

# EVALUATION OF THE EFFICACY OF LOW-LEVEL LASER THERAPY (LLL) IN THE TREATMENT OF TEMPOROMANDIBULAR DISORDERS: A RANDOMIZED CLINICAL TRIAL

## *Avaliação da eficácia do laser de baixa intensidade no tratamento das disfunções têmporo-mandibular: estudo clínico randomizado*

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### ABSTRACT

**Purpose:** the effectiveness of lasertherapy in the treatment o temporomandibular of pain with temporomandibular disorders.**Method:** it consisted of a randomized clinical trial divided into two groups: Group 1: AsGaAl laser; Group 2: InGaAlP laser, 20 patients between 19 and 35 years old, diagnosed with signs and symptoms of TMD. Patients had the range of motion for maximum mouth opening and laterality registered at the beginning and at the end of the laser treatment. Laser was applied in four pre-auricular points three times a week during a month, in a total of 12 sessions to each patient. The patients' pain was noted based on the use of visual analogue scale (VAS) and also by physical examination of the pain points. **Results:** there was a significant reduction ( $p < 0.028$ ) of the level of pain in both treatment groups, but the G1 had higher significance. The evolution of the threshold of muscle sensivity showed a statistically significant difference for G1 and G2. Laser therapy in Group 1 improved the mouth opening 4.643 mm on average, while in Group 2, the average was 3.71 mm per patient. **Conclusion:** there was effectiveness in both lasers in the pain control and mouth opening of patients.

**KEYWORDS:** Lasers; Temporomandibular Joint Dysfunction Syndrome; Facial Pain

### INTRODUCTION

The temporomandibular disorders (TMD) are diseases that consist of a series of clinical signs and symptoms, which involves temporomandibular joint (TMJ) and / or masticatory musculature. It rarely occurs affecting only joint or muscle, but mostly cases have complex symptoms<sup>1</sup>. The TMD has multifactorial etiology and may be associated

with dental and facial factors, which relate to the stomatognathic system<sup>2,3</sup>.

Signs and symptoms of TMD are present in 86% of the population, being more frequent among women, also related to dental occlusion and emotional stress<sup>4</sup>. Are considered signs: limited mouth opening, joint sounds and deviation of the mandible to one side during opening and closing<sup>5</sup>, muscle spasm, pain reflex, impaired joint motion, crepitus, headache and hearing disorders<sup>6</sup>. Otologic symptoms are represented by decreased hearing, vertigo and tinnitus<sup>7, 8</sup>, which can be related to the ontogenetic and anatomical relationship between the middle ear and masticatory structures<sup>2</sup>.

The "Research Diagnostic Criteria for Temporomandibular Disorders" (RDC / TMD)<sup>9</sup> provides the best classification for TMD, as it includes not only methods for the physical diagnostic classification of TMD, present on its axis I, but at the

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same time it also provides methods to assess the intensity and severity of chronic pain and levels of depressive symptoms present in axis II.

The TMD, as it is a complex condition, requires a treatment based on a correct diagnosis, established based on information about possible etiological factors, through the survey of signs and symptoms for each patient<sup>10</sup>. Among the different treatments we can use thermotherapy, electrotherapy, ultrasound, iontophoresis, some analgesics, and low-intensity laser therapy<sup>11</sup>, the last one usually indicated when there is presence of pain, restriction of mandibular movements, tissue inflammation and joint instability<sup>12</sup>.

The low-intensity laser comes in many cases as an alternative therapy for the treatment of disorders of the maxillo-facial region and joint pain, neuralgia and paresthesia<sup>13</sup>. The main justification for the use of low intensity laser therapy (LILT) on TMD is due to its analgesic effects (seen in most studies in the literature<sup>14,15</sup>) anti-inflammatory properties and its tissue repairing effect with modulation of cellular activity<sup>16-18</sup>. LILT influences changes with metabolic energetic and functional character, as it promotes increasing of cells strength and vitality, leading them to their normal functioning quickly<sup>19</sup>.

