FABRICIO DE OLIVEIRA TEIXEIRA LOPES

EFEITO DA MOBILIZAÇÃO ARTICULAR DA ATM NA DOR, NO SINAL ELETROMIOGRÁFICO E NA AMPLITUDE DE MOVIMENTO DE MULHERES COM DTM MUSCULAR.

Dissertação de Mestrado apresentada à Faculdade de Odontologia de Piracicaba da UNICAMP, para obtenção do Título de Mestre em Biologia Buco-Dental, na Área de Anatomia.

Orientador: Prof. Dr. Fausto Berzin

Este exemplar corresponde à versão final da Dissertação defendida pelo aluno e orientada pelo professor Dr. Fausto Berzin

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Conhecer o homem!
Esta é à base de
todo o sucesso!

Charles Chaplin

RESUMO

O objetivo deste estudo foi avaliar o efeito da mobilização articular temporomandibular sobre o sinal eletromiográfico, amplitude de movimento e na dor de 18 mulheres com idade média de 30,38 (±4,31) anos portadoras de disfunção temporomandibular muscular. As avaliações ocorreram em 5 momentos: Pré Placebo, Pós Placebo, Pré Terapia, Pós terapia e Quarenta e oito horas após terapia. Para a obtenção do limiar de dor a pressão utilizou-se o Algômetro digital DDK/20 (Kratos). A atividade elétrica dos músculos temporais e masseteres foi avaliada bilateralmente com o sistema de aquisição de sinais Lynx ADS 1200 um ganho de 1 a 16000, freqüência de amostragem de 2000 hz, filtro passa banda de 20-500Hz e os valores expressos pelo root mean square. A avaliação da amplitude de movimento seguiu os critérios do Eixo I do Research Diagnostic Criteria. Os dados foram submetidos à análise de variância através do procedimento GLIMMIX do sistema SAS. Medidas saneadoras foram aplicadas e onde houve efeito significativo foi aplicado o Teste de Tukey ($p<0,05$). Os resultados mostraram que a mobilização articular gerou efeitos positivos imediatamente após o tratamento levando à diminuição da dor articular e muscular, aumento no sinal eletromiográfico e aumento da amplitude de movimento da articulação temporomandibular, sendo que 48 horas após foram mantidos os efeitos de diminuição de dor articular do lado direito, masseter esquerdo e temporal esquerdo, aumento no sinal eletromiográfico nos músculos masseter e temporal esquerdos e aumento na amplitude de movimento.

Palavras chaves: Eletromiografia, manipulações musculoesqueléticas, fisioterapia, cefaléia.

ABSTRACT

The objective this study was to evaluate the effect of temporomandibular articular mobilization in the pain caudal way, in the Electromyographic sign and in the movement amplitude of 18 women at the average age of 30, 38 (±4.31) years old presenting temporomandibular muscular dysfunction .Evaluations occurred in 5 moments: Pre Placebo, Post Placebo, Pre Therapy, Post therapy and forty eight hours after the therapy. In order to obtain pain threshold for pressure it was used a DDK/20 digital algometer (Kratos). The electric activity of the temporal and masseter muscles was evaluated bilaterally with the Lynx ADS1200 signals acquisition system , a gain from 1to 16000, 2000 Hz sampling frequency, 20-500HZ pass band filter and the values expressed by root mean square. Movement amplitude evaluation followed Research Diagnostic Criteria Axis I .Data were submitted to the variance analysis through GLIMMIX procedure of SAS system (The SAS System, release 9.2. SAS Institute Inc., Cary: NC, 2008). Sanity measures were applied (One-way ANOVAs) and where there was a significant effect $p<0.05$) Tukey Test was applied .The results showed that the articular mobilization generated positive effects immediately after the treatment leading to articular and muscular pain decrease, Electromyographic sign increase and temporomandibular joint movement amplitude increase .After forty eight hours the effects of decreased articular pain in the right side, left masseter and temporal muscles, increase in the electro myographic sign in the left masseter and temporal muscles and increase in the movement amplitude remained.

Keywords: Eletromiography, musculoeskeletical manipulation, physiotherapy, headache.

SUMÁRIO

INTRODUÇÃO

A disfunção temporomandibular (DTM) consiste em um grupo de patologias que afetam os músculos mastigatórios, a articulação temporomandibular (ATM) e demais estruturas relacionadas. É considerado um distúrbio musculoesquelético do sistema mastigatório que afeta mais de 25% da população (1), sendo que as mulheres são 10% mais afetadas do que os homens (2). A DTM frequentemente se manifesta com vários sintomas, como dor, ruídos articulares, limitação de amplitude de movimento, espasmos musculares (3).

A dor miofascial se destaca entre esses sintomas, podendo também ser causa dessas disfunções, logo que estímulos nociceptivos provenientes da capsula articular da ATM podem, por meio de mecanismos musculares compensatórios, alterar o correto funcionamento dessa articulação (4).

Todos os problemas clínicos associados à DTM podem ocorrer simultânea ou separadamente, oscilar ao longo do tempo ou tornar – se crônicos. Frequentemente a disfunção torna-se autolimitante, interferindo na complexa relação existente entre fatores físicos e psicológicos. Pacientes com DTM crônica relatam sintomas de depressão, pobre qualidade de sono e baixo nível de energia, interferindo na qualidade de vida, nas relações interpessoais e atividades sociais (5, 6, 7, 8). Assim, buscando o correto funcionamento da ATM com redução dos sintomas e aumento da qualidade de vida desses pacientes, a fisioterapia tem ganhado grande destaque nos últimos anos. Além de promover a redução da dor, a reabilitação fisioterápica é capaz de promover a redução da inflamação, melhora da amplitude de movimento (ADM) e restabelecimento da função motora. Diversas modalidades fisioterapêuticas são utilizadas no tratamento da DTM, dentre elas, a eletroterapia, exercícios e técnicas de terapia manual (9, 10).

A terapia manual é uma especialização dentro da fisioterapia que consiste na aplicação de técnicas com as mãos utilizadas pelo fisioterapeuta no corpo do paciente, com o objetivo de promover o retorno à função normal dos seus sistemas. Destaca-se por uma resposta rápida no ganho de amplitude de

movimento articular, relaxamento muscular, diminuição da dor e restabelecimento da função (11).

As manobras manuais de decoaptação da ATM têm como objetivo inibir o espasmo dos músculos mastigatórios, devolver a elasticidade da cápsula articular e dos ligamentos, diminuindo desta forma a dor e restaurando a função da ATM e músculos mastigatórios (4). Cada movimento realizado é acompanhado de numerosos reflexos reguladores e de adaptação incluindo o fenômeno de facilitação e inibição. Além de certo limite de tensão, o reflexo miotático direto inverte-se, tornando-se inibidor em conseqüência dos receptores tendinosos de Golgi, que promovem o relaxamento muscular (12). Essas evidências têm sido demonstradas por meio da utilização da EMG. Ela tem apontado mudanças na função muscular após intervenções terapêuticas. (13). Diversos estudos demonstram que indivíduos com DTM apresentam diminuição do rms quando realizam a contração isométrica voluntária máxima (14,15, 16) e que após intervenções terapêuticas, cujos resultados são positivos, é comum haver um aumento no valor deste sinal.

Assim, a terapia manual tem se apresentado como uma boa alternativa ao tratamento das DTMs, sobretudo porque se sugere que é capaz de promover tanto benefícios articulares como musculares, independentemente de sua origem. Entretanto, são escassos na literatura estudos que tenham demonstrado seu efeito. Apesar de no dia-a-dia clínico, a terapia manual ser utilizada com sucesso para o tratamento das DTMs, essa investigação se faz necessária para que evidências científicas demonstrem seus efeitos fisiológicos. Desta forma o presente estudo teve por objetivo avaliar o efeito da mobilização articular da ATM no nível de dor, no sinal eletromiográfico e na amplitude de movimento (ADM) de mulheres portadoras de DTM muscular.

