SERVIÇO PÚBLICO FEDERAL
MINISTÉRIO DA EDUCAÇÃO
UNIVERSIDADE FEDERAL DE UBERLÂNDIA
FACULDADE DE ODONTOLOGIA

PROGRAMA DE PÓS-GRADUAÇÃO EM ODONTOLOGIA

Élcio Alves Guimarães

Avaliação da influência da Postura na Articulação Temporomandibular e o papel da Fisioterapia associada à Odontologia em pacientes portadores de Disfunção Temporomandibular

Tese apresentada à Faculdade de Odontologia da Universidade Federal de Uberlândia, para obtenção do Título de Doutor em Odontologia, na Área de concentração de Clínica Odontológica Integrada.

Uberlândia, 2017

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Ata da defesa de TESE DE DOUTORADO junto ao Programa de Pós-graduação em Odontologia da Faculdade de Odontologia da Universidade Federal de Uberlândia.

Defesa de: Tese de Doutorado nº 022- COPOD
Data: 27/10/2017
Discente: Élcio Alves Guimarães **(11313ODO003)**
Título do Trabalho: Avaliação da influência da Postura na Articulação Temporomandibular e o papel da Fisioterapia associada à Odontologia em pacientes portadores de Disfunção Temporomandibular
Área de concentração: Clínica Odontológica Integrada.
Linha de pesquisa: Tratamento das Deformidades e dor Oro-Facial e das disfunções temporomandibulares.
Projeto de Pesquisa de vinculação: Tratamento das Deformidades e dor Oro-Facial e das disfunções temporomandibulares.
As **quatorze horas** dia **vinte e sete de outubro de 2017** no Anfiteatro Bloco 4L Anexo A, sala 23 Campus Umuarama da Universidade Federal de Uberlândia, reuniu-se a Banca Examinadora, designada pelo Colegiado do Programa de Pós-graduação em junho de 2017, assim composta: Professores Doutores: Marlete Ribeiro da Silva (UFU); Paulo Cézar Simamoto Júnior (UFU); Mário Antônio Baraúna; Leonardo Bíscaro Pereira (UNITRI); Alfredo Júlio Fernandes Neto (UFU) orientador(a) do(a) candidato(a) **Élcio Alves Guimarães.**

Iniciando os trabalhos o(a) presidente da mesa Dr. Alfredo Júlio Fernandes Neto apresentou a Comissão Examinadora e o candidato(a), agradeceu a presença do público, e concedeu ao Discente a palavra para a exposição do seu trabalho. A duração da apresentação do Discente e o tempo de argüição e resposta foram conforme as normas do Programa.

A seguir o senhor(a) presidente concedeu a palavra, pela ordem sucessivamente, aos (às) examinadores (as), que passaram a argüir o(a) candidato(a). Finalizada a argüição, que se desenvolveu dentro dos termos regimentais, a Banca, em sessão secreta, atribuiu os conceitos finais.

Em face do resultado obtido, a Banca Examinadora considerou o(a) candidato(a) a provado(a).

Esta defesa de Tese de Doutorado é parte dos requisitos necessários à obtenção do título de Doutor. O competente diploma será expedido após cumprimento dos demais requisitos, conforme as normas do Programa, a legislação pertinente e a regulamentação interna da UFU.

Nada mais havendo a tratar foram encerrados os trabalhos às 18 horas e 10 minutos. Foi lavrada a presente ata que após lida e achada conforme foi assinada pela Banca Examinadora.

Prof. Dr. Mário Antônio Baraúna

Prof. Dr. Leonardo Bíscaro Pereira - UNITRI

Profª Drª Marlete Ribeiro da Silva – UFU

Prof. Dr. Paulo Cézar Simamoto Júnior– UFU

Prof. Dr. Alfredo Júlio Fernandes Neto – UFU
Orientador (a)

DEDICATÓRIA

A Deus...

... que me abriu a visão e alargou as minhas tendas além da minha capacidade humana, fazendo-me chegar até esse momento.

A minha sempre Cléia (amore)...

...mais uma etapa que vencemos juntos!!! Você é corresponsável por essa conquista. Eu te amo!!!

Aos meus filhos João Alexandre e Ana Júlia...

...Vocês são minha maior conquista. Por vocês eu luto dia-a-dia.

Ao meu pai (in memoriam) que, se hoje estivesse aqui, talvez diria "*Não fez mais que sua obrigação*", mas estaria orgulhoso e feliz por essa etapa vencida. A minha mãe que compartilhou o meu sonho sempre, incentivando-me a prosseguir e sendo minha intercessora!

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“Oh! Tomara que me abençoes e me alargues as fronteiras,
que seja comigo a tua mão e me preserves do mal,
de modo que não me sobrevenha aflição!
E Deus lhe concedeu o que lhe tinha pedido."
I Crônicas 4:10

"Sê forte e corajoso; não temas,
nem te espantes, porque o Senhor, Teu Deus,
é contigo por onde quer que andares."
Josué 1:9

Sumário

RESUMO

Introdução: A articulação temporomandibular (ATM) é um elemento do Sistema Estomatognático, capaz de realizar movimentos complexos, sendo responsável pela mastigação, deglutição e fala. Disfunção temporomandibular (DTM) representa um conjunto de distúrbios musculoesqueléticos associados com o sistema de mastigação e uma série de sintomas. Como mecanismo compensatório podem aparecer alterações da postura corporal. Exige tratamento complexo e multifatorial. **Objetivos:** Comparar a atividade muscular, através da Eletromiografia de Superfície de músculos orofaciais e a Força Máxima de mordida em pacientes sintomáticos em diferentes decúbitos, antes e após a realização da fisioterapia. Observar o efeito imediato do tratamento na dor dos pacientes. **Metodologia:** Pacientes com DTM foram submetidos à avaliação da atividade muscular, por meio da Eletromiografia, de músculos orofaciais e avaliação da Força Muscular Máxima através do Gnatodinamometro, nos decúbitos deitado, sentado e de pé. Em seguida foi realizado tratamento fisioterapêutico aplicando a técnica da Osteopatia. Após foi realizada avaliação da atividade muscular e avaliação da FMM nos 03 decúbitos. **Resultados:** A Postura afeta significativamente a RMS, a condição que o paciente é exposto e o momento avaliado de cada paciente são também significativos. O resultado mostra que há diferença entre as variáveis posição e condição ao mesmo tempo com condição e momento, mostrando que o tratamento foi eficiente quando comparada a condição do paciente. Significativo alívio da dor. **Conclusão:** Concluímos que a postura influencia na ATM, sendo a posição de pé onde se tem a maior contração muscular e força de mordida máxima. A Fisioterapia é fundamental no tratamento da DTM junto a Odontologia, sempre associada a uma equipe interdisciplinar.

ABSTRACT

Introduction: The temporomandibular joint (TMJ) is an element of the Stomatognathic System, capable of performing complex movements, being responsible for mastication, swallowing and speech. Temporomandibular dysfunction (TMD) is a joint disorder associated with the stomatognathic system and with a series of symptoms. As a compensatory mechanism, there might be changes in the body posture. It requires complex and multifactorial treatment. **Objectives:** Comparing the muscular activity, by means of an Electromyography of orofacial muscles and the Maximum Bite Force in symptomatic patients in different positions, before and after physical therapy. Observing the immediate effect of treatment on patients' pain. **Methods:** Patients with TMD were submitted to a muscular activity evaluation by means of an Electromyography of orofacial muscles and evaluation of Maximum Muscular Strength through the Gnatodinamometer, in the lying, sitting and standing body positions. It was followed by physical therapy treatment using Osteopathy. Then it was evaluated the muscular activity and the maximum muscular strenght in the 03 decubitus positions. **Results:** Posture affects significantly the activity of the orofacial muscles depending on the condition that the patient is exposed to and the moment in which the evaluation is done. The result shows that there is a difference between position and condition variables as also in condition and moment variables, showing that the treatment was efficient when compared to the patient's condition. Significant pain relief. **Conclusion:** We conclude that the posture influences the TMJ, the standing position being the one with the highest muscle contraction and maximum bite force. Physiotherapy is fundamental in the treatment of TMD with Dentistry, always associated with an interdisciplinary team.

3. INTRODUÇÃO E REFERENCIAL TEÓRICO:

A articulação temporomandibular (ATM) é um elemento do Sistema Estomatognático, constituído por muitas estruturas internas e externas, capaz de realizar movimentos complexos, sendo responsável pela mastigação, deglutição e fala. Além disso, a estabilidade da ATM refletida na posição do corpo e conseqüentemente a saúde do paciente. Quando ocorre uma alteração nessa articulação é chamada de disfunção temporomandibular (DTM).