The LILT has demonstrated an ability to assist in the symptomatic treatment of pain, providing a considerable degree of comfort to the patient after application<sup>10</sup>. The great advantage of laser applications in the treatment of TMD is that it is a non-invasive therapy<sup>20</sup>, with low cost, and currently has been widely used in dental practice, reducing the demand related to the surgery or the use of drugs to treat relief pain and tissue regeneration<sup>21</sup>.

The application of laser therapy in TMD patients has demonstrated an ability to relieve pain in few minutes after application, promoting well-being significant. However, LILT is an adjuvant treatment in pain relief by its analgesic action, which allows the patient's return to daily chores, providing comfort and better quality of life.

Thus, the objective of this study was to evaluate the effectiveness of low intensity laser in the treatment of pain in patients with TMD treated with twelve sessions by visual analogue scale for pain (VAS) and measurement range of mouth opening.

## ■ METHOD

This study consisted of a descriptive and a quantitative survey. The descriptive part of the study was obtained by analyzing the clinical physical examination of patients before and after application of low-intensity laser therapy three times per week in patients with painful symptoms of TMD.

For the muscle tension evaluation, it was performed palpation of the masseter, temporal, frontal and extensors of the cervical spine, using the classification of Jensen et al.<sup>22</sup>, which described the following scores: 0 – no pain or discomfort, 1 – slight discomfort, 2 – moderate pain and 3-severe pain.

To evaluate pain in a quantitative way we used the visual analogue scale (VAS), initially clarified and then applied to patients at initial evaluation and then weekly after the session.

The patients were submitted to a questionnaire about symptoms of TMJ, consisting of 10 questions designed to evaluate the TMD – anamnestic index DMF (Fonseca et al.<sup>23</sup>). After filling the clinical form and the performance of clinical examination, we evaluated the pain intensity by visual analog scale (VAS) before application of low-intensity laser therapy and then a weekly review was made of pain evaluation.

For the study, we selected 20 subjects, 18 females and two males, aged between 19 and 58 years referred to the pain clinic already with a diagnosis of temporomandibular dysfunction, based on Fonseca<sup>23</sup> clinical examination. The sample was randomly divided by lot into two equal groups: the first, called G1 (n = 10) was treated with infrared laser (GaAlAs) according to the protocol. The second group, called G2 (n = 10), was submitted to the red laser treatment (InGaAlP).

The applications of low-intensity laser were performed in the following points: five points around the joints with pain – in the joint posterior portion, with open mouth (auriculo temporal nerve region and bilaminar zone) – the anterior part of articulation in sigmoid notch, with the mouth at rest position (non-occluding teeth). After localization of the muscle in question by means of palpation, the LILT was applied on the most painful points (including trigger points) with an equidistance between those of 1 cm<sup>2</sup>.

The therapeutic dental laser Biowave (Kondortech) was applied emitting infrared radiation with a wavelength of 830 nm, power 40 mW, the beam delivery system through direct contact with skin, with a focusing area of 0.20 cm<sup>2</sup>. The 4J/cm<sup>2</sup> dose was applied by point at the time of 1'40seg, punctually. The red laser group received red irradiation, with a wavelength of 660 nm, power 30 mW, the beam delivery system through direct contact with the skin, with focusing area of 0.20 cm<sup>2</sup>, and a applied dose per point of 4J/cm<sup>2</sup> at the time of 2'13", punctually. The number of applications was three times a week for four weeks, taken a total of twelve applications. The effectiveness of the laser was also evaluated by making a measurement of

amplitude movements of maximum mouth opening, lateral movement to left and right.

The participants were patients who agreed to sign an Informed Consent Form (ICF). The development of this study followed the requirements of Resolution 196/96 of the National Health Council / Brazilian Ministry of Health, with approval by the Ethics Committee in Research of our institution with No. 0149.0.133.000-09.

Data were analyzed using descriptive statistics, inferential and comparative analyzes. We used the Wilcoxon test and t test for paired samples. Data were entered and analyzed using the SPSS (Statistical Package for Social Sciences) version 13.0. The margin of error of the statistical tests was 5%.

