CoDAS
ISSN 2317-1782 (Online version)

Original Article
Artigo Original

Effects of photobiomodulation associated with orofacial myofactional therapy on temporomandibular joint dysfunction

Efeitos da fotobiomodulação associada à terapia miofuncional orofacial na disfunção temporomandibular muscular

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Keywords

Temporomandibular Joint Disorders
Temporomandibular Joint Dysfunction Syndrome
Laser
Speech Therapy
Quality of Life

ABSTRACT

Purpose: To investigate the influence of photobiomodulation associated with orofacial myofunctional therapy (OMT) in patients with temporomandibular muscle disorders (TMD). **Methods**: Randomized, blinded trial clinical study with a sample of eleven women with muscle TMD divided into two groups. The experimental group (EG) consisted of five women submitted to orofacial myofunctional therapy associated with photobiomodulation, and the control group (CG) consisted of six women submitted to orofacial myofunctional therapy associated with inactive photobiomodulation (placebo). The intervention was performed in the following twelve sessions: one evaluation, ten speech therapy sessions associated with photobiomodulation, and one reevaluation. For outcomes, investigation on pain perception using the visual analogue scale (VAS), investigation of palpation sensitivity with the research diagnostic criteria for temporomandibular disorders (RDC/TMD), and quality of life (QOL) verification through oral health impact profile – short form (OHIP-14) were considered. **Results**: The EG increased measurements of mandibular movements of opening and protrusion and improved in the evaluation of QOL. **Conclusion**: Orofacial myofunctional therapy, when associated with photobiomodulation, contributed to increase the range of mandibular movements, with important improvements in the perception of quality of life and with significant improvement in the painful conditions of volunteers with TMD.

Descritores

Transtornos da Articulação Temporomandibular
Síndrome da Disfunção da Articulação Temporomandibular
Laser
Fonoterapia
Qualidade de Vida

RESUMO

Objetivo: Investigar a influência da fotobiomodulação associada à terapia miofuncional orofacial (TMO) em pacientes com disfunção temporomandibular muscular (DTM). **Método:** Trata-se de uma pesquisa do tipo ensaio-clínico randomizado e cego, com uma amostra de 11mulheres com DTM muscular, dividida em dois grupos. O Grupo Experimental (GE)composto por 05 voluntáriassubmetidas àTMO associada à fotobiomodulação, e o Grupo Controle Positivo (GC) composto por 06 mulheres submetidas à TMO associada à fotobimodulação inativa (placebo). A intervenção foi realizada em 12 sessões: uma avaliação, 10 sessões de fonoterapia associada à fotobiomodulação, e uma reavaliação. Para os desfechos foram consideradas a investigação da percepção de dor, com a Escala Visual Analógica (EVA), a investigação da sensibilidade à palpação com o protocolo *Research Diagnostic Criteria for Temporomandibular Disorders* (RDC/TMD), e a verificação da qualidade de vida (QV) por meio do protocolo *Oral Health Impact Profle – short form* (OHIP-14). **Resultados:** o GE teve aumentonas medidas dos movimentos de abertura e de protrusão mandibular, e evidenciou melhora na avaliação da QV. **Conclusão:** ATMO quando associada à fotobiomodulação contribuiu no aumento da amplitude dos movimentos mandibulares e com ganhos importantes na percepção da qualidade de vida, e com melhora significativa nos quadros dolorosos das voluntárias com DTM.

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Received: June 19, 2020

Accepted: September 26, 2020

Study conducted at Universidade Federal da Paraíba, João Pessoa – UFPB, João Pessoa (PB); and at Universidade Federal de Pernambuco – UFPE, Recife (PE), Brasil.

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Financial support: CNPq, notice PDJ (151812/2019-5).

Conflict of interest: nothing to declare.

INTRODUCTION

Temporomandibular dysfunction (TMD) is a set of clinical conditions that include the masticatory muscles, the temporomandibular joint (TMJ) and associated structures, besides functional disorders of the chewing apparatus[1,2]. It is characterized by changes in the functioning of temporomandibular joint movements, has multifactorial cause and may be related with the existence of harmful habits, such as onychophagy, bruxism, and tongue sucking, to the involvement of structural and emotional aspects[3].