Disfunção temporomandibular (DTM) representa um conjunto de distúrbios musculoesqueléticos associados com o sistema de mastigação e uma série de sintomas. A dor é o sintoma mais comum e geralmente se concentra nos músculos mastigatórios e/ou articulação temporomandibular (ATM), mas agravada pelo movimento mandibular e as funções estomatognáticas. DTM parece ser de etiologia multifatorial, incluindo hábitos parafuncionais, bruxismo, postura corporal deletério, características oclusais, anormalidades de crescimento, trauma, sobrecarga e estresse.(1)

Devido à necessidade de se obter parâmetros precisos nas coletas de dados e elaboração de diagnósticos clínicos referentes à DTM, foi desenvolvido, para a língua inglesa, o Research Diagnostic Criteria for Temporomandibular Disorder - RDC/TMD, sendo posteriormente adaptado, traduzido e validado oficialmente para a língua portuguesa, podendo ser utilizada como índice de avaliação para intervenções clínicas de forma confiável. Além do uso do RDC/TMD para a caracterização da DTM, um crescente número de pesquisas tem investigado uma possível ligação funcional entre os componentes do sistema estomatognático e suas disfunções, especialmente a DTM, em relação ao controle postural.(2)

A alteração da postura corporal pode estar associada a um grande número de desordens, incluindo síndromes dolorosas, como a migrânea, e desordens musculoesqueléticas, como a disfunção temporomandibular (DTM). Entretanto, normalmente apenas a avaliação da postura craniocervical é verificada em pacientes com DTM. Como mecanismo compensatório, podem aparecer alterações da postura corporal nos segmentos corporais adjacentes.(3)

As desordens da articulação temporomandibular exigem tratamento complexo e multifatorial, já que envolvem ruptura do equilíbrio biomecânico e a forte presença de

componentes emocionais, sendo responsáveis por amplo e variado quadro de sinais e sintomas de difícil diagnóstico. São achados frequentes na DTM dor à palpação muscular e/ou articular, função mandibular limitada e ruídos articulares, com a prevalência total em mais de 75% da população adulta e com grande impacto sobre a vida cotidiana do paciente. Em razão de etiologia multifatorial exige abordagem terapêutica interdisciplinar por vários especialistas (cirurgião dentista, fisioterapeuta, psicólogo e fonoaudiólogo), uma vez que a abordagem transdisciplinar e individualizada alicerça o tratamento bem-sucedido.[4]

Uma das formas de tratamento indicado para a DTM é a fisioterapia, por apresentar várias técnicas e equipamentos que podem ajudar nos resultados, como é o caso da estimulação nervosa elétrica transcutânea (TENS), massoterapia, cinesioterapia, termoterapia, eletroterapia e terapia manual como a Osteopatia que proporcionam, não só um alívio da sintomatologia do paciente, mas também o restabelecimento da função normal do aparelho mastigatório e da postura.[5]

A osteopatia é um meio terapêutico utilizado para tratar problemas biomecânicos, através de procedimentos manuais, sendo uma alternativa para o tratamento das disfunções temporomandibulares e dores orofaciais. É uma abordagem do campo de especialidades da fisioterapia, que visa corrigir ou minimizar os efeitos nocivos ao corpo humano pela análise dos sinais e sintomas dos pacientes, correlacionando com a anatomia e a fisiologia e sempre observando o indivíduo como uma unidade corporal.[6].

A dor bilateral ou unilateral é a queixa mais frequente sendo desencadeada durante a palpação ou a movimentação da mandíbula. Há evidências de que a dor miofascial esteja relacionada com a hiperatividade muscular e as alterações no comportamento motor durante o ato mastigatório. Sujeitos com DTM apresentam maior assimetria na atividade mastigatória e maior amplitude de ativação muscular durante o repouso.[7]

A EMG é um método de monitoramento elétrico das membranas excitáveis, retratando a medida de potenciais de ação durante a atividade funcional. O sinal eletromiográfico é o conjunto de todos os sinais elétricos revelados em determinada área muscular.[5]

Até o presente momento não há informações seguras sobre os parâmetros eletromiográficos (EMG) de amplitude (Root Mean Square – RMS) e frequência mediana

(FM) durante protocolos de contração e/ou repouso de músculos mastigatórios de sujeitos com DTM nas avaliações e intervenções terapêuticas. Acredita-se que tais sujeitos apresentem alterações nos valores de RMS e FM durante esses protocolos, comparativamente a sujeitos sem sinais e sintomas de DTM.[6]

A força máxima de mordida (FMM) é considerada a força gerada pelo maior esforço dos dentes inferiores contra os superiores, executada pelos músculos elevadores da mandíbula[8]. Sendo assim, ela é a responsável pela ascensão da mandíbula por meio da ação dos músculos temporal, pterigoideo medial e masseter e sua mensuração indica, quantitativamente, a eficiência muscular em apertamento dentário[9]. Dessa forma, ela influencia a eficácia da mastigação e é um parâmetro usado para avaliar a funcionalidade do sistema estomatognático[10]. Em razão disso, a FMM tem se mostrado um importante método mensurável na avaliação das DTM[11].

É necessário salientar que a força de mordida é influída pelas particularidades individuais, pelo método e pelo dispositivo de registro do estudo[12]. Sua análise, na literatura, tem sido realizada por muitos instrumentos, entre eles, transdutores de extensiometria, garfo de mordida, transdutores em lâmina, tubo de borracha pressurizada, lâmina sensível à pressão, as resistências de sensores de força e o gnatodinamômetro[13].

Além disso, a dor miofascial tem um grande impacto na qualidade de vida dos indivíduos, sem diferença entre as idades.[14]

O presente estudo se justifica devido a DTM de origem miofascial e outras condições de dor orofacial, coletivamente representam um significativo problema de saúde pública, com prevalência equivalente a outras das mais importantes doenças que ocorrem na área da odontologia.

Deste modo, o presente estudo, comparou a atividade muscular, por meio da Eletromiografia de Superfície de músculos orofaciais e a FMM em pacientes sintomáticos em diferentes decúbitos, antes e após a realização da fisioterapia. Além disso, propõe ver o impacto que o tratamento fisioterapêutico no alívio da dor nos pacientes com DTM.

4. CAPÍTULO 1:

Guimarães EA, Sousa LR, Simamoto Júnior PC, Lizardo FB, Sousa GC, Fernandes Neto AJ. Effect of diferente body position in the Electromyographic activity of orofacial muscles in patients with and without temporomandibular disorder. **Wulfenia Jornal**. 2017; 24(9):218-23.

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EFFECT OF DIFFERENT BODY POSITIONS IN THE ELECTROMYOGRAPHIC ACTIVITY OF OROFACIAL MUSCLES IN PATIENTS WITH AND WITHOUT TEMPOROMANDIBULAR DISORDER

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Running title: Body positions and temporomandibular disorder

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Abstract: Myofascial Pain (MP) can be considered more common manifestation of temporomandibular disorder. The etiology is multifactorial and complex, encompassing physical, psychological and social aspects. Given the multifactorial etiology of this disorder, a multidisciplinary approach should be proposed, including several professionals like dentists, physiotherapists, doctors, psychologists, speech therapists and nutritionists. The aim of this study was to investigate the effect of different positions (sitting, lying and standing) on the electromyographic activity of orofacial muscles in patients with temporomandibular disorder (TMD) and individuals without TMD (asymptomatic). The sample consisted of 40 males and females volunteers. Were divided into two groups: Group 1: With TMD / Orofacial Pain and Group 2: Without TMD. These samples were submitted in the collection and analysis of the electromyographic signal in Kinesiologic Electromyography Laboratory - LABEC / UFU. The changes in body position (lying, sitting and standing) caused changes in the recruitment of the masseter and anterior portion of the temporal; however, these changes did not show a similar pattern in the different groups of volunteers. In the symptomatic group standing position produced increased recruitment in most muscles analyzed in all situations, whereas the asymptomatic group, positions lying and standing showed higher activation levels.

Keywords: Temporomandibular Disorder, Orofacial Pain, Treatment

Introduction

The temporomandibular joint (TMJ) is an element of the Stomatognathic System, made up of many internal and external structures, able to perform complex movements, and is responsible for chewing, swallowing and speech. Furthermore, the stability of TMJ reflected in body position and consequently the health of the patient. When occurs a change in this joint, is called temporomandibular disorder – TMD[1].

Approximately 34% of the population have headache and 58% have TMD, womem are more affected, having a TMD association with the headaches. According to the worsening of the TMD, the proportion of headache increases. As the signs and symptoms are the major factor in the stomatognathic system in the painful cases, the dentist should work, tracing a course of multidisciplinary treatment, both in your area through non-invasive procedures, such as occlusal splints, behavioral changes and indication of physiotherapy among others. It is very important the multidisciplinary activities, contributing to the better understanding of the disease process, and identification (s) cause (s) of this disorder [2, 3].

Electromyography (EMG) as a measurement instrument of muscle electrical activity, has many applications about muscle hyperactivity and its consequences on the stomatognathic system. This feature can also be used in the monitoring of therapies used in the treatment of occlusal rehabilitation as with occlusal or functional devices [4].

Considering that neuromuscular etiologic factors of TMD include the ranger and grit of teeth and postural changes, some studies have found the influence of body position on the electrical activity of masticatory muscles. However, there are gaps in the literature evaluating the recruitment of masticatory muscles in different body positions in different situations (isometric contraction and bite). Understanding the standard of the masticatory muscles by varying the positions of the body it is important for directing assessments in dental clinics [5].

Thus, the aim of the study was to investigate the effect of different positions (sitting, lying and standing) in the electromyographic activity of orofacial muscles in patients with temporomandibular disorder (TMD) and individuals without TMD (asymptomatic).

Material and Methods

The various stages of the research were developed at the Clinical Research Laboratory, School of Dentistry and Research Laboratory Kinesiologic Electromyography (LABEC) of the Institute of Biomedical Sciences both located at the Federal University of Uberlândia. All procedures were approved by the Ethics Committee for Research Involving Human Beings of the Federal University of Uberlândia (832,182 number protocol) prior to the study

It is a transversal study.

The sample consisted of 40 male and female volunteers, aged 17 to 24, divided into two groups: Group 1: 20 volunteers With TMD / Orofacial Pain and Group 2: 20 volunteers No TMD.

Patients with signs and symptoms of TMD (tooth wear, presence of facets, clicks and crackle, pain in TMJ, headache etc.) presenting complaint about 6 months, featuring a chronic pain, according to the IASP (International Association for the Study of Pain). Furthermore, the presence of symptoms should have muscle origin.

The EMG recordings were obtained using a computerized electromyography of Myosystembr1 P84 / DATAHOMINIS Tecnology® (Uberlândia, MG, Brazil) connected to a notebook only on battery power. The electromyographic signals were collected and further processed using a software application *Myosystem Br1* (version 2.22). To capture the electromyographic signals we used single differential surface electrodes (Datahominis Tecnologia Ltda., Uberlândia, MG, Brazil). The preparation of volunteers is in shaving and cleansing the skin with 70% alcohol.

