

# Comparative Study of the Physiotherapeutic and Drug Protocol and Low-Level Laser Irradiation in the Treatment of Pain Associated with Temporomandibular Dysfunction

Marcos Fernando Xisto Braga Cavalcanti, PhD,<sup>1</sup> Uoston Holder Silva, PhD,<sup>2</sup>  
Ernesto Cesar Pinto Leal-Junior, PhD,<sup>3</sup> Rodrigo A.B. Lopes-Martins, PhD,<sup>4</sup>  
Rodrigo Labat Marcos, PhD,<sup>5</sup> Rodney Capp Pallotta, PhD,<sup>5</sup> Francesca Diomedea, PhD,<sup>6</sup>  
Oriana Trubiani, PhD,<sup>6</sup> Natalia De Isla, PhD,<sup>7</sup> and Lucio Frigo, PhD<sup>8</sup>

## Abstract

**Background:** The temporomandibular joint (TMJ) is a structure of the craniofacial complex affected by neurological diseases. Orthopedic and musculoskeletal changes can also cause temporomandibular disorders (TMD) and pain. Low-level laser (LLL) therapy has been studied in the treatment of temporomandibular jaw (TMJ) dysfunction, and controversial results were obtained. **Objective:** The objective of this work was comparing the physiotherapeutic and drug protocol (PDP) to LLL therapy in the treatment of pain associated with TMD. **Methods:** A sample of 60 female patients, 20–50 years of age, TMD triggering agents (stress, parafunctional habits) controlled, was randomly divided into three groups, group 1 (G1)—LLL (780 nm laser, dose of 35.0 J/cm<sup>2</sup>, for 20 sec, thrice a week, for 4 weeks); group 2 (G2)—PDP (hot packs thrice a day, morning, afternoon, and evening, for 15 min, exercise of opening and closing the mouth, twice a day, myorelaxing and anti-inflammatory drug administration); and group 3 (G3)—Placebo (450 nm halogen lamp, Max LD Gnatux, light curing unit). **Results:** Patients were evaluated every return appointment for the presence (P) or absence (A) of pain for 4 weeks and results were statistically analyzed. First week: 60% of G1, 100% G2, and 70% of G3-related pain. Second week: 55% of G1, 15% of G2, and 100% of G3-related pain. Third week: 10% of G1, 15% of G2, and 85% of G3-related pain. Last week: 0% of G1, 0% of G2, and 100% of G3-related pain. **Conclusions:** Based on obtained data, we concluded that, compared to PDP, LLL treatment is effective to control pain associated with TMD.

**Keywords:** temporomandibular disorder (TMD), low-level laser therapy, pain management, laser medicine, biophotonics, biostimulation, clinical trial

## Introduction

ORTHOPEDIC AND musculoskeletal changes can cause temporomandibular disorders (TMD) that are characterized by pain symptoms and joint sounds,<sup>1</sup> fatigue of masticatory muscles, and limitation of mandibular movements.

TMD is frequent; however, its symptoms are complex and pain is the main sign,<sup>2–4</sup> usually on the pre-auricular region, which may spread to the temporal, frontal, and occipital regions.<sup>1,5</sup>

Older patients rarely report sounds in the temporomandibular joint;<sup>6</sup> on the other hand, young patients report pain mainly on palpation of the masticatory muscles; women are more affected by TMD in a ratio of two to one.<sup>7–11</sup>

Emotional stress is important in the early stages of TMD development, involving the masticatory muscles and their fascias, the psychophysiological TMD development theory.<sup>12</sup>

In 80% of patients, the main cause of the painful symptoms of TMD are spasms of the masticatory muscles, which can be caused by distension, contraction, or fatigue of those

<sup>1</sup>UMR 7365 CNRS-Université de Lorraine, Faculté de Médecine, Vandoeuvre-Les-Noucy-France and Postgraduation Department-Cruzeiro do Sul University, São Paulo, SP, Brasil.

<sup>2</sup>Departamento de Odontologia—DOD, Rio Grande do Norte Federal University, Natal, Brazil.

<sup>3</sup>Center for Research and Innovation in Laser, Nove de Julho University, São Paulo, SP, Brasil.

<sup>4</sup>Biomedicine Engineering, Mogi das Cruzes University, Mogi das Cruzes, São Paulo, Brasil.