Muscle-related TMDs are the most frequent among patients seeking clinical treatment, being considered masticatory muscle disorders. Such disorders generate pain, which is usually related to muscle overuse, being called myalgia, and can range from mild sensitivity to extreme discomfort[3,4].

Individuals with TMD have high prevalence of signs and symptoms that can directly affect their quality of life, including occurrence of pain, limitation and/or incoordination of jaw movements, joint noises, sensitivity upon palpation in the masticatory muscles, and chewing difficulty[2,3]. Good function, stability, and health of the temporomandibular joint are of great relevance for phonation, posture, mastication, and deglutition of the individual.

TMD can be characterized as being the most common orofacial pain condition[2,3]. Thus, the orofacial myofunctional therapy, one of the fields of the speech therapist, is a strategy used in rehabilitation of subjects with TMD. This intervention uses relaxation and pain relief techniques, as well as orofacial motor exercises and thermotherapy with the main objective of recovering the functionality of the stomatognathic system, so that functions, especially mastication, can be performed without pain, limitation, or risk of aggravating the problem[4]. Manual therapy through manipulation, mobilization, and specific exercises improves mobility, stimulates proprioception, increases fiber elasticity, and stimulates synovial fluid production, reducing tension and eliminating trigger points through slow movements on pain areas, reducing the painful conditions of the dysfunction[5]. Regarding exercises used, it is necessary to be careful, as they are not indicated for all cases or all stages of therapeutic process. Improper use can damage and exacerbate the pain and discomfort condition of the patient[5].

In the literature, several studies have evaluated the effects of photobiomodulation with low-level laser irradiation on TMD, showing results that demonstrated the benefits of the technique as an important tool to assist in the treatment of this dysfunction[1,6-8].

Photobiomodulation has been extensively investigated to treat TMDs for its analgesic, regenerative, and anti-inflammatory effects in the target tissue[6-8]. Low-level laser therapy has shown to be capable of assisting in the symptomatic treatment of pain, promoting a considerable degree of comfort to the patient right after its application[8].

The laser can act at molecular level when absorbed by the tissue, exciting electrons or parts of the molecule and promoting charge movement in the molecule. In the case of low-level laser therapy, biostimulation or bioinhibition may occur for chemical and physiological reactions that naturally occur in this tissue, regulating cellular and physiological functions. Low-level laser therapy produces a very intense monochromatic source of energy, which after being absorbed can induce a cellular response that promotes kinesthesis to the maintenance of homeostasis. This is possible as human cells are not adapted to this type of radiation. However, it is extremely important to highlight the role of the therapist, who must master the technique and have scientific evidence to use adequate doses and conduct application properly[7,9].

The laser is a biomodulating agent that acts directly on muscle fibers, simultaneously reducing pain and muscle contraction by stimulating local microcirculation. It decreases the painful condition of the patient by irradiating the trigger point, acting on tissue repair and reducing hyperemia and edema[1,6-9]. It is a non-invasive procedure that relieves pain and gradually restores the functionality of the stomatognathic system[8].

Painful processes are quite common conditions in TMD, causing considerable discomfort in individuals, besides interfering in their physical and mental function, resulting in high-cost treatments, lost workdays, reduced productivity, and impaired quality of life[10]. The literature demonstrated that signs and symptoms of TMD are capable of negatively affecting the quality of life of these individuals[11], requiring effective interventions for the treatment or control of the dysfunction, which is the motivation of this study.

Considering scientific evidence supporting the efficacy of photobiomodulation with the use of low-level laser therapy for TMD treatment[1,6,7], this research investigates the influence of photobiomodulation associated with orofacial myofunctional therapy in muscle TMD patients, in order to verify if the combination of these interventions promotes functional gains in painful conditions, functional jaw movements, and in the perception of the quality of life of this population.

METHODS

This research is characterized as a randomized, blinded trial clinical study approved by the Human Research Ethics Committee of the institution of origin, under No. 3,354,075. Volunteers who agreed to participate in the research signed the free and informed consent form (ICF).