The surface electrodes were placed in the right masseter (RM), left masseter (LM), front side of the left temporal (LT) and right temporal (RT), with its parallel orientation and signal detection bars perpendicular to the direction of muscle fibers. The location of the electrodes was set based on each muscle function test and use a reference electrode attached to the skin over the frontal bone [6, 7].

The movements were: a) Maximum Voluntary Isometric Contraction (MVIC); b) bilateral bite in different positions (sitting, lying and standing). Each subject performed three repetitions of each movement with five seconds long. In bilateral bite was standardized a rest time of 30 seconds between movements the time was 60 seconds, while for maximum voluntary isometric contraction rest time was 3 minutes.

The electromyographic signal data was quantified by the Root Mean Square (RMS). The gross amount of RMS were calculated from a window of time of 3 central seconds, corresponding to the middle section of the electromyographic activity. The RMS values of each muscle were calculated from the average of the three repetitions of each movement.

After collecting electromyographic signals were verified information about the normality of these signals through the sample distribution histogram and frequency spectrum, which allow to observe any interference that may be present in the samples [8].

Statistical analysis of data was performed using the computer program GraphPad PRISM (Version 3.0 - Graphpad Software, Inc). We used the Kolmogorov-Smirnov Test to assess the normality of the data and subsequently the repeated measures analysis of variance (ANOVA) was used to compare the averages of the RMS values of the same muscle in two situations (MVIC and bilateral bite) with different body positions (lying, sitting and standing), and in all analyzes was performed Bonferroni multiple comparison Test to see where there was difference. The level of significance was set at 5% ($p < 0.05$). All results are presented as mean and standard deviation and the size of the effect (effect size / SS) was calculated using the description to Cohen's interpretation (ES small = 0.2; 0.5 medium and ES = ES = 0 8 large).

Results

The values of the electrical activity (RMS µV) of muscles LT, RT, RM and LM Group 1 - TMD / Symptomatic (GS) are illustrated in Figures 1 and 2. No significant differences were demonstrated ($p > 0.05$) in LT activity of muscles, RT, LM and RM in maximal voluntary isometric contraction situation (MVIC) with different body positions (lying, sitting and standing)

(Figure 1).

Regarding the situation of bilateral bite, no significant differences were demonstrated ($p > 0.05$) in the activity of the muscles LT, RT, LM and RM in different body positions (lying, sitting and standing) **(Figure 2).**

The values of electrical activity (RMS µV) of muscles LT, RT, LM and RM in Asymptomatic Group (GA) are illustrated in Figures 3 and 4. In the MVIC situation was shown that the electromyographic activity (RMS µV) of LT muscles RT and LM was higher in the lying position compared to sitting position ($p < 0.05$; ES = 0.9, 0.7 and 0.8). No differences were demonstrated ($p > 0.05$) in the recruitment of the RM muscle in different body positions (lying, sitting and standing) **(Figure 3).**

In the bilateral bite, it was demonstrated that the electromyographic activity (RMS µV) of LT and RT was higher in muscles lying position compared to sitting position ($p < 0.05$; ES = 0.7 to 0.6). No significant differences were found ($p > 0.05$) in the EMG signal from LM and RM muscles in different body positions (lying, sitting and standing) **(Figure 4).**

DISCUSSION

In the situation of maximum voluntary isometric contraction (MVIC) in the symptomatic group, it has not been demonstrated significant differences in the activity of the muscles analyzed with different body positions (lying, sitting and standing). However, in the asymptomatic group it was shown that the electrical activity LT muscles, RT and LM was higher in the lying position compared to sitting position.

It was observed that the asymptomatic group showed greater changes in the electromyographic signal in MVIC according to changes in the recumbent position, especially in the lying position. In electromyographic study of masseter in clenching situation, found electrical activity of the masseter decreased in lying position compared to a standing position, a situation not demonstrated in this study compared to the asymptomatic group [9].

Regarding the situation of bilateral bite in the symptomatic group, no statistical differences were demonstrated in recruiting every muscle analyzed in different body positions (lying, sitting and

standing). However, asymptomatic group was shown that the activity of the LT and RT was higher in muscles lying position compared to sitting position.

Thus, it is observed that in the asymptomatic group in both situations of MVIC and bilateral bite has been shown increased recruitment in the lying position compared to sitting position. The masticatory muscle most often assessed by electromyography varying body positions is the masseter, with the most jobs increased electrical activity in both standing and sitting. Since, for the temporalis muscle, a smaller number of studies. However, the cited studies indicate a lower electrical activity of this muscle lying down, which contradicts the results described here [5].

In this study it was observed in the symptomatic group, even with the absence of significant differences, which in the standing position was greater recruitment (Figure 2 and 3) most of the muscles analyzed in all situations (MVIC and bite), confirming in part with the findings. It is thought that this effect is related to a work antigravity muscles of mastication, a situation which changes the recruitment of these muscles [5].

However, in the asymptomatic group, we note that the lying and standing positions showed higher activation levels, therefore, muscle activation of the masseter and temporal behavior was not similar between the two groups, in contrast to the statements of the aforementioned authors.

This way, it is noticed that the symptomatic group had a trend of increased activation of these muscles in a standing position, stressing the importance of this position to the clinical aspect. These results demonstrate that the change in body position influences the electrical activity of the masseter and temporal anterior muscles. In dental clinics usually reviews and occlusal adjustments are held in the lying position, however, according to the results of this study, we suggest the inclusion of the standing position in these evaluations due to changes in the recruitment of the analyzed muscles.

Analyzed the prevalence of signs and symptoms of temporomandibular dysfunction in women with neck pain and low back pain. The above authors demonstrated that in patients with neck pain, 75% had associated TMJ pain, noting that the main reason of this condition is the relationship between cervical spine and skull, as any postural changes in the cervical region may lead to a change in biomechanics the TMJ [10].

Thus, a gap of this study was the lack of collection of the electromyographic signal of postural cervical muscles. Moreover, the lack of standardization of results can be explained by variation chewing preferably may influence hyperactivation in a muscle in the right or left side.

CONCLUSIONS

The changes in body position (lying, sitting and standing) caused changes in the recruitment of the masseter and anterior portion of the temporal; however, these changes did not show a similar pattern in the different groups of volunteers

In the symptomatic group standing position produced increased recruitment in most muscles analyzed in all situations, whereas the asymptomatic group, positions lying and standing showed higher activation levels.

This way, we suggest the inclusion of a standing position in the ratings and occlusal adjustments made in dental clinics because of changes in the recruitment of the masseter and anterior portion of the temporal shown in this work.

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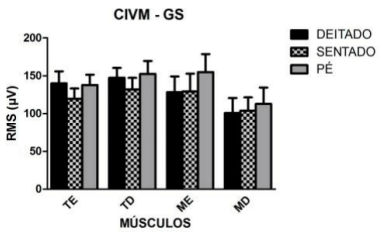

Figure 1: Comparison of RMS values (µV) of LT muscles, RT, LM and RM in the situation of MVIC in positions lying, sitting and standing in the symptomatic group (GS). The bars represent the mean and standard deviation.

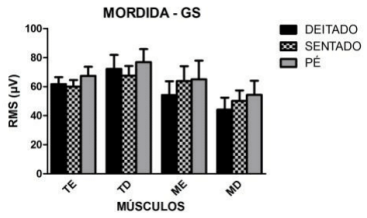

Figure 2: Comparison of RMS values (µV) of LT muscles, RT, LM and RM in bilateral bite in positions lying, sitting and standing in the symptomatic group (GS). The bars represent the mean and standard deviation.

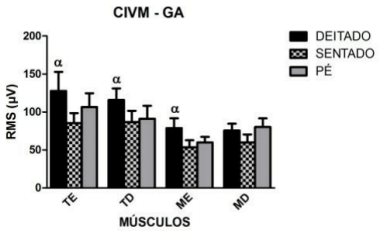

Figure 3: Comparison of RMS values (µV) of LT muscles, RT, LM and RM in the situation of MVIC in positions lying, sitting and standing in the asymptomatic group (GA). The bars represent the mean and standard deviation. p <0.05 indicates significant difference compared to sitting position.

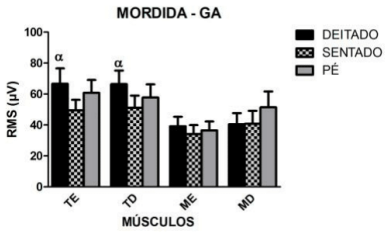

Figure 4: Comparison of RMS values (µV) of LT muscles, RT, LM and RM in bilateral bite in positions lying, sitting and standing in the asymptomatic group (GA). The bars represent the mean and standard deviation. p <0.05 indicates significant difference compared to sitting position.

5. CAPÍTULO 2:

Guimarães EA, Cabral AL, Sousa LR, Simamoto Júnior PC, Sousa GC, Fernandes Neto AJ. Influence of body position on maximum bite force. **MTP&RehabJornal**. 2017; 15:1-4.

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Influence of body position on maximum bite force

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SUMMARY

Objective: To evaluate the maximum bite force (MBF) in subjects with and without Temporomandibular Dysfunction (TMD), in three different positions (sitting, lying and standing). Methods: The sample consisted of 60 individuals, aged between 19 and 35 years, who were divided into two groups: with TMD (n = 30) and without TMD (n = 30). First, the RDC/TMD questionnaire was applied and, after diagnosis, all of the subjects selected were submitted to the measurement of MBF, on each side (right and left), in three different positions (sitting, lying and standing), by means of a digital gnatodynamometer. Results: No significant difference in mean MBF was found between the two groups; however, the mean MBF for the subjects, comparing the same side and different positions, was significantly different, being smaller when the individual was lying down. Conclusions: According to the results, it was concluded that the MBF is influenced by the change of position.