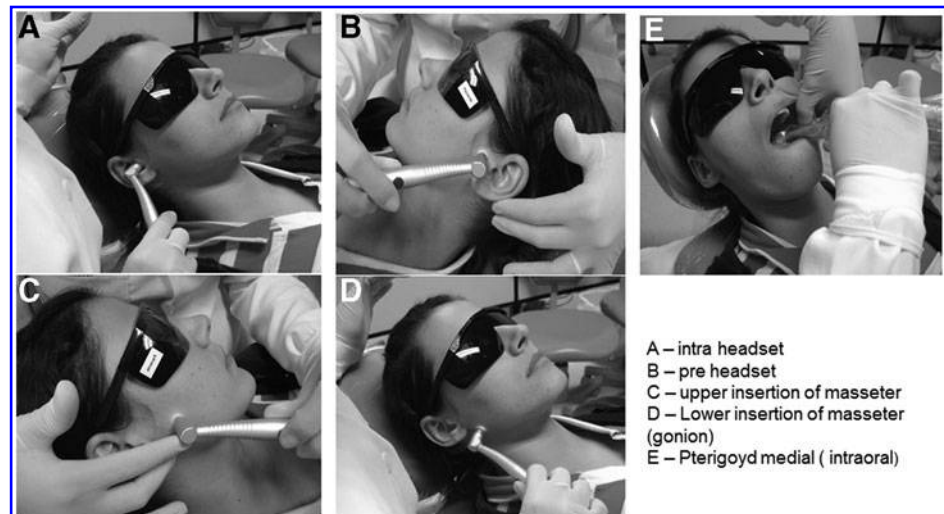
<sup>5</sup>Nove de Julho University, São Paulo, SP, Brasil.

<sup>6</sup>Department of Medical, Oral and Biotechnological Sciences, “G. d’Annunzio” University, Chieti, Italy.

<sup>7</sup>UMR 7365 CNRS-Université de Lorraine, Faculté de Médecine, Vandoeuvre-lés-Nancy, France.

<sup>8</sup>Cruzeiro do Sul University, São Paulo, SP, Brasil.

**FIG. 1.** LLL application points to reduce pain associated to TMD, (A) intra-headset, (B) pre-headset, (C) upper insertion of masseter, (D) lower insertion of masseter (gonion), (E) pterygoid medial (intraoral). LLL, low level laser; TMD, temporomandibular disorders.



muscles, mainly caused by parafunctional habits and affected by emotional stress.<sup>13</sup>

TMD is progressive, creating a cycle where the muscle spasm leads to a functional limitation that leads to pain, and this, in turn, produces more spasm and more pain, the so called “pain-spasm-pain syndrome.”<sup>14</sup>

There are several treatments for pain associated with TMD like drugs [physiotherapeutic and drug protocol (PDP)], heat, cryotherapy, local anesthesia, occlusal appliances, physiotherapy, transcutaneous electrical neural stimulation, and low-level laser (LLL), which can reduce inflammation, relax masticatory muscles, and reduce pain.<sup>15</sup>

Red and infrared LLL wavelengths have been clinically used to reduce different kinds of pain, including pain associated with TMD.

The protocol suggested in this clinical trial has been used at Cruzeiro do Sul University and at Caruaru Federal University with good results.

**Objective**

The objective of this study was evaluating the effectiveness of Gallium-Aluminum Arsenide (GaAlAs) laser diode, 780 nm, (LLL), in the treatment of pain associated with TMD, compared to PDP and placebo.

**Materials and Methods**

The clinical trial was initiated after approval of the Research Ethics Committee in Human Beings, EC protocol number/UCS-167/2011, held in the Stomatology department of Center for Dental Specialties (CEO), at Caruaru Federal

University (ASCES), and conducted by Professor Uoston Holder Silva.

Diagnosis was made using the method of muscle tenderness palpation<sup>16</sup> and the questionnaire of Fonseca,<sup>17</sup> which ranks (0–15) no TMD, (20–40) mild TMD, (45–65) moderate TMD, and (70–100) severe DCM.

*LLL therapy*

LLL device—Twin Flex Evolution, MM optics®, São Carlos, Brazil, sent to be calibrated by the manufacturer before use.