CAPÍTULO 1

Esta dissertação está baseada na Resolução CCPG UNICAMP/002/06 que regulamenta o formato alternativo para teses de Mestrado e Doutorado e permite a inserção de artigos científicos de autoria ou coautoria do candidato. Por se tratar de pesquisa envolvendo seres humanos, o projeto de pesquisa deste trabalho foi submetido à apreciação do Comitê de Ética em Pesquisa da Faculdade de Odontologia de Piracicaba, tendo sido aprovado com o número de protocolo 023/2010 (Anexo 1). Sendo assim, esta dissertação é composta de 1 artigo, conforme descrito abaixo:
ARTIGO:

The effect of TMJ mobilization on pain, range of motion and EMG in women with muscular TMD.

Lopes FOT, Bérzin F,Alves MC, Vera RMDT.

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INTRODUCTION

TMD temporomandibular dysfunction consists in a group of pathologies which affect the masticatory muscles, the temporomandibular joint (TMJ) and other related structures. It`s considered a masticatory system musculoskeletal condition which affects more than 25% of the population (1), being the women 10% more affected than the men (2). TMD frequently presents several symptoms such as pain, articular noise, movement amplitude limitation muscular spasms (3).

Myofascial pain highlights itself among these symptoms and might be the cause of these dysfunctions as nociceptive stimulus coming from the TMJ articular capsule can through compensatory muscular mechanism alter the correct work of this joint (4).

All the clinical problems associated to TMD can occur simultaneously or separately, oscillate through time or become chronic. Frequently the dysfunction becomes self limiting interfering in the complex relationship existent among

psychological and physical factors. Patients presenting chronic TMD report depression symptoms, poor quality sleep and low energy level, interfering in the quality of life, in the interpersonal relationship and social activities (5, 6, 7, 8).

So, aiming the correct work of TMJ with symptoms reduction and increase in life quality, Physical therapy has distinguished itself over the last years. Besides reducing pain , the physical rehabilitation is able to reduce inflammation , improve movement amplitude (DMA) and restore motor function several physical therapeutic types are used I n the treatment of TMD among them, exercises and manual therapy techniques (9,10).

Manual therapy is a specialization inside physical therapy which consists on the application of techniques using the hands performed by physical therapists on the patient's body aiming to promote the return to the normal function of its system (11).

It distinguishes itself by a quick response in the gain of articular movement amplitude, muscular relaxation, pain relief and function restore.

Manual maneuvers of TMJ decoaptation has as an objective inhibit the masticatory muscles spasms, bring back the ligaments and articular capsule elasticity, decreasing the pain and restoring TMJ and masticatory muscles function (4). Each movement is followed by many regulator reflexes and adaptation including the facilitation phenomenon and inhibition. Besides some tension limit, the direct myotactic reflex is inverted becoming inhibitor due to tendinous Golgi receptor which promotes muscular relaxation (12). These evidences have been demonstrated by the means of EMG utilization. It indicated changes in muscular function after therapeutic interventions (13). Several studies demonstrated that individuals presenting TMD show rms decrease when performing maximum isometric volunteer contraction and that after therapeutic interventions whose results are positive, it is common an increase in the value of this signal (14, 15, 16).

Therefore manual therapy has presented itself as a good alternative to the TMDs mainly because it is able of promoting articular and muscular benefits, no matter their origin. However, studies showing its effects are scarce in the

literature. In spite of manual therapy has been used for TMDs treatment successfully on the clinical day-by-day, this investigation is necessary in order to scientific evidences demonstrate its physiologic effects .On this way, the present study has had as an objective to evaluate the effect of TMJ articular mobilization in the level of pain, in the Electromyographic sign and in the movement amplitude of women presenting muscular TMD.

METHOD

Eighteen women, at the average age of 30,38 (+-4,31) years old presenting characterized muscular TMD for a period of ,at least, 3 months This work was approved by the ethical committee of the institution. After being told about all the procedures to be followed the volunteers signed an informed consent form.

INCLUSION CRITERIA

In order to evaluate TMD symptoms and signs it was applied the Research Diagnostic Criteria protocol to the presence of signals and symptoms of TMD so that women who presented muscular TMD were included (group 1 and 2) (17).

EXCLUSION CRITERIA

Individuals with teeth absence, history of systemic disease, facial and temporomandibular trauma a, TMJ articular luxation and neurological pathologies were excluded .Besides that, volunteers who were taking anti-inflammatory and/or painkiller, and /or muscle relaxing were excluded as well.

ELECTROMYOGRAPHIC EVALUATION

Electrical activity of the anterior portion of the masseter and temporal muscles was bilaterally evaluated with the Lyns ADS signals acquisition system 1200 with 8 channels, 14 bits resolution PCI/AD a gain of 1 to 16000, 2000 Hz sample frequency for each channel, 20-500Hz filter butterworf pass band, AqDados software, where the signals was digitalized and stored in the computer

Signals processing and visualization were performed by AqDAnalysis. EMG data were registered by root mean square (RMS).

The electrodes used were disposable ones, ative bipolar, made out of Ag/AgCl, in double circular shape, with 1cm inter electrodes distance and a gain of 20 times (manufactured by Hal Indústria e Comercio Ltda, São Paulo, Brazil).

Electrodes were placed on the masseter muscles ventral portion approximately 1.5 to 2.0 mm above the mandible angle toward the upper eyelid. On the anterior portion of the temporal muscles, about 1.0 to 1.5 mm behind and above the external eyelid commissure. The reference electrode was placed on the external manubrio.

Three isometric contractions of the masticatory muscles were performed lasting 5 seconds, every 60 seconds keeping a Parafilm between the superior and inferior molar teeth®. RMS numbers were obtained in the period of 5 seconds of muscular contraction. The average of these 3 measurements was made and used as a real value.

EVALUATION OF PAIN THRESHOLD PRESSURE

In order to obtain the pain threshold for pressure it was used the digital DDK/20 algometer (Kratos Equipamentos industriais) containing a bar with a flat circular tip which applies a (kg/cm^2) increasing pressure on each demarcated point until the moment that the volunteer signalize indicating that the pressure turned in pain. The measurements were performed 3 times and the average used as a value (18).

EVALUATION OF THE TMJ MOVEMENT AMPLITUDE (MA)

This evaluation followed the criteria of the first item of the RDC axis. The volunteer was sitting and the head in free position. The non-assisted opening without pain and right and left Lateral excursions performed 3 times each one was evaluated. The average of these three measurements was calculated and this value was taken as a reference. The measurements were obtained in millimeters through the Tramontina® paquimeter.

EXPERIMENTAL DESIGN

The experiment was performed on 3 different not consecutive days and the evaluations at 5 different moments. On the first day, moment 1 – Pre Placebo and 2 – Post Placebo were performed. 48 hours after it, moments 3 –Pre Therapy and 4 – Post therapy were performed. 48 hours after the therapy, moment 5 was performed. At all moments, movement amplitude, pain and Electromyographic evaluations were performed respectively. They were applied previously to the interventions and immediately after them, but at moment 5 there was no intervention just evaluation.