Keywords: Temporomandibular Joint Disorder, Maximum Bite Force, Posture.

INTRODUCTION

Temporomandibular Dysfunction (TMD) is defined as a set of musculoskeletal and neuromuscular conditions that affect temporomandibular joint (TMJ), masticatory muscles and associated structures[1]. Its etiology involves several factors, among them: occlusal, traumatic, muscular and articular alterations, being therefore considered of multifactorial origin[2].

The TMJ is most frequently observed in individuals between 20 and 45 years of age[3] and is classified, according to the American Academy of Orofacial Pain, in two major groups: muscular (dysfunctions related to masticatory muscles) and articular (disorders related to joint articulation)[4].

The most common signs and symptoms are: orofacial pain, reduction of joint movements, ringing in the ear, cracking and / or crackling, vertigo and postural abnormalities[3]. In addition, the presence of dysfunction may alter the maximum bite force (MBF)[5]. The MBF is considered the force generated by the greatest effort of the lower teeth against the upper teeth and is responsible for the ascension of the mandible through the action of the temporal, medial pterygoid and masseter muscles[6]. Their measurement indicates, quantitatively, the muscular efficiency of dental tightening[7]. Their values are influenced by several factors. Individual characteristics, the recording device and the posture of the individual's head are some of these conditions[8-10]. Since the latter could be influenced by the positioning of the individual, it would also cause a change in the force.

It is necessary to emphasize that these aspects will not, necessarily, cause a decrease in the MBF. An example is patients with TMD. There are no consistent findings in the literature concerning individuals with TMD having a lower MBF than individuals without the dysfunction[11, 12].

It has also been found that, like the MBF, the DTM is in relation to head position. This is because the TMJ constitutes the connection between the mandible at the base of the skull. The latter being linked to the cervical region by muscular and ligamentous connections, forming the craniocervical mandibular system. It is this relationship between the head and neck area and the TMJ that makes it possible to measure this link between TMD and posture[13]. The action of the mandibular muscles is thus correlated with that of the neck and trunk muscles[14]. This connection is perceived, in practice, during the maximum voluntary contraction in healthy people, when the activity of the masseter and of the temporal differentiates, depending on body position[15,16]. However, no studies were found that investigated whether this change is also capable of modifying MBF. This variable is directly related to individuals' quality of life since the greater the masticatory capacity and efficacy, the better the food fragmentation will be and the better the digestion[17]. It is

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for these reasons that such a study is primordial. Differences in this parameter, according to body position, are important since most diagnoses and dental interventions are performed in only one position, the supine.

The general objective of this study was to evaluate the MBF of subjects with and without TMD in three different positions (lying down, sitting and standing).

MATERIALS AND METHODS

Sample

Sixty subjects of both sexes, aged between 19 and 35 years, were evaluated from May to September, 2016. The selected subjects were divided into two groups. One group diagnosed with temporomandibular dysfunction of muscular origin (n=30) determined by the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD). This group consisted of patients with at least 20 functional teeth in the oral cavity, with bilateral posterior occlusion and with adequate mandibular stability. The second group, without TMD (n = 30), was composed of asymptomatic individuals, with bilateral posterior occlusion and without muscular or articular involvement. Among all individuals (60), the majority (47) presented masticatory preference on the left side. The research project was approved by the Human Research Ethics Committee of the Federal University of Uberlândia, nº 832182.

Instrument

An electromyograph composed of 10 channels (EMG System do Brasil, Sao Jose dos Campos, Brazil) was used for measurement. This device permitted the acquisition of signals received from the digital gnatodynamometer connected to the electromyograph in the channel configured to receive signals from the EMG. The gnatodynamometer supplied signals corresponding to the strain gauge and thus provided a data acquisition system from 0 to 100 kg/f, registered in kg/f or N. In addition, the device featured a flexible two meter cable, 30 AWG wires and twisted pairs with shielding and 2mV/V sensitivity.

Experimental procedure

The research was conducted at - University Center of the Triangulo – UNITRI (Uberlandia, Brazil), following completion of the 'Free and Informed Consent' document by the participating individuals. All participants were placed in three positions: lying down, sitting and standing, and a simple randomization was performed for the order of the positions of each. A dental chair was used for both lying and sitting positions so that the individuals kept their heads in a comfortable position throughout the procedure, keeping the Frankfurt plane parallel to the ground.

The RDC/TMD questionnaire was applied for the diagnosis of TMD followed by measurement of the MBF. After the correct positioning of each individual the gnatodynamometer was placed in the region of the first molars, between the upper and lower arches, and the individual was instructed to bite as hard as possible for five seconds. This was repeated three times on each side (right and left). A rest time of 30 seconds was given between each measurement. Between the changes of position there was a time of one minute for rest. The MBF value, on each side of the individual, was calculated from the average of the three measurements performed.

Statistical analysis

The experiment was conducted using a completely randomized design with replicates. The data were separated into two groups (with and without TMD), with the positions considered as treatments and the sides treated as replicates. The data were submitted to an initial analysis of the normality of the residues of the mathematical model, using the Shapiro-Wilk test and homoscedasticity of the variances of the treatments, using the Bartlett test. In order to evaluate whether the position and the treatment that each individual underwent had any influence on the MBF, an analysis of variance (ANOVA) was performed followed by the Tukey averages comparison test. All analyzes used a significance of 5% using R software.

RESULTS

The mean MBF in patients with TMD was 39.36 kg/f (standard deviation = 12.27) and for patients without TMD it was 47.67 kg / f (standard deviation = 7.27). These data were based on the individual MBF values of each individual.

According to Figure 1, the mean MBF is higher when the individual is standing, moderate when seated and low when the patient is lying down. With analysis of the values between the sides, it was noticed that the averages were practically the same but the left side presented higher averages of MBF. To perform the Fully Randomized Design, normality of the data had to be assured. The Shapiro-Wilk test was performed to verify this normality. The hypothesis tested was:

H^0: Sample from a normal population

H^1: Sample from an anormal population

In Table 1. We verified that the data follow a normal distribution. All p-values obtained were > .05. It can be observed in Figure 2 that the variance of the MBF is different between the right and left sides. According to the figure, data for the right side are similar to the mean (shown in Graph 1): greater when the individual is standing, moderate when seated and low when lying down. The same was not observed for the left side, as shown in Figure 2. Since normality of the data was assured by the Shapiro-Wilk test, it was necessary to verify the homogeneity of the variances. The hypotheses tested are:

H^0: variances are equal

H^1: variances are not equal

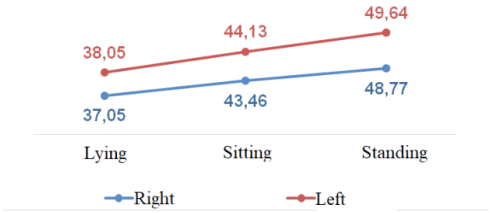

Figure 1. Mean of the MBF considering the position of the patient and the side.

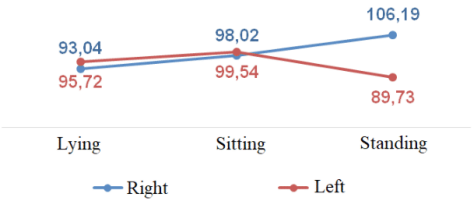

Figure 2. Variances of MBF concerning individuals' position and side.

Table 1. – Values of P obtained from the Shapiro-Wilk test.

Position ⇨ / Side ⇩	Right	Left
Lying	.6963	.2166
Sitting	.3132	.5674
Standing	.2140	.1695

Table 2. P-value obtained using the Shapiro-Wilk test.

	Degrees of freedom	SQMeans	SQF	P-valor
Treatment	5	8237	1647	2E-16*
DTM	1	6209	6209	2E-16*
Residuals	353	28144	80	

* Significant at the .05 level.

Table 3. Confidence intervals obtained from the Tukey test for each of the factors tested.

Factor comparisons		Confidence interval
Lying Right	Lying Left	[-3,67;5,67]
Lying Right	Sitting Right	[1,75;11,09]
Lying Right	Sitting Left	[2,41;11,75]
Lying Right	Standing Right	[7,06;16,40]
Lying Right	Standing Left	[7,92;17,27]
Lying Left	Sitting Right	[0,74;10,09]
Lying Left	Sitting Left	[1,41;10,75]
Lying Left	Standing Right	[6,05;15,40]
Lying Left	Standing Left	[6,92;16,26]
Sitting Right	Sitting Left	[-4,01;5,33]
Sitting Right	Standing Right	[0,64;9,98]
Sitting Right	Standing Left	[1,50;10,85]
Sitting Left	Standing Right	[-0,02;9,32]
Sitting Left	Standing Left	[0,84;10,18]
Standing Right	Standing Left	[-3,80;5,54]
With TMD	Without TMD	[-10,16;6,45]

Using the Bartlett test for paired observations, the p-value obtained was .9922 > .05 (level of significance). Therefore we did not reject the Hº hypothesis of equality of variances (Table 2).

The Anova with post-hoc Tukey test table showed that the differences between the means were highly significant. It was concluded that there is significant difference between the MBF of the participants in the different positions, sides and among those who did or did not have TMD. To verify which factors of sample present significant differences the Tukey test was used (Table 3).

The pairs with significant differences are those with lower positive limits. The details of Tukey's test calculation are described by Zar (1999) and Levin (1985). The differences between the following factors: Lying Right-Sitting Right, Lying Right-Sitting Left, Lying Right-Standing Right, Lying Right-Standing Left, Lying Left-Sitting Right, Lying Left-Sitting Left, Lying Left-Standing Right, Lying Left-Standing Left, Sitting Right-Standing Right, Sitting Right-Standing Left and Sitting Left-Standing Left, are significant at the 5% level ($p < .05$). It was these samples that contributed to the differences detected by ANOVA.

