Effectiveness of low-level laser as a treatment for pain management in arthrogenic temporomandibular disorders

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Abstract

Background: The multifactorial etiology of Temporomandibular Disorders (TMD) justifies the various therapeutic approaches. Low-level laser Therapy (LLLT) is a new treatment modality. The aim of this study is to contrast the analgesic effectiveness of active and passive LLLT in the treatment of arthrogenic TMD.

Methods: 15 patients (30 TMJs) with bilateral Temporomandibular Joint (TMJ) arthralgia were included. Patients were assigned to two groups of treatment: active LLLT (Gallium-Aluminum-Arsenide laser) vs inactive LLLT (laser turned off). The treatments were evaluated at three, six, nine and twelve days after the first evaluation with registration of pain in Visual Analogue Scale.

Results: Most patients were women, aged 33 years. In the right TMJ, pain decreased with both treatments without significant differences. However, the left TMJ had significant differences in both groups (p =0.004) and the ANOVA test reported intra-group differences (p <0.000) in the left TMJ in the active LLLT.

Conclusion: LLLT is an effective treatment for reducing pain associated with arthrogenic TMD, specifically in the left side. The likely explanation is that most right-handed patients prefer chewing on the right side. However, weaknesses of this study were not to consider the type of pain and the size sample.

Key words: Temporomandibular Joint, Temporomandibular Disorder, Low intensity laser, Low-level laser, Low-level Laser Therapy.

Introduction

As a group, Temporomandibular Disorders (TMD) are a pathological entity related to functional changes in the temporomandibular joint (TMJ), mastication muscles and other orofacial structures [1]. They are clinically characterized by pain in the TMJ, the muscles of mastication and/or the pre-auricular area. They are also accompanied by limited or asymmetric mandibular movements and/or joint sounds [2, 3, 4].
Epidemiological studies reveal that TMD affect a significant percentage of the world’s population (80%), with a mean age of 34 and a ratio of two women per every man. Patients with psychological disorders have a three times higher risk of TMD [5, 6, 7].

The multifactorial etiology of TMD justifies the various therapeutic approaches and multidisciplinary care [8, 9, 10, 11]. In addition, the internal derangement of TMJ, which causes TMD, can cause referred pain such as headache, neck pain, shoulder pain, high back pain, eye pain or earache [12, 13]. Professionals from other branches of healthcare such as psychologists, psychiatrists, physical therapists, orthopaedists, otolaryngologists, rheumatologists, and neurologists are often unaware of TMD as a possible cause of pain in their patients or the complications involved in its pathology. To successfully treat the symptoms of this dental condition, which do not appear to have a dental cause, health professionals need to be made aware of the role of the dentist in the treatment of this condition to finally succeed with patients suffering from these disorders [10].

In general, according to Okeson [14], the treatment of TMD can be classified as reversible or conservative treatments and irreversible or permanent treatments. The reversible or conservative treatments modify the patient’s symptoms, but do not have any effect on the etiology of the problem. The irreversible or permanent treatments are designed to eliminate or to modify the etiologic factors responsible for the disorder. Another classification found in the literature [8, 9] divides treatments into surgical or invasive therapies and conservative or non-invasive therapies. In conclusion, the election of treatment of TMD with simple, reversible, non-surgical therapies should be encouraged before progressing to complex and irreversible therapies.

Within the arsenal of treatment modalities lies another kind of conservative therapy for pain management, Low-level laser Therapy (LLLT), which has demonstrated efficiency in the treatment of other disorders that present with severe, disabling pain. This therapy consists of the application of a type of light known as "laser" to a body area for therapeutic purposes [1]. Laser stands for Light Amplification by Stimulate Emission of Radiation and is a quantum device that generates a beam of light, which has a range on the electromagnetic spectrum from visible, ultraviolet to infrared. This light has special characteristics, such as coherence, directionality and monochromaticity, which set it apart from the rest of light [1, 27].

Low-level laser (LLL), also known as therapeutic laser, soft laser or low intensity laser, is used in physical medicine and rehabilitation for its analgesic, anti-inflammatory and bio-stimulating effects. As it has no side effects and is an effective, safe, painless and aseptic method, LLL is establishing itself in the first line of treatment for many diseases in different medical specialties such as Otolaryngology, Neurology, Orthopedics, Traumatology, and even Dentistry. Few studies have investigated the use of LLLT for pain management in TMD, specifically arthrogenic TMD [15, 26], and none have shown or explained the type of protocol it requires in terms of: the type of laser used, power density, dose-specific, pulse duration, and application area. The effectiveness of laser treatment are, therefore, variable. The aim of the present study was to evaluate the effectiveness of LLLT for pain management in arthrogenic TMD.