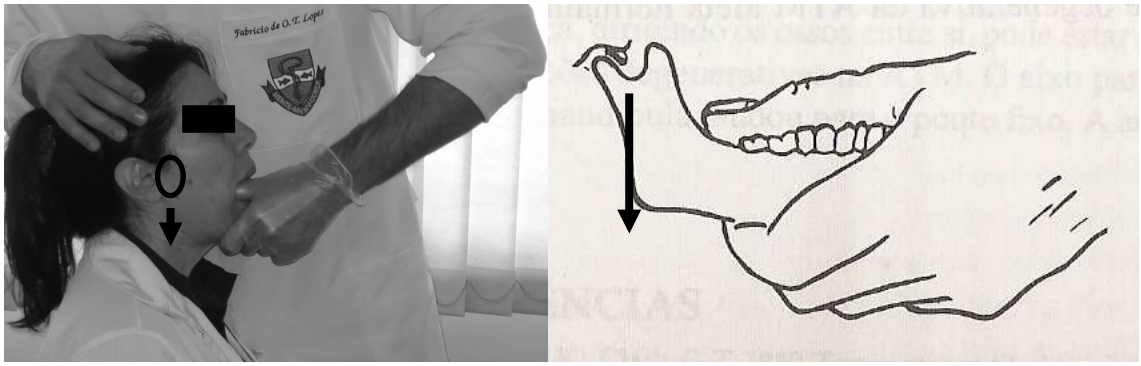
INTERVENTION

The volunteer was placed sitting on a chair, with the feet on the floor, knees and hips in 90 degrees with the trunk on the chair back and the arms on the knees. The cervical and the head were positioned freely, with no correction but the therapist just stabilizes the head during the articular mobilization keeping the previous posture.

The therapist positioned himself standing on the opposite side of the joint to be mobilized. For example, in the right TMJ mobilization, the therapist was at the left side of the volunteer, performing the traction with the left hand and stabilizing the head of the volunteer with the right hand. With the hand which performs the traction properly protected by Danny® disposable vinyl gloves, the therapist with the elbow in 90º, positioned the palmar region below the mandible body, so that the second finger (indicator) positioned itself just below the mandible branch and the fifth finger (minimum) below the thumb was intra-oral on the inferior pre-molar and molar teeth, but the major point of support was on the inferior molar teeth (mandible proximal branch) (19).

Based on the above mentioned positioning the therapist performed an ulnar deviation with the wrist which caused the lowering of the mandible proximal branch generating traction on the TMJ on the caudal way (6-9) (picture 1). 3 series of 10 tractions performed rhythmically following the beats of a Taktell® metronome were performed Each traction motion (glide) lasted 2 seconds plus 2 seconds to return to the initial position. After the tenth traction of every

series, the final position reached by the joint was kept for a period of 20 seconds (20). In the sequence was a break of 30 seconds when the mandible remained in resting position All the breaks of time followed the beats of the Taktell® metronome adjusted at 60 beats per minute. Such programming assured that the beats lasted 1 second (21).



Picture 1: TMJ Joint mobilization. The arrows point in the caudal mobilization.

In the placebo technique, the volunteer and the therapist positions were identical to the articular mobilization technique described , but in this one the therapist did not performed the condilo traction on the cranium caudal way. This positioning was kept for 60 seconds. 3 series with 30 second- breaks were performed.

STATÍSTIC ANALYSIS

Data were submitted to the variance technique with a proper model used in experiments with a factor obtained through repeated measurements condition. Calculus were made through the GLIMMIX procedures of the SAS system (SAS Institute Inc). (The SAS System, release 9.2. SAS Institute Inc., Cary: NC, 2008) which allowed the analysis adequacy to the distribution of data, variables adhering to the following distributions were identified: Gaussian (normal), lognormal, gamma e central. The technique of estimation selected was REML and it was used Kenward-Roger method to standard deviation calculus.

Sanity measures were applied in order to the residues followed the normal distribution and the adopted model to the study was one proper to experiments

with a factor (One-way ANOVAs) obtained in repeated measurements condition once the 3 treatments were applied on the same volunteer.

The cases which presented significant effect detected by the variance analysis was arbitrated “a priori” the Tukey test application.

The study was conducted with a significance level of 5% in all the statistics tests applied.

RESULTS

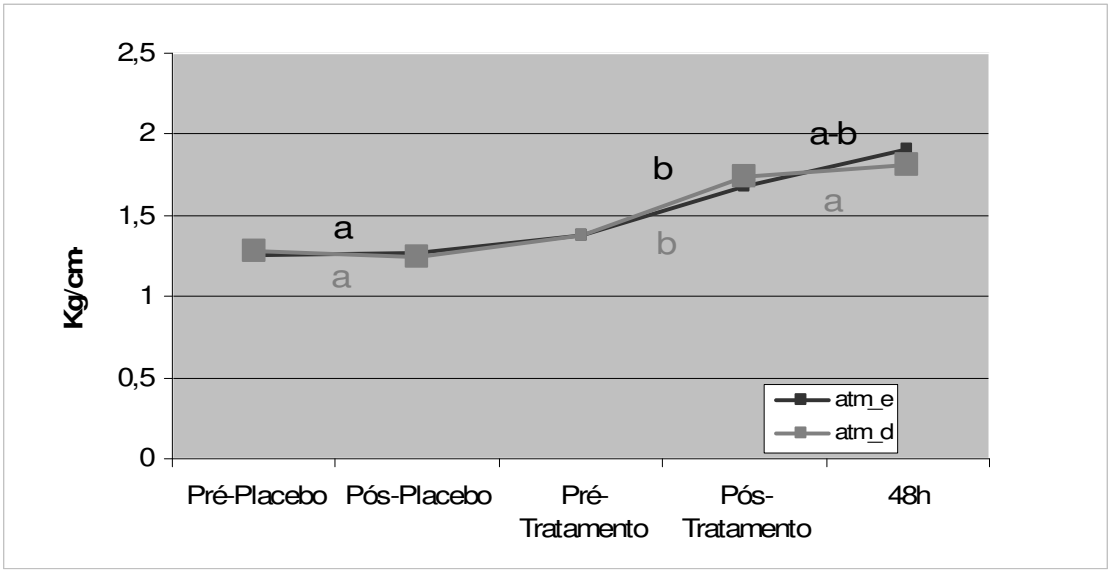
TMJ ALGOMETRY

Pain evolution evaluated by the algometry was studied and the basic statistics are presented in Table 1.

Table 1. TMJ algometry pressure ($Kg.cm^{-2}$) averages (± standard deviation) in the different moments chosen to evaluate the pain.

Evaluation moments	TMJ	
	Left	Right
Pré-Placebo	1,26 (±0,56)	1,28(±0,52)
Pós-Placebo	1,27(±0,52)	1,25(±0,56)
Pré-Treatment	1,37(±0,59)	1,38(±0,56)
Pós-Treatment	1,68(±0,69)	1,74(±,68)
48h	1,91(±0,78)	1,81(±0,73)

Interpretation starts with the evaluation of the pain evolution along the therapy process applied and it can be observed in Picture 2 a line practically horizontal linking pre and post placebo moments, which shows the relative stability of the pain in this period.



Picture 2: Right and left TMJ algometry. Averages shown with equal letters aren't different among them according to Tukey-Kramer test with significance level of 5%.

When the effect of the treatment is evaluated an inclined line is seen, which shows a decreasing in the pain average from the pre-treatment moment to the post treatment moment.

Finally, in the third condition evaluated, post-treatment condition which goes from the post-treatment moment to the 48 h moment after the treatment application, slightly different effects in the right TMJ occur, in which the line is practically horizontal and shows the stability of the pain levels and in the left TMJ where some degree of inclination remains which could indicate the reduction of pain levels.

Analyzing the results through Tukey test, calculated according to the variance analysis model which considers the matter of repeated measurements in the time, it's observed different behaviors in the right and left TMJ averages of pain.

In the right TMJ it's seen a behavior in which the placebo effect doesn't differ from the effect observed in the post treatment condition significantly, both pointing to a relative stability on the pain levels. These two conditions differs from the observed effect of the treatment condition, where there is a reduction

in the pain level, significantly ($p<0,05$). In the left TMJ, signs of difference among the placebo condition pain averages (stable) regarding the pain variation in the treatment are observed as well. Although, when the post treatment effect is compared, no signs of differences between this and the placebo condition (same result observed in the right TMJ) are observed. However, there aren't signs that this effect is different from the treatment condition, either.