The factors that showed no significant differences included: Lying Right-Lying Left, Sitting Right-Sitting Left, Sitting Left-Standing Right and Standing Right-Standing Left. As shown in Table 3, all had lower negative limits. In addition to these, there were no significant differences in the mean MBF among individuals with and without TMD.

DISCUSSION

In this study, it was observed that there was no difference in the mean MBF between the two groups and no disparity for the subjects when the comparison factor was the side, provided that the position was the same. This is to say that the mean MBF for the individual sitting, on the right side, was equal to the MBF average for the individual sitting, on the left side. Machado at al., conducted a study[19] aimed at comparing, among other parameters, the MBF of individuals with and without TMD. Twenty-two women (14 belonging to the TMD group and eight to the control group), aged between 18 and 48 years, were investigated and MBF determined the with three replicates of maximal voluntary contraction. They concluded that there were no significant differences between the two groups. Also, corroborating our findings, an analysis[5] composed of 40 volunteers of both sexes, divided into groups (according to gender and presence/absence of TMD), demonstrated no statistical significance between the groups.

In the present study, no difference in the mean of the MBF was observed between the two groups and there was no disparity, when the comparison factor was the side, provided

that the position was equal. The mean MBF for the individual sitting, on the right side, was thus equal to the MBF average for the individual sitting, on the left side. It was also observed that the highest mean was present on the left side. A justification for this may be related to the masticatory preference of the participants (most of them had left side preference). Accordingly, another study[20] evaluated, among other measures, masticatory preference and MBF in adults of both sexes. The author concluded that the side with the highest MBF value was the side of masticatory preference.

The mean MBF for individuals, comparing side, and distinct positions, was significantly different. Thus the mean MBF for individuals sitting, on the right side, was different from the MBF average for individuals standing, on the left side. It is believed that this occurred because the mandibular elevating muscles are mainly responsible for the mandibular position and the temporal and masseter muscle activity is influenced by body position[21].

It was found that the position which presented the lowest values of MBF was lying down. This can be explained by the decrease in the activity of these muscles due to gravity, which formed a right angle with the fibers. The temporomandibular joint received the mandible load[22].

CONCLUSION

The present study concluded that the maximum bite force (MBF) is influenced by the change of position and the masticatory preference. Thus, it is recommended that dental professionals do not make assessments/interventions based on only one positioning. In addition, it is recommended that more studies be done on the subject, since literature in this area is sparse.

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AUTHORS' CONTRIBUTIONS

All authors contributed equally to this work.

DECLARATION OF CONFLICT OF INTEREST

None.

AUTHOR DETAILS

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6. CAPÍTULO 3:

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The influence of posture in decubitus positions on the temporomandibular joint (TMJ) and the effects of physiotherapeutic treatment among patients with temporomandibular dysfunction

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Running title: Influence of the posture and the effect of physiotherapeutic treatment in TMD

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ABSTRACT

Introduction: Temporomandibular dysfunction is a joint disorder associated with the stomatognathic system. Changes in body posture, requiring complex and multifactorial treatment, may become a compensatory mechanism. **Objectives:** The effect of treatment on muscular activity and patients' pain are compared before and after physical therapy. **Methods:** 25 patients were evaluated by means of Electromyography applied to the orofacial muscles and an evaluation of Maximum Muscular Strength using the Gnatodinamometro in lying, sitting and standing positions. Osteopathic physical therapy was then administered followed by an evaluation of the muscular activity and maximum muscular strength in the three decubitus positions. **Results:** Posture was found to significantly affect the activity of the orofacial muscles, depending on the condition of the patient and the time that the evaluation is conducted. Result demonstrated that there is a difference between position and condition variables and also in condition and time variables. The treatment was found to be efficient considering the patients' conditions. There was notable pain relief. **Conclusion:** It was concluded that posture influences the TMJ, the standing position being the one with the highest muscle contraction and maximum bite force. Physiotherapy is fundamental in the treatment of TMD together with Dentistry, associated with an interdisciplinary team.

Summary Box:
This study demonstrdated the impact of interdisciplinary variables on dental surgery. The results suggest innovative approaches for treating patients with Tempormandibular dysfunction, involving Physiotherapy.

Trial registration

Not applicable.

Keywords: TMD; Surface EMG; MBF; Orofacial Pain; Physiotherapy

Introduction

Temporomandibular dysfunction (TMD) represents a series of musculoskeletal disorders associated with mastication. It has been found to be of multifactorial etiology, including parafunctional habits, bruxism, deleterious body posture, occlusal characteristics, growth abnormalities, trauma, physical overload and stress.(1)

Due to the need for precise parameters in the gathering of data and elaboration of clinical diagnoses related to TMD, Research Diagnostic Criteria - RDC / TMD, was elaborated and officially adapted, translated and validated in Portuguese so that it can be used as a reference for the assessment of clinical intervention. In addition to the RDC / TMD for the characterization of TMD, a growing number of researchers are investigating a possible functional link between the components of the Stomatognathic system and its dysfunctions, especially TMD, in relation to postural control.(2)

Changes in body posture may be associated with many disorders, including painful syndromes such as migraines and musculoskeletal disorders as well as temporomandibular dysfunction (TMD). Usually, however, only an evaluation of craniocervical posture is made on patients with TMD. Compensatory mechanisms, including changes in body posture in adjacent body segments, are thus not considered. (3)

Temporomandibular Joint Disorders require complex and multifactorial treatment since they involve rupture of the biomechanical balance and the notable presence of emotional components. They are, therefore responsible for a broad and diversified variety of symptoms that may be of difficult diagnosis. For this reason multifactorial etiology requires an interdisciplinary therapeutic approach including dental surgeons, physiotherapists, psychologists and phonoaudiologists, for successful treatment. (4)

Physiotherapy is indicated for TMD because it applies various techniques and equipment such as transcutaneous electrical nerve stimulation (TENS), massotherapy, kinesiotherapy, thermotherapy, electrotherapy and manual therapy in the form of Osteopathy that provide not only relief from pain but also aid in the restoration of the normal function of the masticatory apparatus and posture. (5)

Osteopathy is a therapeutic practice for the treatment of biomechanic problems using manual procedures. It is thus an alternative for the treatment of temporomandibular disorders and orofacial pain. This physiotherapeutic approach analyzes the symptoms of patients as bodily unities based on principles of Anatomy and Physiology. (6)

Bilateral or unilateral pain is the most frequent complaint during mandible palpation or movement. There is evidence that myofascial pain is related to muscular hyperactivity and changes in motor behavior during mastication. Individuals with TMD present greater asymmetry in masticatory activity. (7)

Surface Electromyography, EMG, is a method for monitoring membrane excitement. It depicts the measure of action potential during functional activity. Electromyography produces a set of signals pertaining to the particular muscle area. (5) To date, there have been no reliable therapeutic evaluations or interventions reported regarding electromyographic (EMG) results as related to amplitude (Root Mean Square) or median frequency (MF) parameters during contraction and / or other masticatory acts of individuals with TMD. It is believed that these individuals present alterations in the values of RMS and MF when compared to others without symptoms of TMD. (6)

The maximum bite force (MBF) is the force produced by the greater effort of the lower teeth against the upper ones, executed by the elevator muscles of the jaw.(8) The jaw is responsible for lifting the mandible by the action of temporal muscles, medial pterygoid and masseter. Their measurement indicates the muscle efficiency in dental tightening. (9) This information is used to evaluate the functionality of the stomatognatic system. (10) For this reason, the MBF has become an important, measurable method in the evaluation of TMD. (11)

It should be noted that bite force is influenced by individual characteristics, by the method used to measure it and by the mechanisms of measurement.(12) Its analysis, in the literature, has been conducted by various instruments including extensiometry transducers, bite forks, blade transducers, pressurized rubber tubes, pressure sensitive blades, force-sensing resistors and gnathodynamometers. (13) It should be noted that myofascial pain causes a major impact on the quality of life of individuals, of all ages. (14)

The present study is justified by the prevalence of TMD of myofascial origin and other orofacial pain conditions. Collectively this affliction represents a significant public health problem equal to that of other important problems that occur in the area of Dentistry.

Materials and methods

1 - Casuistry:

Twenty-five patients with Temporomandibular Dysfunction and orofacial pain were selected for treatment in the "Reception, Treatment and Follow-up of Patients Program" of the Faculty of Dentistry of Federal University of Uberlândia (PRODAE-UFU).

Among the patients selected, ten were male and fifteen were female, all of them were between 19 and 35 years of age and had been diagnosed with TMD: 23 with right TMD and 02 with left TMD. All of these cases were of muscular origin and were determined by RDC/TMD. Four patients had mild TMD, fourteen patients were moderate and seven patients had severe TMD. All of them reported Myofascial Pain (symptomatic). This was registered by the Visual Analogue Scale (VAS) together with the presence of prematurity and / or occlusal interference among individuals with at least 20 functional teeth in the oral cavity and with bilateral posterior occlusion which would allow adequate mandibular stability. [15]

Individuals with compromised occlusal stability due to extensive dental loss were eliminated from the sample as well as those with open or crossed bite, with arthralgia, osteoarthritis or disc displacement and others who continuously used analgesic drugs or anti-inflammatory drugs, or who had undergone treatment less than six months ago.

The research was conducted at the Odontological Hospital of the Dentistry Faculty and at the Laboratory of Kinesiological Electromyography of the Institute of Biomedical Sciences, Federal University of Uberlândia.

The sample of 25 individuals was based on the minimum sample size according to the methodology suggested by Dawson and Trapp. [16]

2 - Electromyography and Maximum Bite Force:

The patients of the sample were submitted to an evaluation of muscular activity using surface electromyography of orofacial muscles, an evaluation of MBF in decubitus (lying down, sitting and standing) and a physiotherapeutic evaluation. The physiotherapeutic treatment was performed using Osteopathy. Immediately following the treatment an evaluation of the muscular activity and of the MBF in the three decubitus as well as another physiotherapeutic evaluation were conducted.