The study was conducted in the speech therapy clinic of a higher education institution. Initially, volunteers who sought TMD treatment were screened in order to identify volunteers who met the eligibility criteria of the study. Women with diagnosis of mild to moderate muscle TMD who were not undergoing TMD treatment were included in the research, according to the research diagnostic criteria for temporomandibular disorders (RDC/TMD)[12]. Women that were pregnant; undergoing chemotherapy or radiotherapy; in chronic treatment of TMD with analgesics or anti-inflammatories; and with class II or III occlusion, moderate or severe, were excluded from the study.

The sample consisted of eleven women with TMD affecting muscles bilaterally, of a mild to moderate degree, aged between twenty-five and fifty-five years old. They were randomly distributed (chosen by lot) in two groups, in which

odd numbers belonged to the control group (CG) and the even numbers to the experimental group (EG). Initially, eight women were selected to compose each group. However, during the treatment period, two volunteers from the CG and three from the EG abandoned treatment for personal reasons. For data analysis and interpretation, the EG consisted of five women who underwent orofacial myofunctional therapy associated with photobiomodulation, and the control group consisted of six women who underwent orofacial myofunctional therapy associated with inactive photobiomodulation (placebo). The term inactive photobiomodulation was given for the situation in which there was simulation of laser application using the low-level laser therapy protocol, with the sound of device activation, but without emitting the light beam, considering that all patients in this group did not receive photobiomodulation. Volunteers were unaware of which group they belonged to.

For outcomes, pain perception was investigated using the visual analogue scale (VAS), which has extremities numbered from zero to ten, with zero being absence of pain and ten being unbearable pain[9]. Palpation sensitivity was investigated through axis I of the research diagnostic criteria for temporomandibular disorders (RDC/TMD)[12]. The impact of oral changes on quality of life was verified through the oral health impact profile - short form (OHIP-14)[13].

In the session following evaluation, patients underwent irradiation with low-level laser of gallium-aluminum-arsenide (GaAlAs), in the cases of the EG, using the Laser Pulse Diamond Line equipment manufactured by IBRAMED with 830 nm wavelength, providing a dose of 3J with fluency of 48 J/cm^2 in the temporomandibular joint (TMJ) region. Although knowing that the dose is still undefined by studies[7], and that high doses (8J) are the most indicated in the literature for analgesia[1], it was decided to start the research with a low dose, in order to understand how different doses behave in clinical cases[14]. In addition, the aim was to achieve other objectives complementary to analgesia, such as improving mandibular movements. With low doses it is possible to promote tissue repairs that are fundamental for the physiological recovery and harmony of the TMJ[1-7].

During photobiomodulation, the following protection measures recommended when using low-level laser therapy were applied: use of safety goggles for therapists and patients; being careful not to direct the beam towards the eyes; care for mirrored surfaces within the therapeutic environment; and operational ergonomics. In addition, sessions were performed in an isolated room with identification of laser use.

The infrared wave was applied bilaterally, punctually, into light contact with the skin, in five points in the TMJ region, namely: towards the condyle in anterior/posterior upper and lower points of the condylar position and in painful areas of the masseter, temporalis, sternocleidomastoid, and trapezius muscles indicated by the volunteers[8].

Afterwards, the volunteers were submitted to orofacial myofunctional therapy, including: guidance on TMD and elimination of harmful habits, guidance on how to perform thermotherapy and exercises at home; strategies for pain relief with massage and muscle relaxation; oromyofunctional exercises for lips, tongue, and cheeks, mandibular exercises, and training of orofacial functions[4,5,8]. Orofacial myofunctional therapies were structured based on the needs of each patient, with guidelines, specific orofacial myofunctional exercises, and individualized functional training, besides the attention given to proprioception to eliminate harmful habits. During guidance, given at the end of every session, the forms of execution and frequencies of home activities were analyzed, as well as the persistence or not of habits. Analysis was based on the reports of participants regarding how activities were performed, as well as demonstrating to the researcher how these activities were performed in their daily lives. At that moment, new activities to the following week were also determined.

The study groups underwent twelve sessions (in weekly meetings) lasting fifty minutes each, with fifteen minutes of laser therapy, thirty minutes of orofacial myofunctional therapy, and five minutes of orientation. The first session was dedicated to evaluation, the ten subsequent sessions were dedicated to clinical intervention, and the last session was dedicated to reevaluation. In the latter, protocols were reapplied in order to measure gains by comparing results of pre and post intervention of photobiomodulation associated with OMT in both groups.