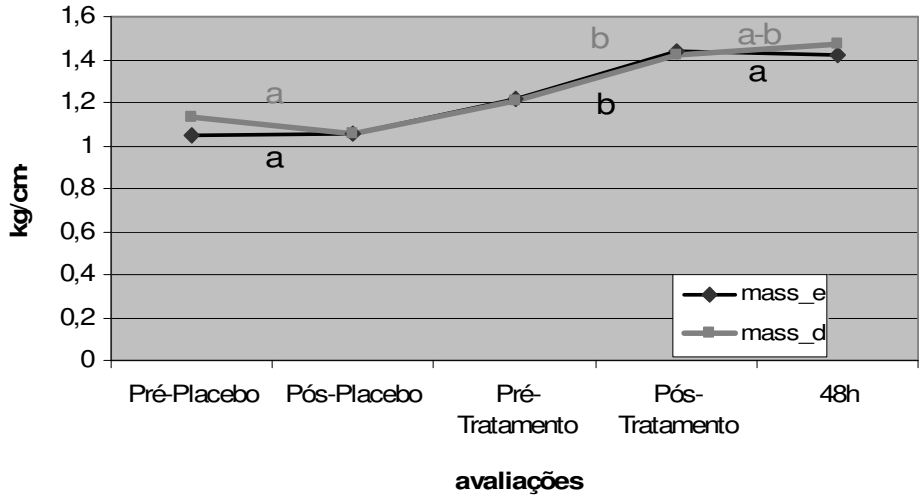
MASSETERS MUSCLES ALGOMETRY

Evolution of pain evaluated by the algometry and its basic statistic are presented in Table 2.

Table 2. Masseters algometry pressure ($Kg.cm^{-2}$) averages (±standard deviations) in the different moments chosen to evaluate the pain.

Evaluation moment	MASSETER	
	Left	Wright
Pré-Placebo	1,05(±0,48)	1,13(±0,48)
Pós-Placebo	1,05(±0,41)	1,06(±0,42)
Pré-Tratamento	1,21(±0,55)	1,21(±0,54)
Pós-Tratamento	1,44(±0,50)	1,42(±0,56)
48h	1,42(±0,50)	1,48(±0,58)

It can be observed in Picture 3, a line practically horizontal linking pre and post moments regarding to left masseter showing a pain stability in this period and a line with decreasing inclination referring to right masseter which shows a slightly worsening in the pain during this period.



Picture 3: Right and left masseter muscles algometry. Averages shown with equal letters aren't different among them according to Tukey-Kramer test with significance level of 5%.

When the effect of the treatment is evaluated an inclined line is seen which shows a bilaterally decreasing pain average from the pre treatment to the post treatment moments.

In the third condition evaluated, condition of post treatment which goes from the moment post treatment moment to the 48 moment after the treatment application, slightly different effects occur on the left masseter muscle in which the line is horizontal and shows stability of pain levels and in the right masseter where some degree of inclination remains which could indicate the reduction of pain levels.

Tukey test points that in the left masseter muscle it`s clear a behavior in which the placebo effect doesn`t differ from the effect observed in the post treatment condition significantly, there is a relative stability in the pain levels. These two conditions differ significantly ($p<0,05$) from the effect observed in the treatment condition where there is pain level reduction.

In the right masseter muscle signs of difference among the placebo condition pain averages (stable) and the pain variation in the treatment are observed as well. There is no sign that this effect is different from the treatment condition. When the post treatment effect is compared there is no sign of difference

between this and the placebo condition (same result is seen in the left masseter) .However, there aren't signs that this effect is different from the treatment condition, either.

TEMPORAL MUSCLES ALGOMETRY

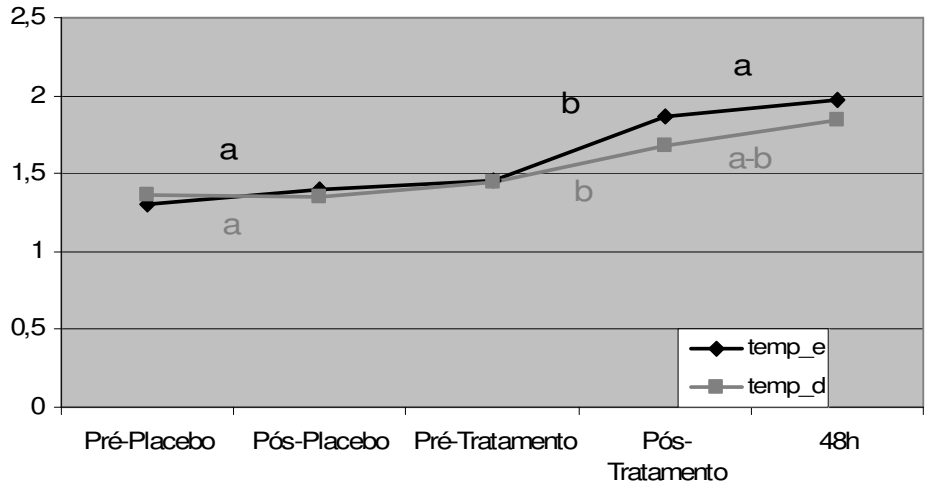
Evolution of pain evaluated by the temporal muscles algometry and its basic statistic analysis are presented in Table 3.

Table 3. Temporal muscles algometry pressure ($Kg.cm^{-2}$) averages (±standard deviations) in the different moments chosen to evaluate the pain.

Evaluation moments	TEMPORAL	
	Left	Right
Pré-Placebo	1,30(±0,54)	1,36(±0,55)
Pós-Placebo	1,40(±0,53)	1,35(±0,54)
Pré-Treatment	1,45(±0,65)	1,45(±0,70)
Pós-Treatment	1,86(±0,70)	1,68(±0,62)
48h	1,98(±0,91)	1,84(±0,77)

It can be observed in Picture 3, practically horizontal lines linking pre and post moments regarding to temporal muscles showing bilateral pain stability in this

period.



Picture 4: Right and left temporal muscles algometry. Averages shown with equal letters aren't different among them according to Tukey-Kramer test with significance level of 5%.

When the effect of the treatment is evaluated an inclined line is seen which shows a bilaterally decreasing pain average from the pre treatment to the post treatment moments.

In the condition of post treatment which goes from the moment post treatment moment to the 48 h moment after the treatment application , it`s possible to see an inclination on the line of the left and right temporal muscles ,indicating pain levels reduction .the left temporal muscle presents significant difference regarding the therapy.

Through Tukey test it's seen different behaviors on the right and left joints pain averages.

In the left temporal muscle it's clear a behavior in which the placebo effect doesn't differ significantly from the effect observed in the post treatment , These two conditions differ significantly ($p<0,05$) from the effect observed in the treatment condition where there is pain level reduction.

In the right temporal muscle signs of difference among the placebo condition pain averages (stable) and the pain variation in the treatment are observed as well . When the post treatment effect is compared there is no sign of difference between this and the placebo condition (same result is seen in the left temporal) .However, there aren't signs that this effect is different from the treatment condition, either.