An EMG System do Brasil electromyograph was used for data collection: Model EMG-800C; 16-bit Analog / Digital conversion card resolution; EMG amplifier with total gain gain of 2000 times; 20 to 500 Hz bandpass filter performed by a two-pole Butterworth analog filter, gain of each channel = gain 100 times (configurable), system impedance = 109 Ohms, software for collecting and analyzing signals with frequency 2000 Hz sampling per channel; common mode rejection ratio> 100 dB; signal noise rate <3 μV RMS, Windows platform and active surface bipolar electrodes with 20 times gain preamp, shielded cable and end pressure clip to couple the disposable adhesive electrodes.

As a measurement instrument for FMM, a gnatodynamometer connected to the electromyograph was used in the channel configured to receive the signal from the gnatodynamometer (EMG System brand from Brazil, São José dos Campos, SP, Brazil). The gnatodynamometer provides the signal corresponding to the strain gauge, has a data acquisition system that allows reading from 0 to 100 kg / f and a register in the actual unit of measurement (Kg / f or N). In addition, it features flexible 2 meter cable, 30 AWG wires, twisted pair with shielding and 2mV / V sensitivity.

A gnatodynamometer was connected to the electromyograph to measure MBF. The patients were initially acquainted with the equipment and information was provided as to the procedure to be performed. For each evaluation, the movement to be carried out was practiced so that the patients could function effectively during the experiment.

For placement of the electrodes, the skin was pre-cleaned with 70% alcohol to remove impurities and decrease impedance. The surface electrodes were bilaterally placed on the skin in the regions of the temporal muscle (anterior), masseter, sternocleidomastoid and trapezius (descending fibers). The location of the electrodes was defined based on the function of each muscle and one electrode was placed on the glabella as a reference. [17, 18]

The procedures for collecting data on the muscular movements from the electromyographic signals before and after the physiotherapeutic treatment included: rest; Maximum Voluntary Isometric Contraction (MVIC) [the patients were asked to bite a parafilm using maximum force on the bilateral bite]; bilateral bite (natural chewing); and unilateral bite (R and L) with the use of the Gnatodynamometer. Each movement was repeated three times and a mean of the patients' bite rates were noted for each exercise. Between each contraction a rest time of 30 seconds was provided and between movements the rest time of the patients was 60

seconds. For the MVIC, the interval was two minutes. The sequence of movements was randomly defined. Data on the electrical activity of the muscles were collected before and one after the physiotherapeutic intervention.

3 - Physiotherapeutic Evaluation and Treatment Approval

The selected group was submitted to the physiotherapeutic treatment, which consisted of an osteopathy session.

The present study was approved by the Human Research Ethics Committee of the Federal University of Uberlândia (CEP / UFU): No. 832,182 on 07/25/2014. All participants signed the Term of Free and Informed Consent.

Results

To assess the influence on the Root Mean Square, RMS, of the positions (lying down, sitting and standing), conditions (at rest, MIC, bilateral bite and unilateral bite) and the time (before and after the treatment), an analysis of variance (ANOVA) was performed and Tukey's range test applied. For each muscle, two ANOVA calculations were performed: one for the right side and one for the left. In order to classify the intensity of the pain the Wilcoxon test for paired data was applied. The analyses were carried out in R and Excel programs. The level of significance was set at .05.

See Table 1

It was observed that RMS was greater when the patient was standing, moderate when seated and low when the patient was lying down. RMS values for condition and timing, for R and L muscles, were higher when the patient was in tightening condition, moderate during bite and low when the patient was resting. Position and condition for R and L muscles were plotted using the average RMS for the 25 patients for each position. The result showed that the variations occurred depending on the position of the patient. The mean was higher when the patients were in a tightening condition, medium when in bite condition and low when at rest.

Intensity of pain before and after treatment

See Graphic 1

The graph reveals a notable difference in the data before and after treatment. Before treatment the patients classified the pain as being more intense. After treatment, the intensity of the pain decreased and remained practically at zero. Using the Wilcoxon test for paired observations, the p-value was 0.0006963, <.05. There was, thus, a significant difference between pain intensity before and after treatment.

Maximum Bite Force- MBF

See Graphics 2, 3 and 4.

When the patient was lying down, the MBF was classified as low; when sitting, the MBF was moderate and when standing, the MBF was high. Observing the interaction graph (Graph 2) to evaluate the MBF according to the position and side (R and L), it is observed that the MBF is higher when the patient is standing, moderate when seated and low when the patient is lying down. From the interaction graph (Graph 3) to evaluate the MBF according to the position and the time of the evaluation, we observe that the MBF is higher when standing and there are small differences in MBF before and after treatment.

ANOVA was performed on the MBF variable with three factors: position, side and time. The interactions tested were: position and side, position and time, side and time. Results showed that only the position and time variables were significantly related. For the two tests that involved time, before and after treatment, the observed average for MBF was slightly higher after treatment.

Discussion:

As presented in the results, posture (lying down, sitting and standing) was found to be significantly related to RMS. The condition of the patient (at rest, CVM and bite) and the moment (before and after the physiotherapeutic treatment) were also significant and thus exert great influence on the TMJ. The decubitus variations exerted the greatest influence on muscle contraction of the orofacial and cervical musculature. In the standing posture there were higher values of RMS in comparison to sitting and lying postures. In the literature of the main databases, correlations have been reported between posture and the Stomatognathic System (SE). Postural changes may, for this reason, reflect a general lack of balance in an individual. Postural imbalance may indicate general malaise. Clinical experience thus suggests that an interdisciplinary approach is probably the most reliable and sufficient for the diagnosis and development of plans for treatment.[19]

It has been suggested that it is not currently possible to draw conclusions about actual clinical conditions (other than statistical) regarding the significance of correlations between SE and body posture. If these correlations are in fact limited to a biological level without clinical implications, there is indeed, need for further research.[20]

From our results using EMG, the analysis of cervical and orofacial muscles in different positions and functions demonstrated significant changes in muscular electrical activity. In the standing position and in the tightening condition, the highest RMS values were observed, showing greater muscular activity. In reviewing the literature, 12 articles, confirmed that the EMG method has made it possible to investigate information on muscle activity in a more detailed way and is thus important for the diagnosis and treatment of muscular disorders.[5]

In the present study it was observed that posture exerts great influence in the TMJ and that patients with TMD have increasing muscle contractions and orofacial pain when they undergo weight loss. In this case, the body must make adjustment to balance the three scales of body balance. These include the Temporomandibular Joint R and L, the scapular waist and the pelvic girdle. Biasotto-Gonzalez, et al. conducted a study in 2008 to characterize degrees of TMD and relate them to cervical posture and the quality of life among university students. They found that there was a higher prevalence of soft Temporomandibular Dysfunction (TMD) in relation to the cervical angle. There was also an increase in the severity of the TMD degree with worsening of the quality of life in this population. [21]

Our study found significant differences in electrical muscular activity (RMS) and MBF with changes in the patient's position, corroborating with other research that evaluated participants with Migraine and TMD (GMTMD) and migraine without TMD (GM). The participants were submitted to a static posture evaluation by means of photogrammetry. The results of the study demonstrated the presence of changes in body posture in women with migraines, with and without TMD. The changes in posture were similar between the GM and GMTMD according to clinical relevance analysis. [3]

The present study is in accord with other research in which there were cross-sectional cohorts and case-control studies that evaluated body posture in patients with TMD. Strong evidence has been reported of craniocervical postural changes in Myogenic TMD. [22]

One possible explanation for the manifestation of cranio-cervical posture in patients with TMD is the mechanism of convergence of the cervical region and the face in the brainstem. That convergence of afferents can lead to the development of cervical pain in patients with TMD, with consequent limitation on movement and changes in the posture of the head and neck region. [3] Our study noted that TMD patients exhibit significant changes in electrical muscle activity when subjected to posture changing, resulting in orofacial pain and difficulty in orofacial movements. In a standing position, the largest RMS values for orofacial and cervical muscles, showed that the body adjusts and balances to hold itself up against the gravity, thus seeking a balance of all body segments, including the TMJ in that body balance.[6]

In the present study there was no statistically significant difference in MBF between the R and L sides. Although not significant, however, it was observed that the left side had higher values and larger MBF and RMS than the right. This suggests that the TMD carrier tends to use more the contralateral side. We noted that position is associated with MBF; in the standing position we recorded the highest values and we also observed that physical therapy improved muscular electrical activity and produced a muscle relaxation and reduced MBF, an immediate effect seen after treatment. This is in accordance with a study conducted by Paulini *et al.* in 2012 that demonstrated that the bite force in patients with TMD and bruxism can be compromised due to pain and changes in functional and structural disturbances of the masticatory system. It was concluded that treatment with an occlusal splint increased the lateral bite force of patients with bruxism and TMD. [23]

Another study verified and analyzed correlations between the electrical activity of the temporal and masseter muscles, the bite force and the morphological indices of the face in adults. As previously reported in the data of habitual postural characteristics, the electrical activity of the temporal muscle was found to be greater than masseter activity. [24] This study confirms findings of the present research in which increased activity of the temporal muscles and masseter, mainly in the standing posture and in the tightening condition were associated with the MBF. This higher muscular electrical activity of the temporal muscle and MBF demonstrated a

dysfunction between the temporal muscle and the masseter muscle, which should be synergistic so that the temporal acts as a stabilizer of the TMJ (static function) and the masseter works as a dynamic muscle, making the bite movement. Because of the TMD, the temporal muscle presents higher values of RMS and MBF than the masseter muscle, even in bite movement.