Materials and Methods

Prior to the start of the research project protocol was approved by Ethics Committee of Autonomous University of Puebla. 15 patients (30 TMJ) were included in this double-blind randomized controlled clinical trial. The patients had bilateral TMJ arthralgia, as confirmed by the Diagnostic Criteria for Temporomandibular Disorders Research (RDC / TMD) for standardized researcher (kappa 0.76). Aged 18 to 55 years old, they agreed to participate voluntarily in the study and an informed consent form was obtained from each patient prior to participation in the study. They were able to read and to write and they had received no treatment for TMD in the last six months.

The patients were referred by a Maxillofacial Surgeon to LLLT, and the therapy was provided by the investigator assigned in a private bureau adapted to the application of LLLT. The study excluded all patients with degenerative joint diseases, psychiatric disorders, patients with severe pain who were treated of independently during the course of treatment way. The patients that received treatment for other
conditions during the protocol were eliminated. Pain in each TMJ was recorded in its baseline state on a Visual Analogue Scale (VAS) by a person external to the research project who safeguarded the data and delivered them to the researchers on completion of the study. The patients were subjected to randomization. For the right TMJ, they selected one of two sealed envelopes, one marked with the letter A that corresponded to the study group and another envelope marked with the letter B for the control group. The treatment of the study group (active LLLT) was performed with GaAlAs laser (Model Laser Dent & KVT-206, Brand Lasertech) which has an emission power of 0.125 W. The treatment dose was 6-9 J/cm², with a trip time at each point of 80 s. The application technique was pointed, with an application surface of 3 cm² (1 cm² at each point). The application area consisted of three points on each TMJ chosen in accordance with the literature (Fig 1): (a) back of the neck of the condyle with the mouth open, (b) anterior neck of the condyle with the mouth closed, and (c) the center of the articular disk with mouth open. There were four sessions with a frequency of every 48 hours. The treatment of the control group (passive LLLT) to the contralateral TMJ was managed in the same way but with the laser device not turned on. The result of the treatment assignment remained unknown to the evaluator and patient.

Each patient received instructions related to the maintenance of a soft diet, the limitation of mouth opening, recommended exercises, and the elimination of parafunctional habits, such as the use of chewing gum, nail biting, object biting, and bruxism. Each patient also received a sheet outlining the same instructions for the patient’s reference during the treatment.

The evolution of each person’s TMJ pain was registered on a VAS at three, six, nine and twelve days after the first evaluation. Finally the outcomes were collected. For statistical analysis the SPSS V17.0 software program was used. The mean, median, standard deviations and proportions were calculated. The effectiveness of LLLT was evaluated through a comparison of the pain averages of patients in both groups with Mann Whitney U test, and the intra-group differences were calculated with ANOVA test for repeated measures and significance less than 0.05.

Results
Demographic data showed that most patients in the study were women, with an average age of over 33, and who had a level of education between High School University level and a stable socioeconomic status (Table I).

In comparing the results between active LLLT and passive LLLT in the right TMJ (Fig 2), there is considerable decrease in pain in both treatments on the third day. However, the group of patients treated with inactive LLLT continued to show a decrease in pain until the end of the study, unlike the group of patients treated with active LLLT whose pain showed more irregular behaviour, and showed no statistical significance when comparing the differences in pain before and after.

The behaviour of the left TMJ pain with both treatments are shown in Fig 3, in which both treatments denotes a noticeable decrease in pain in the group of patients undergoing active LLLT, but the group of patients managed with inactive LLLT indicated almost the same levels of pain perception. A significant reduction of pain relief following active LLLT is noted in a comparison of differences between the treatment groups in the left TMJ category before and after treatment.

Finally, the ANOVA test was used to identify inter-group differences. In the right TMJ did not reveal differences between any treatment group. Although the description of inactive LLLT seems to indicate a greater level of pain relief, the statistical results denote that the actual pain perception was the same before as after treatment in both groups. Conversely, in the left TMJ the active LLLT showed a decrease in pain among the first two evaluations and the last two and last two evaluations when a Post-Hoc Tukey test was applied, but the results of the inactive LLLT did not indicate great variations in pain (Table II).

Discussion
The participants in this research study were predominantly female, which is consistent with other epidemiological and clinical studies which have shown that TMD affects more females [11, 17, 21, 23], as well as other
variables such as the greater frequency with which women come to seek treatment for any condition. Moreover, the average age of this study (33 years) is consistent with the average reported in the literature, which fluctuates between 30 and 45 years [7, 10, 19], because it is at this age when the disease presents higher peak frequency.

This study was able to demonstrate the effectiveness of LLLT for pain relief of arthrogenic TMD only in the left TMJ. To obtain the results, both treatments in the right and left TMJ were compared. The right TMJ showed a marked decrease in pain perception between the baseline state and the evaluation of pain perception at the end of the study (12 days later) regardless of the type of treatment used (active or inactive LLLT), which demonstrates a placebo effect in this type of treatment, as has been reported by several authors [7, 10]. Pain behaviour did not indicate visible changes in the inactive LLLT in the left TMJ, however the active LLLT showed a remarkable decrease in perceived pain from baseline state to the last application of therapy. These results could be explained on the basis that 80% of right-handed patients chew on that side, which makes the left TMJ in a joint more susceptible to morphological changes and less susceptible to the effects of treatments [8, 12, 25].