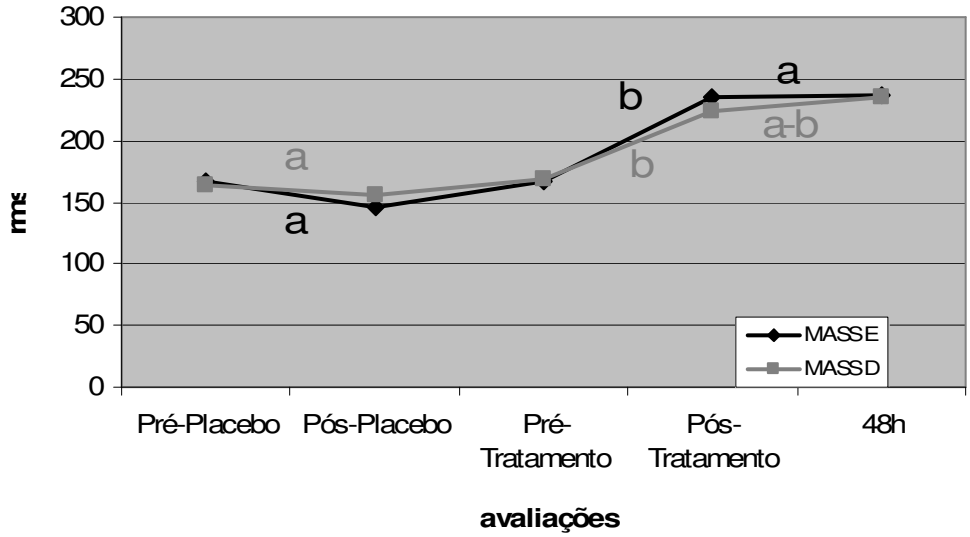
MASSETER EMG

Electromyographic sign evolution was studied and the basic statistics are presented in Table 4.

Table 4. Left and right temporal muscles Electromyographic sign averages (± standard deviation) (rms) at different moments chosen to perform Electromyographic evaluation.

Evaluation moment	MASSETER	
	Left	Right
Pré-Placebo	166,81(±117,97)	164,54(±129,28)
Pós-Placebo	145,56(±123,01)	155,10(±120,90)
Pré-Treatment	166,51(±111,49)	169,07(±114,85)
Pós-Treatment	235,48(±149)	224,12(±134,76)
48h	236,19(±153,02)	235,37(±145,27)

Interpretation starts with the evaluation of the electromyography along the therapy process applied and it can be observed in Picture 4 a horizontal line and another slightly inclined linking pre and post placebo moments which shows a relative stability of the eletromiography sinal.



Picture 5: Right and left masseter muscles EMG. Averages shown with equal letters aren't different among them according to Tukey-Kramer test with significance level of 5%.

When the effect of the treatment is evaluated an inclination on the 2 lines is seen what shows an increase in the rms value from the pre treatment to the post treatment moments . This fact shows an increase in the level of muscular recruitment after the therapy.

In the post treatment condition which goes from the post treatment moment to the 48 h moment after the treatment application, slightly different effects occur on the left masseter in which the line is practically horizontal, and shows the stability of the Electromyographic sign and in the right masseter where some degree of inclination remains which could indicate an increase in the EMG sign.

Analyzing the results through Tukey test, different behaviors in the left and right masseter EMG sign averages are observed.

In the left masseter is clear a behavior in which the placebo effect doesn't differ significantly from the effect observed in the post treatment condition, both indicating a relative stability in the EMG sign. These two conditions differ significantly ($p<0.05$) from the effect observed in the treatment condition, where

there is an increase in the EMG sign and consequently an increase in the muscular fibers recruiting.

In the right masseter signs of difference among the placebo condition EMG sign averages (stable) and the EMG sign variation in the treatment are observed as well. When the post treatment effect is compared there is no sign of difference between this and the placebo condition (same result is seen in the left masseter) .However, there aren't signs that this effect is different from the treatment condition, either.

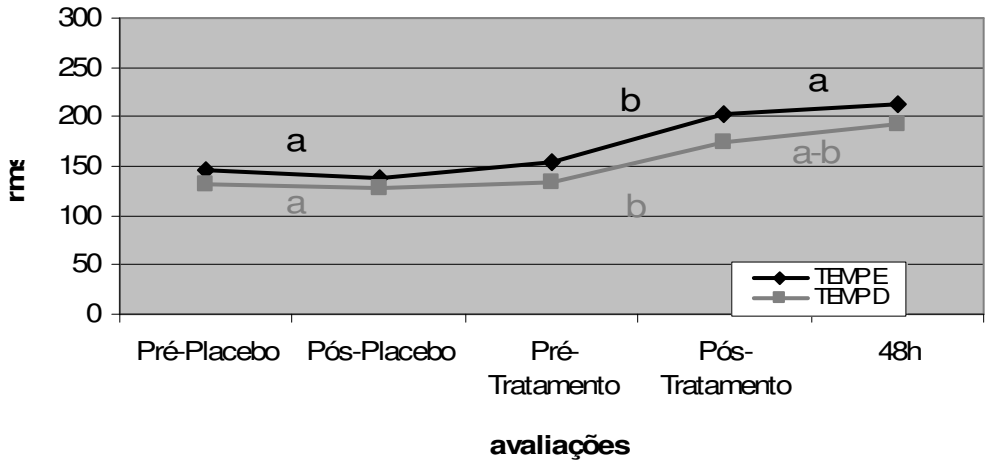
TEMPORAL EMG

Electromyographic sign evolution was studied and the basic statistics are presented in Table 5.

Table 5. Left and right temporal muscles Electromyographic sign averages (± standard deviation) (rms) at different moments chosen to perform Electromyographic evaluation

Evaluation moment	TEMPORAL	
	Left	Wright
Pré-Placebo	146,71(±67,63)	131,81(±58,87)
Pós-Placebo	137,81(±70,42)	126,77(±59,17)
Pré-Tratamento	154,05(±78,23)	133,25(±60,90)
Pós-Tratamento	202,43(±103,42)	173,72(±68,39)
48h	212,41(±116,89)	131,81(±78,47)

Interpretation starts with the evaluation of the electromyography along the therapy process applied and it can be observed in Picture 5 horizontal lines linking pre and post placebo moments which show a relative stability of the eletromiografic sinal.



Picture 6: Right and left temporal muscles EMG. Averages shown with equal letters aren't different among them according to Tukey-Kramer test with significance level of 5%.

When the effect of the treatment is evaluated an inclination on the 2 lines is seen what shows an increase in the rms value from the pre treatment to the post treatment moments. This fact shows an increase in the level of muscular recruitment after the therapy.

In the post treatment condition which goes from the post treatment moment to the 48 h moment after the treatment application, slightly different effects occur on the left temporal in which the line is practically horizontal with some inclination. Shows the stability of the Electromyographic sign and in the right temporal where some degree of inclination remains which could indicate an increase in the EMG sign.

Analyzing the results through Tukey test, different behaviors in the left and right temporal EMG sign averages are observed.

In the left temporal is clear a behavior in which the placebo effect doesn't differ significantly from the effect observed in the post treatment condition, both indicating a relative stability in the EMG sign. These two conditions differ significantly ($p<0.05$) from the effect observed in the treatment condition, where

there is an increase in the EMG sign and consequently an increase in the muscular fibers recruiting.

In the right temporal signs of difference among the placebo condition EMG sign averages (stable) and the EMG sign variation in the treatment are observed as well When the post treatment effect is compared there is no sign of difference between this and the placebo condition (same result is seen in the left temporal).However, there aren't signs that this effect is different from the treatment condition, either.

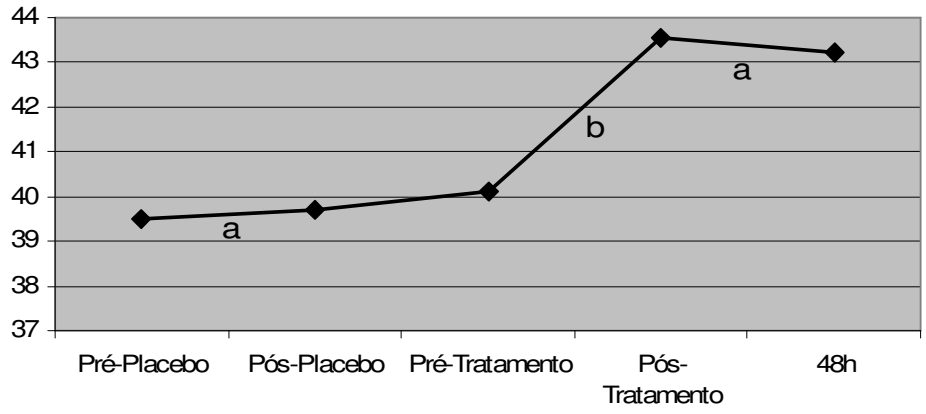
MOUTH OPENING MA EVALUATION

MA evolution was studied according to RDC Axis I and the basic statistics are presented in Table 6.