LLL description—780 nm GaAlAs infrared laser diode, power 70 mW, irradiance 1.75 W/cm<sup>2</sup>, and laser spot 0.04 cm<sup>2</sup>

LLL application protocol—35 J/cm<sup>2</sup> was applied in contact with each of the five following points: (intraoral) pterygoid medial, (extraoral) intra-headset, pre-headset, gonion, and anterior superior insertion of masseter (Fig. 1), for 20 sec every other day, except weekends, for four weeks, total dose applied to each point 420 J/cm<sup>2</sup>, patient cumulative dose 2100 J/cm<sup>2</sup>, total energy delivered per patient during treatment 84 J (Table 1).

*PDP therapy*

Hot packs, thrice a day (morning, afternoon, and evening) for 15 min each, at intervals of 5 min; mouth exercise of opening and closing twice a day, associated to MIOFLEX-A (myorelaxing drug) thrice a day; and MOVATEC 7.5 mg (anti-inflammatory drug) once a day.

TABLE 1. LOW-LEVEL LASER TREATMENT PARAMETERS

	<i>Each point</i>	<i>Each session (five points)</i>	<i>Each week (3 weeks)</i>	<i>Total treatment (4 weeks, 12 sessions)</i>
Dose energy density or fluence (J/cm <sup>2</sup> )	35	175	525	2100
Time exposure (seconds)	20	100	300	1200
Energy (J)	1.4	7	21	84

Dose energy density or fluence (J/cm<sup>2</sup>), time exposure (seconds), energy (J), gallium-aluminum arsenide (GaAlAs) infrared wavelength 780 nm, irradiance or power density 1.75 W/cm<sup>2</sup>.

TABLE 2. SAMPLE ASPECTS

Gender	Social status	Smoking	Age	TMD	Parafunctional habits
Female 100% (60)	Class C and D 100%	No 100%	20–50 years 100%	Severe 25%	No 100%
Male 0%	Class A and B 0%	Yes 0%	Other ages 0%	Moderate 75%	Yes 0%

All patients were females, from class C and D, nonsmoking, ages varying between 20 and 50 years, presented severe and moderate TMD, and had parafunctional habits removed before treatment started.

TMD, temporomandibular disorders.

### Placebo therapy

Application of 480 nm halogen light of the Optilight® curing device at the same points and with the same frequency of the LLL application, simulating LLL irradiation.

Exclusion criteria and ethical considerations were excluded from this study, all patients diagnosed as mild TMD, whose TMD was associated with systemic diseases, arthrogenic TMD, traumas, disc displacements, and cancer.

Sample—60 females, 20–50 years old, with moderate and severe TMD, controlled in relation to the triggering agents (stress, parafunctional habits) (Table 2) were randomly divided into three groups: group 1—LLL, group 2—PDP, and group 3—placebo.

### Statistical analysis

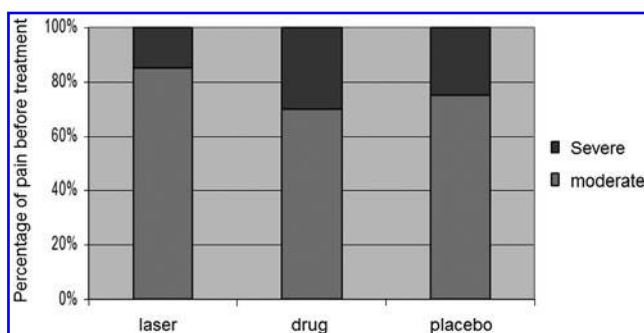
The statistical program used to analyze the results was the Statistical Package for Social Sciences, SPSS 17.

Data were analyzed using the chi-square test and Fisher's exact test ( $p < 0.05$ ).

### Results

Evaluation results of pain before treatment, the majority in each group had moderate pain, with percentages ranging from 70% (PDP group) to 85% (LLL group), and the rest of the patients in each group had severe pain, without statistical differences ( $p > 0.05$ ) (Fig. 2).

Data of LLL and placebo groups were collected and analyzed on Mondays, Wednesdays, and Fridays, but for the PDP group, data were collected and analyzed just on Fridays.