After collection procedures, data were categorized and allocated in a digital spreadsheet for descriptive statistical analysis through frequency, central tendency, and inferential measurements. Normality of data distribution was observed through Kolmogorov-Smirnov test and parametric analysis was performed using Student's t-test for paired samples. The statistical software R, version 3.2.2, was used with significance level of 5%.

RESULTS

Data regarding characterization of the degree of pain of volunteers before and after interventions in the EG and CG was analyzed according to the pain VAS. In the intragroup analysis, significant reduction of reference to pain was observed for both groups (EG $p = 0.002$; CG $p = 0.007$). The EG showed previous average value of 8.60 and subsequent average value of 1.00, while the CG showed previous average value of 7.50 and subsequent average value of 1.83. The other results are shown in Tables 1 to 3.

Table 1 shows the results of comparison of measurements of mandibular movements before and after therapy of the EG and CG. Intragroup analysis showed significant improvement of anthropometric measurements in the EG for all movements, namely: opening ($p = 0.042$), right and left sides ($p = 0.033$; $p = 0.026$), and protrusion ($p = 0.048$). As for the CG, significant results were observed only in the measurements of right and left sides ($p = 0.040$; $p = 0.036$).

When comparing variables related to mandibular movements before and after therapy in the EG, significant improvement was observed for the following variables: pain on mouth closing ($p = 0.035$), pain on the right side ($p = 0.049$), pain on the left side ($p = 0.025$), pain on protusion ($p = 0.0.009$), noise at the right and left TMJ on mouth opening ($p = 0.016$; $p = 0.030$), noise at the right TMJ on mouth closing ($p = 0.030$), noise at the right and left TMJ on protrusion ($p = 0.178$; $p = 0.039$), noise at

Table 1. Comparison of variables related to the measurements of mandibular movements before and after therapy in the EG and CG

VARIABLE	PRETHERAPY		POSTTHERAPY		p-value
	Mean	SD	Mean	SD	
Experimental group					
Opening	41.80	9.09	47.40	6.80	0.042*
Right side	7.70	3.11	11.30	1.41	0.033*
Left side	7.40	2.58	11.20	1.64	0.026*
Protrusion	6.94	1.69	9.48	0.90	0.048*
Control group					
Opening	41.13	6.21	43.63	4.62	0.081
Right side	7.23	2.60	10.00	4.19	0.040*
Left side	7.43	2.46	10.00	1.41	0.036*
Protrusion	5.26	1.75	6.38	1.49	0.077

significance* p <0.05; Source: ALVES, GAS, 2020
Caption: SD - Standard Deviation; T - Student's t-test - related samples

Table 2. Comparison of variables related to mandibular movement before and after intragroup therapy in the EG and CG