Table 6. Mouth opening (mm) averages (± standard deviation) (rms) at different moments chosen to perform MA evaluation

Evaluation moment	Mouth opening
Pré-Placebo	39,50(±5,74)
Pós-Placebo	39,72(±6,22)
Pré-Treatment	40,11(±5,60)
Pós-Treatment	43,56(±5,44)
48h	43,22(±4,68)

Interpretation starts with the evaluation of the mouth opening MA along the therapy process applied and it can be observed in Picture 6 a horizontal line linking pre and post placebo moments which show a relative stability of MA in this period.



Picture 7: mouth opening MA. Averages shown with equal letters aren't different among them according to Tukey-Kramer test with significance level of 5%.

When the effect of the treatment is evaluated an inclined line is seen what shows an increase in the mouth opening MDA from the pre treatment to the post treatment moments. This fact shows possible improvement in the muscular length and/or decrease in the muscular tension of the mandible lifting muscles.

In the post treatment condition which goes from the post treatment moment to the 48 h moment after the treatment application, a different effect occurs in which the line is horizontal again with some inclination which shows the stability of the mouth opening MA with slight regression regarding the average reached immediately after the therapy.

Tukey test analysis indicates different behavior in the MA averages at different moments of the evaluation,

It is clear a behavior in which the placebo effect doesn't differ significantly from the effect observed in the post treatment condition, both indicating a relative stability in MA. These two conditions differ significantly ($p<0.05$) from the effect observed in the treatment condition, where there is an increase of the mouth opening MA.

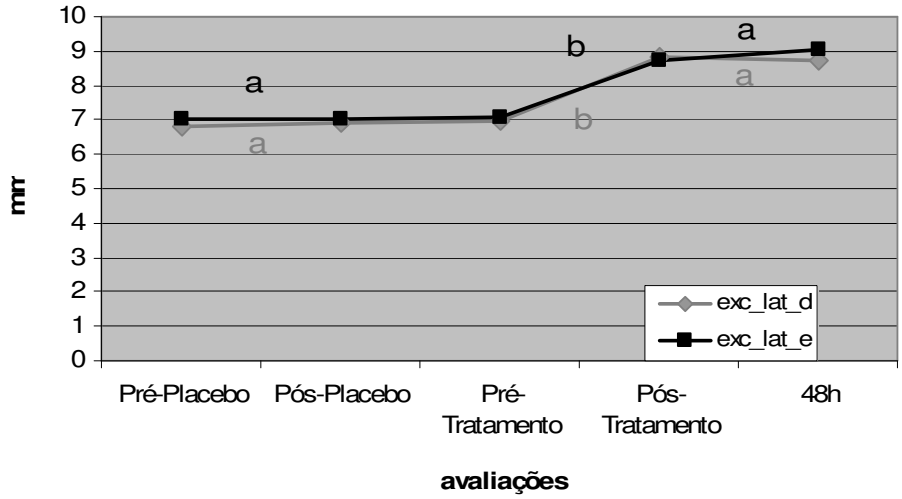
RIGHT AND LEFT LATERAL EXCURSIONS MA

MA evolution was studied according to RDC Axis I and the basic statistics are presented in Table 7.

Table 7. *Right and left lateral excursions MDA a*verages (± standard deviation) at different moments chosen to perform MDA evaluation

Evaluation moment	Lateral excursions	
	Left	Right
Pré-Placebo	6,83(±2,38)	7,00(±2,38)
Pós-Placebo	6,89(±2,54)	7,00(±2,56)
Pré-Treatment	6,94(±2,69)	7,06(±2,26)
Pós-Treatment	8,83(±2,63)	8,72(±3,07)
48h	8,72(±2,90)	9,06(±3,32)

Interpretation starts with the evaluation of the right and left lateral excursions MA along the therapy process applied and it can be observed in Picture 7 a horizontal line linking pre and post placebo moments which show a relative stability of MDA in this period.



Picture 8: right and left lateral excursions of MAs evaluation Averages shown with equal letters aren't different among them according to Tukey-Kramer test with significance level of 5%.

When the effect of the treatment is evaluated an inclined line is seen what shows an increase in right and left lateral excursions MA averages from the pre treatment to the post treatment moments. This fact shows possible improvement in the muscular length and/or decrease in the muscular tension of the muscles responsible for the movement, involved in the lateral excursions.

In the post treatment condition which goes from the post treatment moment to the 48 h moment after the treatment application, the line is practically horizontal which shows the stability of the right and left lateral excursions MDA.

Tukey test shows, in both movement directions, a behavior in which the placebo effect doesn't differ significantly from the effect observed in the post treatment condition, both indicating a relative stability in MA. These two conditions differ significantly ($p<0.05$) from the effect observed in the treatment condition, where there is an increase in the MDA. But, there isn't any indication that this effect is different from the treatment condition.

DISCUSSION

The main objective of this study was to verify the effect of TMJ articular mobilization on the pain, on Electromyographic sign and on the range of motion

of women presenting muscular TMD. Our results indicated that the TMJ articular mobilization had a positive effect on all the variables immediately after its performance. The placebo effect showed, as expected absence of significant difference in all the variables studied.

The effect of therapy persisted at least for 48 hours on the following variables: right TMJ, left masseter and temporal algometry, EMG of left masseter and temporal, mouth opening MA and left and right lateral excursions. Such affirmation justifies itself, because in all these variables the 48 hours effect was different from the therapy effect but it was not different from the placebo effect.

The same effect of therapy maintenance 48 hours after its application was observed in all the other variables left TMJ , right masseter and temporal algometry, EMG of the right masseter and temporal . But, in all these cases there was no difference among the treatment and post treatment steps. Although some interesting signs were shown, once the inclination indicates positive evolution in the condition, and continues ascending in the post treatment period, these facts were not verified in this study.

Among the effects of the manual therapy the analgesia is one of the aspects of great value in the treatment of patients with TMD (22,23). In fact, it was observed in this present study that the pain levels decreased significantly immediately after the articular mobilization and 48 hours after the analgesic effect remained in the right TMJ and in the left masseter and temporal muscles. That effect of manual therapy can be due to neurophysiological effects which it can produce. The manipulation can cause simpatoexcitatory or simpatoinhibitory effects, which participate in the inhibitory process of nociceptive effects that lead to pain (24).

It is thought that in the case of articular manipulation or mobilization simpaticoexcitatory effects are generated initially and in the period between 20 to 45 minutes a transition to simpatoinhibitory effects occur. Both lead to analgesia (25).

The TMJ articulator decoaptation technique in the caudal way caused slow and lasting of the articular capsule stretching and ligaments trying to get back its

elasticity (26). As these structures have important nociceptores, the maneuver contributed in the phase of pain transduction, decreasing the nociceptive effect and this way decreasing the pain. Besides that the articular maneuver might have contributed in the phase of modulation stimulating the descendent analgesic via releasing serotonin and noradrenalin to the CNS modulating the pain (27).

However, the innervations of those structures don't play just the role of nociceptor, but of a mecanoceptor as well. In the insertion of the pterygoideo lateral muscle, are the receptors of Ruffini, Golgi and Paccini (28).

The lasting and slow stimulus of the articular mobilization is favorable to the autogenic inhibition (29). Such process is characterized by a muscular relaxing caused by the activation of Golgi tendinous organ (GTO), which acts in response 6 seconds after a muscular contraction started by the action of a neuromuscular fuse in response to a stretching. If this stirament is kept causes the muscular stretching (30).