## ■ RESULTS

Of the 20 patients evaluated, 18 patients were female (90%) and two males (10%) with mean age of 28.2 years to 39.1 years. It was observed that, before treatment with infrared laser (GaAlAs), the opening mouth in group 1 averaged 41.35 mm, and after the treatment, the mean aperture increased to 46.16 mm. According to the t test, there is sufficient evidence that the mouth opening after treatment with the infrared beam was statistically

higher than before treatment ( $p < 0.028$ ). Similarly occurred with the visual analogue scale (VAS) pain, as the average of the group before the laser was 8.4, and after treatment this number decreased to 1.4, showing significant difference ( $p < 0.00$ ). In group 2, treated with red laser (InGaAlP), it could be observed that before treatment mouth opening average was 46.34 mm, and after it the mouth opening increased to 50.05 mm. By applying the t test the result showed that there is sufficient evidence that the mouth opening after treatment with the red laser is statistically higher than before the treatment at 5% significance ( $p < 0.00$ ). Similarly occurred with the visual analogue scale (VAS) of pain, where before treatment, the pain average was 8.1 and after treatment decreased to 1.9, with statistical significance ( $p < 0.027$ ). Observed changes in mouth opening between the groups treated with infrared and red lasers, and visual analog scale of pain by VAS among patients treated with infrared and red lasers, it was verified a statistically significant difference at 5 % significance (Table 1 and Table 2).

Table 3 shows nociceptive points during movement of the patients after the application of the laser. In both groups, about the auscultation of joint sounds, the crack was the most prevalent (35%), followed by the jump (25%) and noise (20%) (Table 4).

**Table 1 – Mouth opening and pain in patients suffering from Temporomandibular Dysfunction (TMD) before and after infrared (Group 1) and red (Group 2) laser treatments**

		Mean	Standard deviation	Confidence interval (95%) for difference between means		T	gl	p
				Lower limit	Upper limit			
				G1	Opening before treatment			
	Opening after treatment							
G1	Pain by VAS before treatment	7,000	1,491	5,934	8,066	14,849	9	0,000
	Pain by VAS after treatment							
G 2	Opening before treatment	-3,711	4,461	-6,902	-0,520	-2,631	9	0,027
	Opening after treatment							
G 2	Pain by VAS before treatment	6,200	1,317	5,258	7,142	14,892	9	0,000
	Pain by VAS after treatment							

\* Statistical significance for comparison, using the T test.

Source: Research conducted in Campina Grande, PB, Brazil.

**Table 2 – Mean of initial/ final mouth opening and initial/ final pain by VAS of patients suffering from temporomandibular dysfunction (TMD) before and after treatment with red (Group 1) and infrared (Group 2) laser**

		Mean	N	Standard deviation
Red Group 1	Initial opening	41,73	10	10,003
	Final opening	46,37*	10	7,618
	Initial pain	8,40	10	1,430
	Final pain	1,40	10	1,506
Infrared Group 2	Initial opening	46,34	10	8,852
	Final opening	50,05*	10	6,521
	Initial pain	8,10	10	1,197
	Final pain	1,90	10	1,197

\* Mean with statistical significance for comparison, using the T test.

Source: Research conducted in Campina Grande, PB, Brazil.

**Table 3 – Algic locations of patients suffering from temporomandibular dysfunction (TMD) before and after treatment with red (Group 1) and infrared (Group 2) laser**

Location	Infrared laser		Red laser	
	Right side	Left side	Right side	Left side
Anterior TMJ	0,007 *	0,007*	0,007*	0,004*
Masseter	0,011*	0,006*	0,010*	0,006*
Anterior temporal	0,014*	0,023*	0,010*	0,006*
Middle temporal	0,011*	0,041*	0,023*	0,009*
Posterior temporal	0,007*	0,006*	0,004*	0,002*
Posterior sternocleidomastoid	0,011*	0,498	0,052	0,038*
Anterior sternocleidomastoid	0,01*	0,343	0,038*	0,023*
Neck posterior muscles	0,038*	0,596	0,014*	0,023*
<b>Mouth opening</b>	0,028 *		0,027*	
<b>Pain by VAS</b>	0,000 *		0,000*	

\* Statistical significance for comparison, using the T test.

