regarding this treatment tended to use the mouthguards as a therapeutic aid\textsuperscript{11-12,28}. For this reason, the goals of this research done in volunteers presenting bruxism was to verify the effect of the physiotherapeutic treatment, utilizing the massage technique,
considering the possible variation of the electromyographic signal during bilateral isotonic mastication.

The results showed that the massage technique (sliding and kneading) was useful to decrease the electric activity of the studied muscles, which were hyperactive because of the onset of bruxism presented by the subjects.

The results of this research, considering the experimental conditions in which it was conducted, lead us to these conclusions:

1. There was an improvement in the volunteer’s symptoms.
2. The decrease of the electromyographic activity in the studied muscles was significant in the sample groups submitted to treatment.
3. There was evidence of efficiency in the use of massage therapy in the Myogenic Temporomandibular Disorder.

The 15 sessions used for treatment attained the proposed objectives.

Based on the results, we can consider that the therapeutic protocol presented in this research can be added to other treatment plans, where they can achieve certain treatment goals as complements of each other, considering its own unique importance.

References