The traction in the caudal way generated the muscular stretching in the Masseter, Temporal (anterior fibers) and medial and lateral pterygoideos , since the way of the maneuver is favorable to the distance of the origin of these muscles and its respective insertions and the movement amplitude of the mandible opening limited by the masseter, temporal and medial pterygoideo, and the lateral excursions, limited by the lateral and medial pterygoideo (31), increased significantly immediately after the therapy and such effect remained after 48 hours of its performance.

Besides these muscular effects caused by the traction the pain reduction by the decreasing of nociceptive stimulus might improve the function of neuromuscular fuse improving the articular mechanic and muscular function (32). This fact might have contributed in the changing of the muscles masticatory Electromyographic sign which showed a significant increase post therapy. Being EMG a technique which shows the level of muscular activity supplying a n estimation of action potential and its adding, enables to evaluate alterations in the magnitude and pattern of muscular response (33, 34, 35, 36, 37) .So it is

expected that an increase in the values of RMS submit the reduction of the actives motor unities number or the activation of smaller caliber fibers , being the opposite true Therefore through the presented results (Graphics 4 and 5), it was observed an increase in the level of muscular recruiting powering muscular action during maximum volunteer isometric contraction in the masseter and temporal muscles bilaterally and such effect remained 48hours in the left masseter and temporal muscles.

Several studies show that individuals with MTJ present decrease in rms when they perform maximum volunteer isometric contraction indicating a shorter capacity to use this muscle properly (38, 39) .So, besides the reduction of the pain levels the present study indicates a positive effect of the manual therapy on the TMJ and on the muscular function as well. This result is very important because it demonstrate that even in patients with TMD muscular; the articular treatment might have effects in the local musculature. It is thought that the changing in the EMG might have come from the stretching of the masticatory muscles and the inhibition of muscular spasms due to articular mobilization, which were demonstrated by the significant changes in the increase of opening MDAs and right and left lateral excursions.

When the nociceptive reflexes act modifying the monosynaptic reflexes the muscular control, the passive stretching resulting of the articular TMJ mobilization acts in order to undo the pathologic neuronal circuit generating new monosynaptic reflexes in the musculature (40).

Forty eight hours after the therapy at no moment they obtained values were equal to the initial ones pre placebo and post placebo. But, there is a tendency to reduce the value reached immediately after the therapy. This study has performed just one treatment session with articular mobilization. More studies are necessary to evaluate the effect of therapy in long term, using a larger number of volunteers and a larger number of sessions. However, this study suggest that periods of 48hours between the sessions should be respected because during this period there are signs that the effect of the therapy remains and after this period the effect might decrease. So, a 48-hour period is a good moment for a new intervention.

Several authors state that the cause of the TMD is multifactorial and might be related to a bad occlusion, postural alterations of the head and cervical column and psychological factors (41, 42). Due to the MTJ complex motor control and the muscular response to its nociceptors, it is likely that, in the different causes, masticatory muscles are involved in the painful processes of the TMJ contributing to cover up the real cause of this dysfunction. Such fact should be considered in the volunteers evaluation future studies.

It's fallows that the TMJ articular mobilization interfered positively on the treatment of women with muscular TMD, decreasing the pain, increasing mouth movement amplitude and increasing rms value in the Electromyographic sign in women with muscular TMD immediately after its application. Forty eight hours after the therapy the effects of pain relief in the right TMJ, left temporal and masseter muscles remained as well as the increase of Electromyographic signs in the left temporal and masseter muscles, the increase of the mouth opening MAs and right and left lateral excursions of the mandible. Therefore, the manual therapy is an attractive way of treatment for patients with TMD because it is able to bring these benefits with low operational cost and relatively easy performance since it is performed by habilitated professionals.

CONCLUSÕES

Este estudo permite concluir que a mobilização articular da ATM interferiu positivamente no tratamento de mulheres com DTM muscular, gerando imediatamente após a sua aplicação uma diminuição da dor, aumento da amplitude de movimento da boca e aumento do valor rms no sinal eletromiográfico de mulheres portadoras de DTM muscular, sendo que 48 horas após a terapia foram mantidos os efeitos de diminuição de dor na ATM direita, masseter esquerdo e temporal esquerdo, o aumento no sinal eletromiográfico nos músculos masseter esquerdo e temporal esquerdo e aumento das ADM's de abertura da boca e excurssões laterais direita e esquerda da mandíbula. Assim, a terapia manual se mostra como uma atrativa forma de tratamento para pacientes com DTM, pois é capaz de promover esses benefícios sendo de baixo custo operacional e de relativa fácil execução, desde que por profissionais aptos a realizá-la.

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ANEXO 1

COMITÊ DE ÉTICA EM PESQUISA
FACULDADE DE ODONTOLOGIA DE PIRACICABA
UNIVERSIDADE ESTADUAL DE CAMPINAS

CERTIFICADO

O Comitê de Ética em Pesquisa da FOP-UNICAMP certifica que o projeto de pesquisa **"Influência da mobilização articular da ATM na dor, amplitude de movimento e no sinal eletromiográfico de mulheres portadoras de DTM"**, protocolo nº 023/2010, dos pesquisadores Fabricio de Oliveira Teixeira Lopes e Fausto Bérzin, satisfaz as exigências do Conselho Nacional de Saúde - Ministério da Saúde para as pesquisas em seres humanos e foi aprovado por este comitê em 20/05/2010.

The Ethics Committee in Research of the School of Dentistry of Piracicaba - State University of Campinas, certify that the project **"The influence of TMJ articular mobilization in the pain, mandibular mobility and eletromiographic sinal of women with TMD"**, register number 023/2010, of Fabricio de Oliveira Teixeira Lopes and Fausto Bérzin, comply with the recommendations of the National Health Council - Ministry of Health of Brazil for research in human subjects and therefore was approved by this committee at 05/20/2010.

Prof. Dr. Pablo Agustin Vargas
Secretário
CEP/FOP/UNICAMP

Prof. Dr. Jacks Jorge Junior
Coordenador
CEP/FOP/UNICAMP

Nota: O título do protocolo aparece como fornecido pelos pesquisadores, sem qualquer edição.
Notice: The title of the project appears as provided by the authors, without editing.

ANEXO 2

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

TÍTULO: **"**A influência da mobilização articular da ATM na dor, na amplitude de movimento e no sinal eletromiográfico de mulheres portadoras de DTM**."**

Introdução

Você está convidado a participar da pesquisa acima citada, a ser desenvolvida pelos pesquisadores Fabrício de Oliveira Teixeira Lopes e Prof. Dr. Fausto Bérzin. O documento abaixo é o Termo de Consentimento Livre e Esclarecido que contém todas as informações necessárias sobre a pesquisa que será realizada. As informações contidas neste Termo, bem como a apresentação e a obtenção do consentimento, serão realizadas por nós, pesquisadores responsáveis pela pesquisa. Sua colaboração neste estudo será de muita importância, mas se desistir a qualquer momento, isso não lhe causará nenhum prejuízo.

Estou ciente que:

I) Justificativa

Este trabalho justifica-se pela necessidade em compreender as alterações musculares e o comprometimento dos músculos da bochecha e da lateral da cabeça em pacientes com Disfunção Temporomandibular (DTM), visto que a disfunção pode comprometer a estrutura do músculo e sua função. A presença de dor também pode prejudicar o funcionamento normal destas estruturas. Este estudo também se mostra importante em auxiliar o diagnóstico e a seleção de uma terapêutica apropriada, bem como fornecer informações a indivíduos saudáveis e orientações preventivas.

II) Objetivo

O estudo tem por objetivo verificar a interferência da mobilização articular na atividade eletromiográfica dos músculos mastigatórios, na dor e na amplitude de movimento da ATM (abertura da boca) em portadores de DTM (dor nos músculos da face e do pescoço e dor na articulação próxima ao ouvido).