Source: Research conducted in Campina Grande, PB, Brazil.

**Table 4 – Noise joint present in patients with temporomandibular dysfunction (TMD) during clinical examination prior to treatment with laser therapy**

Types	%
Estalido	35
Salto	25
Crepitação	20
NDN	20
Total	100%

Source: Research conducted in Campina Grande, PB, Brazil.

## ■ DISCUSSION

In the present study the highest concentration of individuals with temporomandibular disorder is among women aged between 21 and 30 years in accordance with Okeson researchs<sup>4,24-27</sup>. One possible explanation for the higher prevalence of pain in women, according to Salvador et al.<sup>26</sup> lies in the fact that women have lower levels of muscle strength under fatigue than men, and plasma concentrations of the main anabolic hormones (testosterone GH and IGF-1), at rest or after intense exercise, that are very different for men and women.

The most prevalent joint sounds of this research were the crackling, followed by the jump and crepitation, appearing in 80% of patients with TMD. These data corroborate Lopez<sup>28</sup>, which said the joint noise is the first sign of TMD to manifest in more than 70% of cases. Moresca and Urias<sup>29</sup> found that the higher frequency of joint noises in women demonstrates

a greater female predisposition to develop TMJ problems, corroborating what was observed in this study.

According to Dworkin and Leresche<sup>30</sup>, the restriction of mandibular mobility and pain are considered the main clinical signs of temporomandibular disorders. In adults, the maximum opening of the jaw average is between 53 and 58 mm, ranging from 40 to 60 mm. The mandibular opening is usually smaller in women than in men and decreases with age as it were seen by Friedman<sup>31</sup>. However, most of the patients in this study had no restriction of the maximum voluntary opening when was used 40 mm as the normal reference to measure opening. In the present study it was found that the initial average maximum mouth opening in Group 1 was 41.73 mm and the average end, after the twelve sessions of laser therapy, was 46.37 mm. The restriction of mouth opening was not the main complaint of the sample, but the improvement in this feature can be understood as a secondary effect of pain reduction. These results are consistent with Kogawa<sup>32</sup>, who reported to found an average mouth opening before therapy of 44.65 mm, and after treatment with laser, 48.5 mm. Studies indicate that pain presents a several incidence in TMD, besides a large amount of associated signs and symptoms such as headaches and neck region pain<sup>33,34</sup>.

The use of low-intensity laser therapy is a noninvasive treatment modality with low cost, which has been widely used to control several diseases, among which, the muscular-joint diseases, for the relief of pain and tissue regeneration. This technique has been certified as beneficial in the treatment of TMD. Treatment of TMD is based on a correct diagnosis,

established based on information of possible etiological factors, through the survey of signs and symptoms for each patient<sup>35</sup>. By means of the VAS (Visual Analogue Scale), we observed the evolution of painful symptoms in both treatment groups in this study. It was found that in both treatment groups was statistically significant reduction in pain, confirming Frare Nicolau<sup>36</sup> about lasers efficiency in controlling inflammation, what shows its effect in reducing pain through the absorption of exudates and by the allogeneic substances removing. The low-intensity laser therapy presents an analgesic local mechanism, working directly to reduce inflammation, which favors the elimination of allogeneic substances, stimulates a reflex action and leads to the production of substances such as endorphins, blocking the pain, as it improves local microcirculation and blood supply in areas of muscular tension<sup>37</sup>. Therefore, the laser acts as a stabilizer of the rest membrane potential factor by acting directly on nerve endings and maintaining longer analgesia, which makes the transmission of painful stimulus<sup>38</sup>. The results of this study indicate a significant improvement in mouth opening in both groups, and these results corroborate those found by McNeely et al<sup>39,40</sup> that in their studies demonstrated that laser therapy yielded satisfactory effects on the parameters used. However, the pain relief the present study showed significant results in both groups with regard to reduction of pain of the table, different from those found by McNeely<sup>39</sup>.