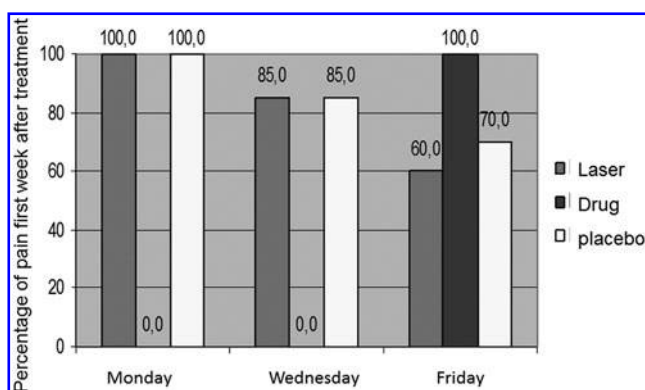


**FIG. 2.** Evaluation of pain before treatment; the majority in each group had moderate pain, with percentages ranging from 70% (PDP group) to 85% (LLL group) and the rest of the patients in each group had severe pain. PDP, physiotherapeutic and drug protocol.

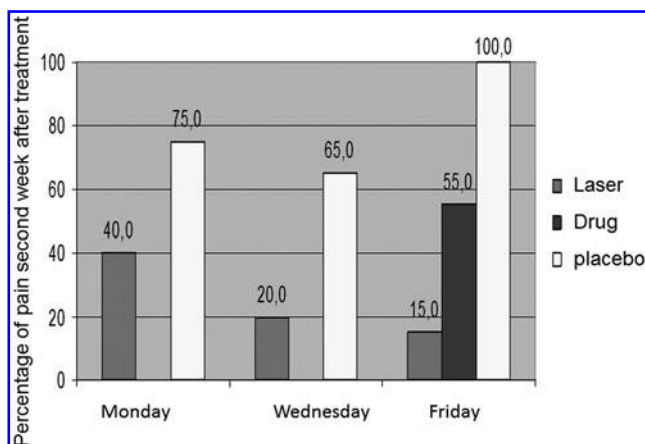
First week: On Monday, all patients from each of the LLL and placebo groups had pain.

On Wednesday, 85% of the samples of LLL and placebo had pain. On Friday, 60% of LLL, 70% of placebo, and all PDP patients related pain (Fig. 3).

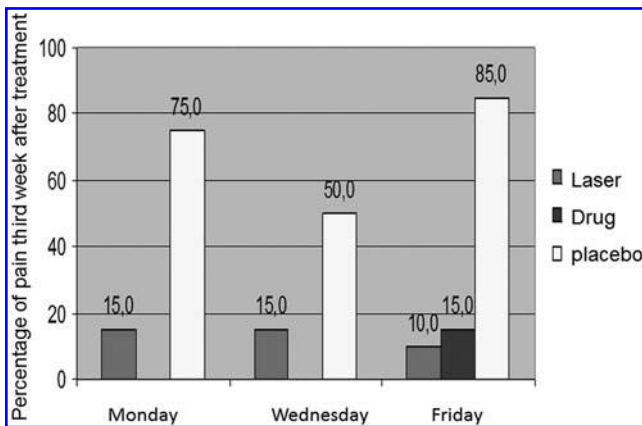
Second week: On Monday, the percentage of patients with pain was much higher in the placebo group than in the LLL group, 75% placebo and 40% LLL; on Wednesday, 65% of placebo and 20% of LLL related pain; and on Friday, 100% of placebo, 55% of LLL, and 15% of PDP had pain (Fig. 4).



**FIG. 3.** Evaluation of pain first week after treatment initiation, 60% of LLL, 70% of placebo, and all PDP patients related pain.



**FIG. 4.** Evaluation of pain second week after treatment initiation, 100% of placebo, 55% of LLL, and 15% of PDP had pain.



**FIG. 5.** Evaluation of pain third week after treatment initiation, placebo group reported 85% of pain, the PDP group 15%, and the LLL group 10%.

Third week: On Monday, the placebo group reported more pain than the LLL group, 75% placebo and 15% LLL; on Wednesday, 50% of placebo and 15% of LLL had pain; and on Friday, the placebo group reported 85% of pain, the PDP group 15%, and the LLL group 10% (Fig. 5).

Fourth week: On Monday, the percentage of pain was much higher in the placebo group (70%) than in the LLL group (5.0%); on Wednesday, all patients in the placebo group had pain, while the LLL group had no pain. On Friday, while all patients in the placebo group had pain, no patient of LLL and PDP presented pain.