Também busca analisar os sinais e sintomas de Disfunção Temporomandibular (DTM) por meio do questionário de Critérios de Diagnóstico para Pesquisa das Desordens Temporomandibulares (RDC/TMD).

III) Metodologia

1. Para a realização da pesquisa, todos os voluntários serão submetidos à entrevista verbal para informar os dados pessoais, história médica e odontológica. Será realizado um exame clínico intra (dentro da boca) e extra-oral (face e crânio), no laboratório de eletromiografia da FOP/UNICAMP. Assim, será realizado o preenchimento do questionário RDC/TMD e avaliação da presença de sinais e sintomas que caracterizem o quadro clínico de DTM.

2. Para a avaliação da dor será utilizada a EVA (Escala Visual Analógica) e a Algometria. A EVA é uma linha horizontal impressa em um papel onde o seu início significa nenhuma dor e seu final significa máxima dor. Os voluntários receberão duas EVAS. A primeira será preenchida antes da terapia com mobilização articular da ATM e a segunda será preenchida imediatamente após a terapia. A algometria é realizada através de um instrumento, o algômetro, que exerce uma pressão mecânica crescente no ponto doloroso a ser avaliado. No momento em que o voluntário sentir dor, ele avisará o examinador que imediatamente retirará o aparelho do voluntário, cessando seu estímulo e anotando o valor da pressão máxima exercida pelo equipamento. Esta avaliação também será realizada antes e depois da terapia com mobilização articular da ATM.

3. Para o exame da atividade elétrica dos músculos, serão fixados eletrodos sobre a superfície da pele na região dos músculos masseter (região da bochecha), temporal (região a frente e acima do ouvido) e suprahioideos (região atrás e abaixo do queixo). Este exame não provoca dor, nem choque ou desconforto ao voluntário. Uma coleta será realizada com o paciente sentado, em repouso e outra, na mesma posição, durante o apertamento dos dentes.

4. A mobilização articular da ATM será realizada por um profissional fisioterapeuta especialista em Terapia Manual, devidamente treinado para a realização da técnica. O mesmo estará posicionado em pé do lado da voluntária, realizando a tração com uma das mãos e apoiando a cabeça da voluntária com a outra mão. Com a mão que realiza a tração devidamente protegida por luva de vinil descartável Danny® o terapeuta posiciona a palma da mão abaixo do queixo. O polegar encontra-se intra-oral (dentro da boca) sobre os pré-molares e molares inferiores (dentes inferiores do lado a ser mobilizado). A partir desta posição o terapeuta realiza uma leve manobra para baixo, que proporciona o abaixamento da mandíbula gerando uma tração na ATM (articulação temporomandibular) visando à diminuição da dor.

5. Os laboratórios das áreas de anatomia humana estão adequadamente equipados para a realização dos exames de eletromiografia e algometria.

6. Cada voluntário será solicitado a comparecer ao Laboratório em dias e horários marcados, de modo a não comprometer suas atividades diárias. Para cada sessão, estima-se o tempo aproximado de 60 minutos, suficientes para realização de cada etapa deste trabalho. Será necessária apenas uma sessão para cada voluntário.

7. **Possibilidade de inclusão em grupo controle**

Neste estudo não haverá grupo controle, sendo que todos os voluntários participarão integralmentede todas asetapas descritas acima.

8. **Métodos alternativos para obtenção da informação ou tratamento da condição**

Para alcançar os objetivos desta pesquisa, os métodos a serem aplicados são os mais indicados para a obtenção correta da informação desejada, pois são exames de superfície, sem efeitos colaterais. Outros métodos alternativos como tratamentos medicamentosos via oral podem trazer efeitos colaterais e uma resposta mais lenta ao tratamento. A medicação local (injeção de medicação introduzida seringa e agulha na ATM) podem trazer desconforto e dor na sua aplicação por ser um processo invasivo.

IV) Descrição crítica dos desconfortos e riscos previsíveis

A Mensuração da Dor, da Abertura da Boca e a Avaliação Eletromiográfica, são testes não invasivos, portanto, não causam riscos previsíveis aos voluntários, visto que todas as variáveis são controladas. Da mesma forma, o preenchimento do questionário RDC não provoca nenhum incômodo ou desconforto ao indivíduo. Estes exames, quando realizados por profissional habilitado, com técnica adequada, como propõe a metodologia deste projeto, não causa quaisquer desconfortos e efeitos colaterais negativos.

V) Descrição dos benefícios e vantagens diretas ao voluntário

Dentre os benefícios esperados para os participantes desta pesquisa, incluem o diagnóstico do quadro clínico, com a análise das características dos músculos, o tratamento imediato da disfunção com o uso da técnica de mobilização articular realizada por profissional habilitado, bem como o encaminhamento para centros especializados em tratamento.

Forma de acompanhamento e assistência ao sujeito

O acompanhamento e a assistência serão dados pelos pesquisadores responsáveis, para sanar qualquer necessidade relacionada à pesquisa.

VI) Forma de contato com os pesquisadores e com o CEP

O contato com um dos pesquisadores responsáveis ou CEP (Comitê de Ética em Pesquisa) poderá ser feito através de telefone ou endereço presente no fim deste termo de consentimento.

VII) Garantia de esclarecimentos

Quaisquer dúvidas poderão ser esclarecidas antes, durante e após o desenvolvimento da pesquisa, entrando em contato com os pesquisadores ou com o CEP.

VIII) Garantia de recusa à participação ou de saída do estudo

Tenho a liberdade de desistir ou de interromper a colaboração neste estudo, no momento em que desejar, sem qualquer penalidade de qualquer natureza, mediante o contato com um dos pesquisadores responsáveis ou CEP.

IX) Garantia de sigilo

Fica garantido o sigilo de dados confidenciais ou que, de algum modo, possam provocar constrangimentos ou prejuízos a minha pessoa, preservando sempre minha integridade e identidade.

X) Garantia de ressarcimento

Os voluntários desta pesquisa terão despesas apenas com o transporte até o laboratório desta instituição, sendo garantido o ressarcimento desses gastos.

XI) Garantia de indenização e/ou reparação de danos

Não há riscos previsíveis para a realização desta pesquisa. Entretanto, se por ventura houver qualquer dano causado durante a realização dos exames, os pesquisadores tomarão medidas para repará-los.

XII) Garantia de entrega de cópia

Tenho garantido o recebimento de uma cópia deste Termo de Consentimento Livre e Esclarecido.

Eu, abaixo assinado, concordo de livre e espontânea vontade, em participar como voluntário do estudo **"A influência da mobilização articular da ATM na dor, na amplitude de movimento e no sinal eletromiográfico de mulheres portadoras de DTM"**. Declaro que obtive todas as informações necessárias fornecidas pelos pesquisadores responsáveis, bem como todos os eventuais esclarecimentos quanto às dúvidas por mim apresentadas.

Nome:_____Data de nascimento: _____/_____/_____

Endereço: _____ Telefone: _____

Identidade (RG): _____ CPF: _____

Assinatura: _____ Data: _____/_____/_____

"Em caso de dúvidas ou outros assuntos relativos à pesquisa, entre em contato com um dos pesquisadores. Em relação a dúvidas quanto aos seus direitos, como voluntário de pesquisa, entre em contato com o CEP-FOP."

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ANEXO 3

Submission Confirmation

Thank you for submitting your manuscript to *Journal of Oral Rehabilitation*.

Manuscript ID:	JOR-12-0092
Title:	The efect of TMJ mobilization on pain, range of motion and emg in women with muscular TMD
Authors:	Lopes, Fabricio Bérzin, Fausto Alves, Marcelo Pereira, Marcelo Vera, Rosário
Date Submitted:	23-Feb-2012

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