A review of the literature pertaining to Temporomandibular Disorders (TMD) reveals emphasis on etiopathogeny, clinical characteristics and the treatment offered by Physiotherapy and Dentistry. The main aspects associated with temporomandibular disorders (TMD) are highlighted. Studies confirm the importance of this disorder within the Physiotherapy and Dentistry fields, and recognize the complexity and the need for an interdisciplinary approach. Thus, it has been concluded that physiotherapeutic therapies are important supporting means for the treatment of TMD as well as the dental procedures necessary to diagnose the causes, seek possibilities that eliminate or minimize the damage on the stomatognathic system structures and contribute to the comfort and well-being of individuals with TMD.[25] Our study fully agrees, We observed that Physiotherapy presents a significant, immediate effect in reducing the electrical muscle activity, the MBF and significant relief from orofacial pain, thus demonstrating the importance of including physical therapy and an interdisciplinary team for TMD treatment.

The results of our study corroborate others that have verified an immediate effect of nonspecific mandibular mobilization (MMI) on postural control in individuals with and without a diagnosis of TMD. It was also noted that the nonspecific mobilization of the temporomandibular joint contributes to the immediate improvement of postural control in individuals with TMD. [26]

Osteopathy, the technique used in the present study also proved to be an effective technique for the treatment of TMD, presenting significant results in the improvement of muscle electrical activity, the MBF and for immediate pain relief. Osteopathy allows us to think more wholistically, seeking the relations that exist among all of our body structures. It attempts to minimize pain, improve the range of motion, improve posture and reduce inflammation. [19]

Studies of the relations between dental occlusion, body posture and temporomandibular disorders (TMD) have concluded that there is no evidence of a predictable relation between occlusal and postural characteristics nor is the presence of TMD pain related to the existence of measurable occluded-postural abnormalities. Therefore, the tools and techniques used with for measuring alleged occlusal, electromyographic, cinesiographic or posturographic irregularities cannot be justified in the practice of TMD. [27] Our study is, however, in conflict with this study because we have seen, from the evaluation of EMG associated with the analysis of MBF and the assessment of pain in patients with TMD, significant results that suggest that posture influences TMJ as the orofacial and cervical muscles are affected. It becomes increasingly evident that Physiotherapy is an important tool for TMD treatment.

Due to the multifactorial etiology of temporomandibular disorders (TMD), accurate diagnosis remains a matter of debate and validated diagnostic tools are necessary. Surface electromyography (EMG), has proved to be effective in the case of amplitude of the root mean square (RMS) in the diagnosis of TMD. Such findings thus indicate that EMG (RMS) is a complementary tool that is useful for the clinical diagnosis of myogenic TMD. [28] Our findings agree. We found that EMG was able to quantify muscle activity, demonstrating the effects of decubitus change and in different functions. We observed that muscle activity of all assessed muscles was higher in the standing position. It is for this reason that accurate assessment of TMJ in different positions is necessary, to do better therapeutic intervention planning.

In the present study we also observed a notable reduction in pain following physical therapy. Patients stated that after Osteopathy they felt the orofacial region lighter and freer for movement. This agrees with research that defined Temporomandibular Disorder (TMD) as a term that implies chronic pain. The effect of osteopathic manual therapy (OMT) in patients with TMD is largely unknown or controversial. However, empirical evidence suggests that OMT may be effective in relieving symptoms. Patients receiving OMT require less medication (non-steroidal medication and muscle relaxants). [29]

It is importance of wholistic analysis is increasingly evident and has enriched understanding that the TMJ is a joint like all others and needs to be evaluated in the totality of the body. It must be evaluated and analyzed in all body positions, not only in the horizontal position as is usual. Other positions may provide more satisfactory responses to the treatment of TMD. It is of great importance that interdisciplinary teams perform the assessment and programs of intervention for patients with TMD.

Conclusion:

It was concluded that body posture influences the TMJ. The standing position demonstrates the largest muscle contraction and maximum bite force. Physiotherapy is fundamental for the treatment of TMD in association with Dentistry, always enacted by an interdisciplinary team. In this way effective treatment that will promote improvement in contraction muscle, a balance of MBF and pain relief will become reality.

Abbreviations

TMJ - temporomandibular joint

TMD - temporomandibular disorder

EMG - Electromyography

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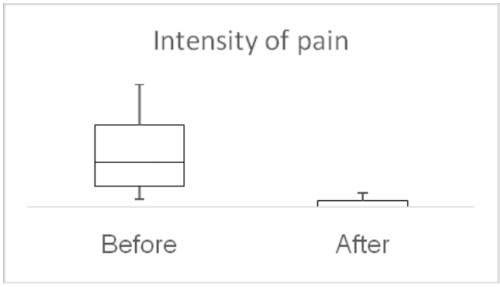
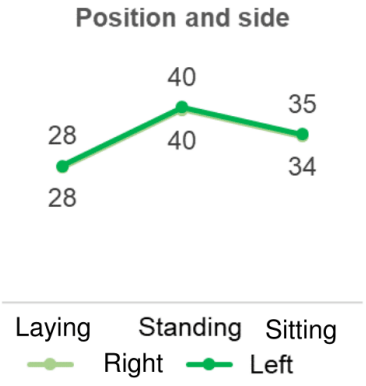
Tabela 1. P values obtained from ANOVA for each muscle and side.

VARIABLES	Temporal		Masseter		ECOM		Trapeze	
	R	L	R	L	R	L	R	L
Position	<2e-16 *	<2e-16 *	<2e-16 *	<2e-16 *	4,26e-12 *	3,86e-14 *	<2e-16 *	<2e-16 *
Condition	<2e-16 *	<2e-16 *	<2e-16 *	<2e-16 *	1,33e-11 *	<2e-16 *	4,65e-08 *	5,33e-09 *
Time	1,05e-07 *	<2e-16 *	0,00084 *	1,41e-08 *	0,0011 *	1,06e-07 *	7,98e-10 *	8,10e-12 *
Position: Condition	7,78e-15 *	<2e-16 *	4,11e-09 *	6,19e-12 *	0,63	0,73	0,46	0,34
Position: Time	0,62	0,07	0,57	0,19	0,54	0,35	8,56e-05 *	2,63e-05 *
Condition: Time	0,000185 *	1,03e-08 *	0,048 *	0,00044 *	0,80	0,045 *	0,59	0,54
Position: Condition: Time	0,95	0,671	0,899	0,74	1,00	0,99	0,86	0,91

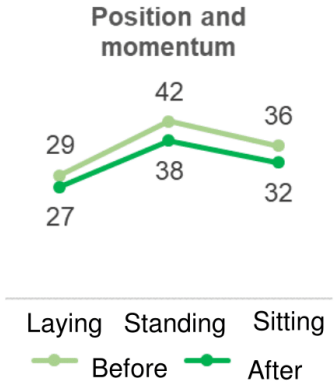


Graph 1. Intensity of pain before and after treatment.

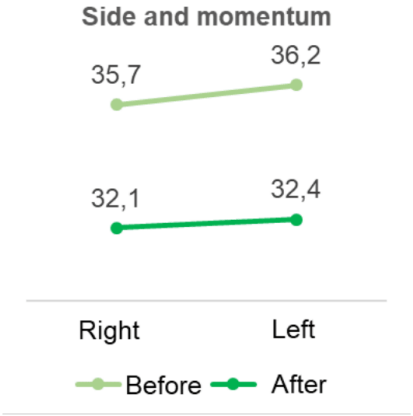
Graph 2 - MBF average in relation to patient's position, comparing the left and right sides.



Graph 3 - MBF average in terms of patient's position before and after Of treatment



Graph 4 – Average MBF for each side, before and after treatment.



7. DISCUSSÃO OU CONSIDERAÇÕES GERAIS:

Como apresentado nos artigos, a Postura (deitado, sentado e de pé) em que o paciente se encontra afeta significativamente a RMS, também a condição que o paciente é exposto (repouso, CVM e mordida) e o momento (antes e após o tratamento fisioterapêutico) avaliado de cada paciente são também significativos e exercem grande influencia na ATM, sendo que a variação de decúbito exerceu as maiores influências sobre a contração muscular da musculatura orofacial e cervical. Na postura de pé foram encontrados os maiores valores de RMS em relação à postura sentada e deitado.

Os resultados da EMG, através da análise das musculaturas cervicais e orofaciais em diferentes decúbitos e funções, demonstraram que a atividade elétrica muscular se altera significativamente, demonstrando que na posição de pé e na condição de apertamento ocorrem os maiores valores de RMS, demonstrando assim uma maior atividade muscular.

A postura exerce grande influência na ATM e os pacientes com DTM apresentam maiores contrações musculares e dores orofaciais a medida que são submetidos a maior descarga de peso, onde o corpo tem que se ajustar para se equilibrar as três balanças de equilíbrio corporal, sendo elas a balança da Articulação Temporomandibular D e E, a balança da cintura escapular e a balança da cintura pélvica.

Uma das possíveis explicações para a associação entre alteração da postura crânio-cervical nos pacientes com DTM é o mecanismo de convergência das aferências da região cervical e da face no tronco cerebral. Essa convergência de aferências pode levar ao desenvolvimento de sintomas de dor cervical nos pacientes com DTM, com consequente limitação na amplitude de movimento e alterações da postura da cabeça e região cervical. Os pacientes com DTM apresentam significantes alterações na atividade elétrica muscular quando submetidos a variação da postura, queixando de dor orofacial e dificuldade nos movimentos orofaciais. Na posição de pé encontramos os maiores valores de RMS para a musculatura orofacial e cervical, mostrando que o corpo se ajusta e se equilibra para se sustentar contra a gravidade, buscando assim o equilíbrio de todos os segmentos corporais, incluindo assim a ATM nesse equilíbrio corporal.

Não ocorre diferença estatisticamente significante entre a FMM entre os lados D e E. A amostra foi composta de pacientes com DTM D e com DTM E. Mesmo não sendo

significativo, foi observado que o lado E apresentou maiores valores de FMM e RMS maior do lado E. Isso mostra clinicamente que o portador de DTM tende a usar mais o lado contralateral. A postura influencia diretamente a FMM, onde na posição de pé temos os maiores valores e também observamos que o tratamento fisioterapêutico melhora a atividade elétrica muscular e produz um relaxamento muscular pois observamos uma diminuição da FMM após o tratamento, sendo esse um efeito imediato.