No patients in the actual study reported any side effects.

The results were statistically significant ( $p < 0.05\%$ ). After the fourth week, all patients in the placebo group received conventional therapy to control pain. All patients were seen for 60 days and showed no recurrence during this period (Fig. 6).

**Discussion**

Our results state that LLL can control pain associated with TMD.

Comparing LLL and PDP treatments is important because, despite the fact that there are other treatment options,<sup>18-21</sup> PDP is widely used to control this kind of pain.

LLL has been used to control acute and chronic pain associated or not with drugs; it promotes analgesia,<sup>22</sup> but the analgesic power of opioids or mimetic opioids is higher than that produced by LLL, its biological principle is related to lessen the releasing of algogenic factors (serotonin and bradykinin) at tissue injury sites.<sup>23</sup>

Chow et al.,<sup>24</sup> states that the specific inhibition of nerve fibers A $\delta$  and C by LLL is of particular relevance to the explanation of the analgesic effects; experiments also point to a reduction in the responses of the nociceptors stimulated by a wide variety of noxious stimuli, including pro-inflammatory.

Pain reduction mechanism of LLL reduces inflammation<sup>25</sup> and also promotes muscle relaxation,<sup>26</sup> like PDP that uses anti-inflammatories associated with muscle-relaxing drugs and physiotherapy to control pain.

In our experiment, patients evaluated before treatment-related severe and moderate pain.

Analyzing our results, pain began to decrease at the end of the first week for patients who received LLL and more gradually at the end of the second week in the PDP group.

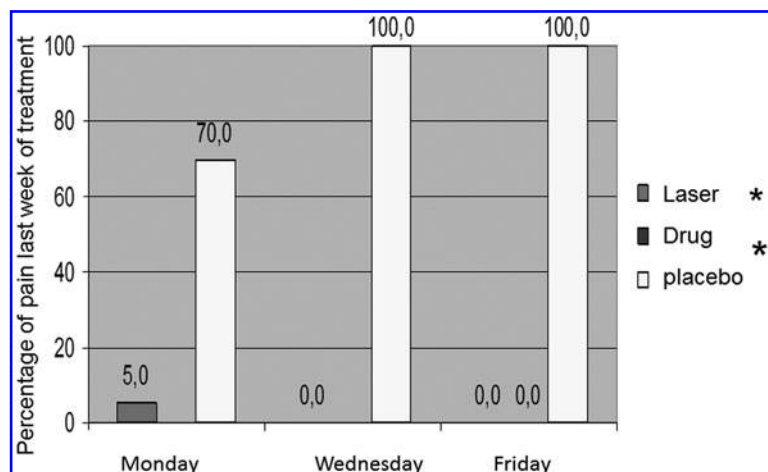
During treatment, the placebo group-related pain variation, which can be attributed to anxiety and depression control,<sup>27-30</sup> but at the end of the treatment, the placebo group had pain in 100% of cases and LLL and PDP groups presented no pain.

In the economic point of view, the laser patients had to visit the clinic (3x4)=12 times, while the PDP patients only had to come 4 times. This reveals a weakness in the LLL treatment compared to PDP, which was more convenient and cost effective, when chair time, travel, and staff expenses are included. Using a home care laser device could even these differences in cost-effectiveness.

In our opinion, just like Bjordal et al.,<sup>31</sup> the use of LLL fulfills therapeutic requirements.

**Conclusions**

Based on obtained data, we concluded that, compared to PDP, LLL treatment is effective to control pain associated with TMD.



**FIG. 6.** Evaluation of pain fourth week after treatment initiation, all patients in the placebo group had pain, no patient of LLL and PDP presented pain (\*statistically significant,  $p < 0.05$ ).

### Acknowledgments

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### Author Disclosure Statement

No competing financial interests were reported.

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Address correspondence to:  
 Marcos Fernando Xisto Braga Cavalcanti  
 UMR 7365, Faculté de Médecine  
 CNRS-Université de Lorraine  
 Cruzeiro do Sul University  
 Rua Galvão Bueno 868, Liberdade  
 São Paulo 01311940  
 Brasil

E-mail: mxistocavalcanti@gmail.com

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