VARIABLE	PRETHERAPY		POSTTHERAPY		p-value
	Mean	SD	Mean	SD	
Experimental group					
Opening – Deviation	1.20	0.84	1.20	0.84	1.0
Opening – Pain	2.20	0.84	0.70	1.20	0.047*
Closing – Deviation	1.20	0.83	0.80	0.83	0.374
Closing – Pain	1.60	1.14	0.00	0.00	0.035*
Right side – Pain	1.20	1.30	0.40	0.89	0.049*
Left side – Pain	1.60	1.14	0.20	0.44	0.025*
Protrusion – Pain	2.20	0.83	0.40	0.89	0.009*
Protrusion – Deviation	0.60	0.89	0.20	0.44	0.374
TMJ noise R – Opening	1.00	0.00	0.20	0.44	0.016*
TMJ noise R – Closing	0.80	0.44	0.20	0.44	0.030*
TMJ noise R – Protrusion	0.60	0.54	0.20	0.44	0.178*
TMJ noise R – Right side	0.80	0.44	0.20	0.44	0.030*
TMJ noise R – Left side	0.80	0.44	0.40	0.54	0.178
TMJ noise L – Opening	0.80	0.44	0.20	0.44	0.030*
TMJ noise L – Closing	0.60	0.54	0.20	0.44	0.178
TMJ noise L – Protrusion	0.60	0.54	0.00	0.00	0.039*
TMJ noise L – Right side	0.80	0.44	0.20	0.44	0.040*
TMJ noise L – Left side	0.80	0.44	0.00	0.00	0.016*
Control group					
Opening – Deviation	1.67	1.21	0.67	1.03	0.076
Opening – Pain	1.66	1.20	1.16	0.98	0.080
Closing – Deviation	1.00	0.89	0.83	0.98	0.363
Closing – Pain	1.16	1.16	0.50	0.83	0.102
Right side – Pain	1.00	0.89	0.83	0.98	0.741
Left side – Pain	1.50	0.54	0.50	0.83	0.041*
Protrusion – Pain	0.50	0.83	0.00	0.00	0.203
Protrusion – Deviation	0.66	1.03	0.33	0.81	0.363
TMJ noise R – Opening	1.33	1.03	0.83	1.16	0.203
TMJ noise R – Closing	1.16	1.16	0.66	1.21	0.611
TMJ noise R – Protrusion	0.33	0.51	0.16	0.40	0.203
TMJ noise R – Right side	1.00	1.26	0.50	1.22	0.102
TMJ noise R – Left side	1.33	1.03	0.66	1.21	0.175
TMJ noise L – Opening	1.50	0.83	1.16	0.98	0.076
TMJ noise L – Closing	1.33	1.03	0.83	1.16	0.203
TMJ noise L – Protrusion	0.66	0.81	0.16	0.40	0.203
TMJ noise L – Right side	1.16	1.16	0.66	1.21	0.102
TMJ noise L – Left side	1.33	1.03	0.66	1.21	0.363

Source: ALVES, GAS, 2020; significance *p <0.05
Caption: SD - Standard Deviation; T-Student's T test - related samples

Table 3. Comparison of OHIP-14 scores referring to quality of life pre- and posttherapy in the EG and CG

Variable	PRETHERAPY		POSTTHERAPY		p-value
	Mean	SD	Mean	SD	
Experimental group					
Functional limitation	2.60	1.67	0.80	0.83	0.048*
Physical pain	5.40	2.40	0.80	1.30	0.006*
Psychological discomfort	6.20	2.04	1.80	1.30	0.006*
Physical limitation	5.80	1.30	0.60	0.89	0.002*
Psychological limitation	3.60	2.07	0.80	0.83	0.038*
Social limitation	2.40	1.14	0.80	1.30	0.012*
Disability	1.40	0.89	0.00	0.00	0.025*
Total OHIP	**27.40**	**7.63**	**5.60**	**4.61**	**0.002***
Control group					
Functional limitation	1.50	1.76	0.00	0.00	0.091
Physical pain	6.16	1.16	1.33	1.36	0.0001*
Psychological discomfort	5.66	2.33	2.33	1.63	0.022*
Physical limitation	3.50	2.42	1.16	1.60	0.040*
Psychological limitation	2.83	2.85	1.83	1.60	0.447
Social limitation	1.50	2.81	0.33	0.81	0.402
Disability	1.83	2.85	0.00	0.00	0.177
Total OHIP	**23.00**	**13.46**	**7.00**	**5.40**	**0.015***

Source: ALVES, GAS, 2020; significance *p <0.05
Caption: SD - Standard Deviation; T- Student's T test - related samples

the right and left TMJ on the right side (p = 0.030; p = 0.040), and noise at the left TMJ on the left side (p = 0.016). In the CG, when comparing mandibular movements before and after therapy, there was improvement only in pain on movement in the left side (p = 0.041) (Table 2).

Table 3 shows the comparison of scores of quality of life of volunteers of EG and CG before and after interventions. There was significant improvement in the EG in relation to the seven aspects of evaluation, namely: functional limitation (p = 0.048), physical pain (p = 0.006), psychological discomfort (p = 0.006), physical limitation (p = 0.002), psychological limitation (p = 0.038), social limitation (p = 0.012), and disability (p = 0.025). In general, the quality of life of the experimental group improved, as significant evolution (p = 0.002) was observed in the total score of the OHIP-14 protocol. As for the CG, a significant improvement in quality of life was also observed according to the total score of the protocol (p = 0.015). However, improvement was observed only for the following three aspects: physical pain (p = 0.0001), psychological discomfort (p = 0.022), and physical limitation (p = 0.040).