An analysis of related studies found that precisely those studies reporting an actual beneficial effect of laser therapy [14, 15, 19, 28], did not include inactive LLLT - that is a true control group. In these studies, laser therapy was simply compared with other treatments such as painkillers or anti-inflammatory medication, which may explain the differences in pain relief for patients undergoing such treatment. However, the studies that documented only a placebo effect with LLLT were those that compared active and inactive LLLT [7, 10]. They implemented a different protocol than that used in this study, as well as different areas of application, dosages, application techniques, power densities.

In general the most commonly used therapeutic laser in laser research has been the Ga-As:Al, semiconductor laser, which belongs to the group of continuous wave lasers that provide treatment through biostimulant, anti-inflammatory and analgesic effects. It is a small medical device with greater availability on the market, factors which facilitate and optimize its extensive utility in the dental clinic. It is also not limited to the treatment of one disease. These are the reasons why we decided to use this type of laser in the study. One of the main strengths of this study was that the researchers were able to control many of the variables. The TMJ compared (right and left) were in the same patient, which avoided the bias of all the variables that influence pain perception from one patient to another and which otherwise could not have been controlled by the researcher. Furthermore, the benefit provided by the randomization of the process, allows results to be attributed solely to the process itself. Finally the researcher who evaluated the pain associated with TMD was unconnected to the treatment provided for each TMJ, which ensured that the results involuntarily obtained were not influenced by the researcher. However, weaknesses of this study were not to consider the type of (acute or chronic) received by patients and the size of the sample. Type of pain may have influenced the results because it is known that chronic conditions do not heal themselves, if not that, it tend to settle in the category of incurable diseases [30].

Conclusions

LLLT is an effective treatment for reducing pain associated with arthrogenic TMD, specifically in the left side. The likely explanation is that most right-handed patients prefer chewing on the right side, and as a result, the left TMJ is the more susceptible to pressure and therefore inclined to hurt more severely as it is the balance joint.

References

2. Conti PC, Ferreira PM, Pegorano LF, Conti JV, Salvador MC. A cross sectional study of prevalence and etiology of signs and symptoms of temporomandibular disorders in high

**Table I.** Demographic analysis of the population

<table>
<thead>
<tr>
<th></th>
<th>n (15)</th>
<th>% (100)</th>
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<td>Sex</td>
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<tr>
<td>Women</td>
<td>11</td>
<td>73.3</td>
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<tr>
<td>Men</td>
<td>4</td>
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<tr>
<td>Schooling</td>
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<tr>
<td>High school</td>
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<tr>
<td>Universitary</td>
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<td>73.3</td>
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<tr>
<td>Age</td>
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<td>Monthly income</td>
<td>7200</td>
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**Table II.** Analysis of variance of pain perception by group

<table>
<thead>
<tr>
<th>Right Temporomandibular joint</th>
<th>Treatment</th>
<th>Baseline State</th>
<th>3 days</th>
<th>6 days</th>
<th>9 days</th>
<th>12 days</th>
<th>*p</th>
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<tbody>
<tr>
<td>Active LLLT</td>
<td>41.4</td>
<td>32.9</td>
<td>32.9</td>
<td>25.7</td>
<td>25.7</td>
<td>0.700</td>
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<tr>
<td>Inactive LLLT</td>
<td>45.0</td>
<td>36.3</td>
<td>30.0</td>
<td>22.5</td>
<td>0.267</td>
<td></td>
<td></td>
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<tr>
<td>Left temporomandibular joint</td>
<td><strong>67.5</strong></td>
<td><strong>57.5</strong></td>
<td><strong>43.8</strong></td>
<td><strong>33.8</strong></td>
<td><strong>20.0</strong></td>
<td><strong>0.000</strong></td>
<td></td>
</tr>
<tr>
<td>Active LLLT</td>
<td><strong>31.4</strong></td>
<td><strong>21.4</strong></td>
<td>15.7</td>
<td>20.0</td>
<td>27.1</td>
<td>0.630</td>
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<tr>
<td>Inactive LLLT</td>
<td><strong>31.4</strong></td>
<td><strong>21.4</strong></td>
<td>15.7</td>
<td>20.0</td>
<td>27.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Repeated measures ANOVA
** Tukey Post Hoc test <0.01

**Fig 1.** Places of application of LLLT

**Fig 2.** Behavior of pain in right TMJ.
**Mann-Whitney U (p=0.337).**

**Fig 3. Behavior of pain in left TMJ.**

*Active LLLT (47.5) vs Inactive LLLT(4.3).

**Mann-Whitney U (p=0.004).**