With regard to the type of laser used in accordance with the data obtained in this study, the reduction of pain after treatment was significant for both lasers, the infrared and the red laser, with an average scale reduction of 7 and 6.2, respectively. There are not studies in the literature about the red laser application for temporomandibular dysfunction, and studies in this situation usually are with the infrared laser and control group (placebo), without comparative study comparing both, red and infrared lasers. The results of this study indicate the complexity of temporomandibular dysfunction, since it is influenced by different factors, among which we can mention the psychoemotional and the activities performed by the individual in their day to day<sup>4</sup>. However, it may be questioned why some patients

do not respond to such treatment and also why in some cases the patients reported exacerbation of symptoms<sup>10,19</sup>, which becomes necessary adjustments in dose or the sessions interval for the laser application, being possible that some TMJ conditions may not respond in the same model than others. Factors such as stress, time to disease progression and severe loss of vertical dimension negatively influence the analgesic efficacy of low intensity laser<sup>19</sup>. For professionals dealing with patients with TMD, laser therapy has become an invaluable aid for this type of treatment, often by eliminating the use of analgesics, anti-inflammatories and muscle relaxants. This type of therapy is very effective, due to it also promotes biomodulation, an important factor in the treatment of degenerative disorders, being the correct dosage essential for successful treatment. Maybe that's the reason that some patients in the reviewed studies remained symptomatic after the LILT application sessions. Furthermore, it is still needed more studies that evaluate the effectiveness of protocols for low-intensity laser administration. Laser therapy has demonstrated an ability to assist in the symptomatic treatment of pain, providing a considerable degree of comfort to the patient, moments after its application, and its improvement in mouth opening reached with range of motion of the temporomandibular joint can also be achieved, according to the assessment tools used.

## ■ CONCLUSIONS

Laser therapy induced a reduction in symptoms after application and increased the patient's mouth opening. The evolution of the muscle pain through the first to the last session in the clinical evaluation on the threshold of muscle tenderness demonstrated difference between the infrared laser and red laser. It has been found effective in application of both laser emission, infrared and Red, in the treatment of TMD patients pain and recovery of mouth opening. The laser is a supportive therapy effective in treating patients with temporomandibular disorder, relieve pain symptoms without changes in the etiology or cause of the disorder, but etiologic factors should therefore be viewed and disposed so that the success of treatment in long term can be achieved.

**RESUMO**

**Objetivo:** avaliar a eficácia do laser de baixa intensidade no tratamento da dor em pacientes com desordens temporomandibulares. **Método:** consistiu de um ensaio clínico randomizado divididos em dois grupos: Grupo 1: laser AsGaAl, Grupo 2: laser InGaAlP, do qual participaram 20 pacientes entre 19 e 35 anos de idade, com diagnóstico de sinais e sintomas de DTM. Os pacientes tinham a amplitude de movimento para abertura máxima da boca e lateralidade registados no início e no final do tratamento a laser. O Laser foi aplicado em quatro pontos pré-auriculares, totalizando 12 sessões três vezes por semana, durante um mês. Dor dos pacientes foi registrado com base na utilização da escala analógica visual (EAV) e também por exame físico dos pontos algícos. **Resultados:** observou-se redução significativa ( $p < 0,028$ ) do nível de dor em ambos os grupos, porém no G1 a significância foi maior. A evolução do limiar de sensibilidade muscular evidenciou diferença estatisticamente significativa ( $p < 0,05$ ) para G1 e G2. A laserterapia no Grupo 1 melhorou a abertura bucal em média de 4,643 mm, enquanto no Grupo 2, a média foi de 3,71 mm por paciente. **Conclusão:** houve eficácia em ambos os lasers no controle da dor e abertura bucal dos pacientes.

**DESCRITORES:** Lasers; Síndrome da Disfunção da Articulação Temporomandibular; Dor Facial

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