DISCUSSION

The study demonstrated through the visual analogue scale, applied before and after interventions, reduction of painful symptoms for both groups. However, there was a tendency for these results to be inferior in the mean of the EG (mean = 1) when compared to the CG (mean = 1.83).

In the literature, several studies showed positive effects of laser therapy for pain relief in individuals with TMD[6-8,15-18]. Positive effects are probably provided by the laser acting as a stabilizing factor of the potential of the membrane at rest, acting directly on nerve endings and resulting in increased maintenance of analgesia, preventing transmission of painful stimulus to the point irradiated[6,16].

Orofacial myofunctional therapy has been little explored in the literature as an intervention strategy for TMD, although scholars have discussed its practical application to treat this dysfunction[4,5,8]. However, few studies have shown positive effects of this therapeutic modality in TMD treatment[5]. Research on the effects of myofascial techniques show pain reduction in musculoskeletal structures, which consequently restore functions due to biomechanical and neurophysiological effects[5].

Besides evidencing benefits of orofacial myofunctional therapy in this study, with significant results when measuring movements in the right and left side in the CG, laser therapy associated with OMT also showed significant results when measuring opening and protusion movements, corroborating several studies[1,8,17,19].

Moreover, similar results were observed in relation to pain, deviation, and joint noise in the mandibular movements of the groups under study, showing extremely significant results for the experimental group compared to the control group. Such findings corroborate the literature regarding randomized clinical trials, which shows more significant results for mandibular movements in groups treated with laser therapy[1,6-8,14,20-22].

Data in the literature show that TMD patients are affected by signs and symptoms capable of negatively affecting their quality of life[23-25]. In addition, these authors identified that TMD patients obtained statistically better results compared to the placebo group after being treated with laser therapy[23-25]. In this research, statistically significant improvement in the QOL of both study groups was observed after clinical interventions, although better results were observed for the experimental group.

Regarding evidence of OMT for TMD treatment, there was evidence of significant reduction of pain upon palpation of

masticatory muscles; increased mandibular movement; reduced frequency and severity of signs and symptoms; and increased scores for orofacial myofunctional conditions. However, these authors did not obtain satisfactory results regarding pain relief upon palpation for TMJs[5]. This fact may highlight the contribution that laser therapy can promote when associated with orofacial myofunctional therapy, which is even more evident in the results obtained for the experimental group of the present study.

In order to verify the effect of OMT in TMD patients, 30 days after laser therapy for analgesia was concluded, it was observed that the treatment balanced orofacial functions and decreased remaining signs and symptoms of TMD, according to the self-perception of treated individuals[26], even though interventions were not applied integrated in the same speech therapy setting. In the application of orofacial myofunctional exercises with laser therapy, increased effectiveness of this therapeutic combination was observed for rehabilitation of TMD patients compared to application of low-level laser alone[27].

When comparing the effects of laser therapy associated with OMT and OMT-only in measurements of oral opening and degree of pain, it was observed that laser therapy is an important resource to complement speech therapy, helping to promote immediate analgesia, contributing to the adequacy of oral opening and improving the physiological patterns of stomatognathic structures and functions[8].

This research also identified the influence of laser therapy associated with orofacial myofunctional therapy in clinical intervention to treat temporomandibular muscle disorders, evidencing in this pilot study through statistically significant data the benefits of combining both therapeutic modalities.

CONCLUSION

It was concluded that photobiomodulation therapy can contribute with additional gains to orofacial myofunctional therapy, improving the results of speech therapy in the treatment of temporomandibular disorders.

ACKNOWLEDGEMENTS

To CNPq for encouraging research.

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Author contributions

GASA: Elaboration of the study design, data collection and analysis, Scientific writing, guidance; YRRG: Elaboration of the study design, collection and Scientific writing; JASL: Elaboration of the study design, data collection; MAPS: data collection and analysis; DSFF: Data collection; LNAA: Elaboration of the study design, descriptive and analytical statistics of the data; HJS: Elaboration of the study design, review of Scientific writing, and research advisor.