Encontrou-se uma atividade dos músculos Temporal e Masseter aumentada, principalmente da postura de pé e no apertamento. O músculo Temporal foi o que apresentou maior a atividade elétrica muscular e FMM, demonstrando assim uma disfunção entre M Temporal e M Masseter, que deveriam ser sinérgicos, onde o M Temporal funciona como um estabilizador da ATM (função estática) e o M Masseter funciona como um músculo da dinâmica, realizando o movimento de mordida. Em função da DTM o M Temporal apresenta maiores valores de RMS e FMM, em relação ao M Masseter, mesmo no movimento de mordida.

As terapias fisioterapêuticas são meios coadjuvantes importantes no tratamento das DTM assim como a intervenção odontológica participa no sentido de diagnosticar as causas, buscando recursos que eliminem ou minimizem os danos sobre as estruturas do sistema estomatognático, o que também contribuirá para gerar conforto e bem-estar ao indivíduo portador de DTM. A Fisioterapia apresentou um efeito imediato significante na diminuição da atividade elétrica muscular, da FMM e um alívio significativo da dor orofacial, demonstrando assim a importância da inclusão da Fisioterapia na equipe interdisciplinar para o tratamento da DTM.

A Osteopatia foi a técnica utilizada nesse estudo e também demonstrou ser uma técnica efetiva para o tratamento da DTM, apresentando resultados significativos na melhora da atividade elétrica muscular, na FMM e no alívio imediato da dor.

Devido à etiologia multifatorial da disfunção temporomandibular (DTM), o diagnóstico preciso permanece uma questão de debate e são necessárias ferramentas diagnósticas validadas. Foi utilizado a eletromiografia de superfície (EMG), avaliada no domínio da amplitude pelo quadrado médio da raiz (RMS), no diagnóstico de DTM. Concluiu-se que a EMG (RMS) é uma ferramenta complementar para o diagnóstico clínico da DTM miogênica, capaz de quantificar a atividade muscular, demonstrando suas alterações nas variações de decúbitos e nas diferentes funções. A atividade muscular de

todos os músculos avaliados foi maior na posição de pé. Portanto isso mostra a necessidade de avaliar a ATM nas diversas posições afim de realizar um melhor planejamento de intervenção terapêutica.

Ocorreu uma melhora significativa da dor após o tratamento fisioterapêutico, sendo relatado pelos pacientes que após a Osteopatia sentiam a região orofacial mais leve e com mais liberdade e leveza de movimentos.

É importante analisar o paciente de forma global, entendendo que a ATM é uma articulação como todas as outras, e necessita ser avaliada na globalidade do nosso corpo. Entendendo assim, a ATM deve ser avaliada e analisada em todas as posturas, e não somente na posição deitada como normalmente é feita, podendo ter respostas mais satisfatórias no tratamento da DTM. É de grande importância que toda avaliação e intervenção no paciente com DTM seja realizado por uma equipe interprofissional.

8. CONCLUSÃO:

Concluímos que a postura influencia na ATM, sendo a posição de pé onde se tem a maior contração muscular e força de mordida máxima. A Fisioterapia é fundamental no tratamento da DTM junto a Odontologia, sempre associada a uma equipe interdisciplinar, afim de promover uma melhoria na contração muscular, um equilíbrio da FMM e um alívio da dor.

9. REFERENCIAIS BIBLIOGRÁFICAS

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ANEXO I

UNIVERSIDADE FEDERAL DE UBERLÂNDIA/MG

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Avaliação da eficácia de diferentes condutas terapêuticas em pacientes portadores de dor miofascial: estudo clínico prospectivo randomizado

Pesquisador: Alfredo Júlio Fernandes Neto

Área Temática:

Versão: 3

CAAE: 23669014.8.0000.5152

Instituição Proponente: FACULDADE DE ODONTOLOGIA

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 832.182

Data da Relatoria: 25/07/2014

Apresentação do Projeto:

Esse projeto será composto pacientes assintomáticos e pacientes que apresentam dor miofascial e necessitam de tratamento. Desta forma, os pacientes sintomáticos serão distribuídos aleatoriamente (de acordo com a procura pelo tratamento) nos seguintes procedimentos: ajuste oclusal, tratamento fisioterapêutico, biofeedback e placa oclusal. A sintomatologia bem como a atividade eletromiográfica será avaliada antes e após o tratamento e posteriormente comparada com o grupo controle.

Será necessário um grupo sem nenhuma intervenção para comparar a atividade muscular deste com os grupos que serão submetidos ao tratamento. Contudo esse grupo-controle será composto de pacientes que não necessitarão de qualquer tratamento, ou seja, pacientes com ausência de dor miofascial.

Objetivo da Pesquisa:

Avaliar a eficácia de diferentes modalidades de tratamento odontológicos e fisioterapia por meio de índices de qualidade de vida e testes de sincronismo muscular em pacientes sintomáticos para dor miofascial em contraste a pacientes assintomáticos.

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Avaliação dos Riscos e Benefícios:

Segundo os pesquisadores os riscos previsíveis para a realização desta pesquisa envolvem a identificação dos participantes. Entretanto, cada voluntário participante será identificado por um número, com a finalidade de diferenciá-lo e manter a integridade e identidade do mesmo, protegendo a confidencialidade. Os dados serão coletados pelos pesquisadores, que manterão a privacidade e o sigilo das informações, as quais serão armazenadas em arquivos na memória do computador para posterior análise. Assim, os riscos de divulgação da identidade dos voluntários serão minimizados.Além disso, para definir o diagnóstico e tratamento de pacientes com DM, será realizado o exame complementar de eletromiografia bem como a utilização do questionário de qualidade de vida, ambos validados na literatura, porém não utilizados no PRODAE. Desta forma, o tempo clínico será maior devido à utilização de metodologias complementares. A fim de minimizar o desconforto do paciente, o tratamento será dividido em várias sessões.

E como benefícios os pesquisadores informa que os participantes da pesquisa serão beneficiados indiretamente, pois a pesquisa promoverá geração do conhecimento, a fim de compreender o papel do cirurgião-dentista no tratamento da dor miosfacial.

Comentários e Considerações sobre a Pesquisa:

A pesquisa é pertinente e de ampla abrangência.

Considerações sobre os Termos de apresentação obrigatória:

Os termos foram apresentados. O TCLE foi adequado ao projeto, atendendo o pedido do CEP.

Recomendações:

Não há.

Conclusões ou Pendências e Lista de Inadequações:

As pendencias apontadas no parecer 696.118 foram atendidas pelos autores do projeto.

De acordo com as atribuições definidas na Resolução CNS 466/12, o CEP manifesta-se pela aprovação do protocolo de pesquisa proposto.

O protocolo não apresenta problemas de ética nas condutas de pesquisa com seres humanos, nos limites da redação e da metodologia apresentadas.

Situação do Parecer:

Aprovado

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Necessita Apreciação da CONEP:

Não

Considerações Finais a critério do CEP:

Data para entrega de Relatório Final ao CEP/UFU: julho/agosto de 2015.

OBS.: O CEP/UFU LEMBRA QUE QUALQUER MUDANÇA NO PROTOCOLO DEVE SER INFORMADA IMEDIATAMENTE AO CEP PARA FINS DE ANÁLISE E APROVAÇÃO DA MESMA.

O CEP/UFU lembra que:

a- segundo a Resolução 466/12, o pesquisador deverá arquivar por 5 anos o relatório da pesquisa e os Termos de Consentimento Livre e Esclarecido, assinados pelo sujeito de pesquisa.

b- poderá, por escolha aleatória, visitar o pesquisador para conferência do relatório e documentação pertinente ao projeto.

c- a aprovação do protocolo de pesquisa pelo CEP/UFU dá-se em decorrência do atendimento a Resolução CNS 466/12, não implicando na qualidade científica do mesmo.

Orientações ao pesquisador :

• O sujeito da pesquisa tem a liberdade de recusar-se a participar ou de retirar seu consentimento em qualquer fase da pesquisa, sem penalização alguma e sem prejuízo ao seu cuidado (Res. CNS 466/12) e deve receber uma via original do Termo de Consentimento Livre e Esclarecido, na íntegra, por ele assinado.

• O pesquisador deve desenvolver a pesquisa conforme delineada no protocolo aprovado e descontinuar o estudo somente após análise das razões da descontinuidade pelo CEP que o aprovou (Res. CNS 466/12), aguardando seu parecer, exceto quando perceber risco ou dano não previsto ao sujeito participante ou quando constatar a superioridade de regime oferecido a um dos grupos da pesquisa que requeiram ação imediata.

• O CEP deve ser informado de todos os efeitos adversos ou fatos relevantes que alterem o curso normal do estudo (Res. CNS 466/12). É papel de o pesquisador assegurar medidas imediatas adequadas frente a evento adverso grave ocorrido (mesmo que tenha sido em outro centro) e enviar notificação ao CEP e à Agência Nacional de Vigilância Sanitária – ANVISA – junto com seu posicionamento.

• Eventuais modificações ou emendas ao protocolo devem ser apresentadas ao CEP de forma clara e sucinta, identificando a parte do protocolo a ser modificada e suas justificativas. Em caso de

projetos do Grupo I ou II apresentados anteriormente à ANVISA, o pesquisador ou patrocinador deve enviá-las também à mesma, junto com o parecer aprobatório do CEP, para serem juntadas ao protocolo inicial (Res.251/97, item III.2.e).

UBERLANDIA, 15 de Outubro de 2014

Assinado por:
Sandra Terezinha de Farias Furtado
(Coordenador)

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