APPLICATION OF LOW POWER LASER IN THE MANAGEMENT OF ACUTE DENTAL PAIN. CASE REPORT

Utilização do laser de baixa potência em dor aguda proveniente de pulpite irreversível. Relato de Caso Clínico

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ABSTRACT

Anxiety, pain and discomfort are situations of great stress in daily dental practice, in particular in Endodontics. Several studies have concluded that therapy with low power laser was effective in chronic and acute pain control caused by several pathologies. As connective tissue of the pulp has the peculiar characteristic of being surrounded by dentin, the irreversible inflammation of the pulp is accompanied by exacerbate acute pain. Furthermore, due to inflammation installed, the pH of the medium is acidified and the anesthetic agent is not always able to promote full analgesia. The present clinical case reported the application of low power laser before the urgency endodontic treatment in a patient suffering from acute pain, due to irreversible pulp inflammation. Laser parameters applied were: 780nm, 40mW, 40J/cm^2 per point, 1.6J per point, and total of 2 irradiation points. Pain range was measured through *Visual Analogue Scale (VAS).* The urgency endodontic treatment was conducted successfully, with patient comfort, without the need of complementation of anesthesia. Low power laser applied in this specific case report showed to be safe. Patient related a decrease of 33% of pain immediately after laser irradiation and 90% pain decrease fifteen minutes after laser irradiation. In the present case report, the application of low power laser during acute pain due to inflammation of the pulp brought comfort and decrease anxiety of patient during dental attendance. This finding proved interesting, however, randomized controlled clinical trials should be performed in order to investigate and scientifically prove any real beneficial of the application of low power laser in acute dental pain.

Descriptors: Pulpitis, Acute Pain, Low Power Laser

RESUMO

Ansiedade, dor e desconforto são situações de grande estresse na prática odontológica diária, em particular, na prática endodôntica. Vários estudos concluíram que a terapia com laser de baixa potência foi eficaz no controle da dor crônica e aguda, causada por diversas patologias. Como o tecido conjuntivo da polpa tem a característica peculiar de ser rodeado por dentina, a inflamação irreversível da polpa é acompanhado por dor aguda exacerbada. Além disso, devido ao processo inflamatório instalado, o pH do meio é acidificado e o agente anestésico nem sempre é capaz de promover a analgesia desejada. O presente caso clínico descreve a aplicação de laser de baixa potência em um paciente que apresenta dor aguda, devido à inflamação pulpar irreversível. Os parâmetros do laser utilizados foram: 780nm, 40mW, 40J/cm^2 por ponto, 1.6J por ponto e total de 2 pontos de irradiação. A mensuração da dor foi realizada por meio de Escala Analógica Visual (VAS). O tratamento endodôntico de urgência foi realizado com sucesso e conforto ao paciente, sem a necessidade de complementação anestésica. A aplicação do laser de baixa potência especificamente no presente caso clínico mostrou-se segura. O paciente relatou redução de 33 % da dor imediatamente após a irradiação laser e diminuição de 90% da dor 15 minutos após a irradiação laser. A aplicação de laser de baixa potência durante a manifestação de dor devido à inflamação aguda da polpa no presente caso clínico trouxe conforto e diminui a ansiedade do paciente durante o atendimento odontológico. Estes achados se mostraram interessantes, no entanto, estudos clínicos controlados e randomizados devem ser realizados, a fim de investigar e provar cientificamente o efeito da aplicação do laser de baixa potência na dor aguda resultante de inflamação pulpar irreversível

Descritores: Pulpite, Dor Aguda, Laser de Baixa Potência

INTRODUCTION

The effect of low power laser has been studied since 1960. In 1968, the Hungarian researcher, Endre Mester first demonstrated this effect on wound repair in rats [1]. Nearly 20 years later, the researcher Friedrich Plog from Canada, showed that monochromatic light could be an alternative, non-invasive treatment of acupuncture with needles for pain relief [2]. Currently, this technology has been used worldwide for various pain-related conditions such as arthritis, tendinitis, pain derived from muscle injuries, carpal tunnel syndrome, back pain, between others pathologies [3-16]. Therapy with low power laser is non-invasive and without described side effects in literature [17].

The laser is a source of radiation capable of producing extremely fine spectral bands, intense and coherent electromagnetic fields extending from the ultraviolet to the infrared remote [18,19]. Once laser is absorbed by the tissue, it may act at the molecular level by exciting electrons or parts of some molecules, by promoting charge movement of molecules. If there is a small excitability promoted by low power laser irradiation, cell biostimulation may occur though physiological reactions [18]. However, regarding high power laser irradiation, the energy deposited in the target tissue will be able to break chemical bonds of molecules, or even remove electrons, resulting in the disruption of this tissue [18] . This would be the basic difference between a high and low power laser. While the low power laser modulate cellular and physiological functions, high power lasers breaks or permanently modified tissue through cutting, vaporization, ablation and coagulation [18].

Studies have been elucidated the detailed mechanism by which low power laser act in cell. Firstly, photons need to be absorbed by the target tissue, or more accurately by tissue chromospheres. Chromospheres or photoreceptors consist of a group of inter-related molecules as enzymes, cell membranes or other extracellular substances that has the ability to absorb light at a particular wavelength [18]. The absorption of light by the photoreceptors produces biological response. This absorption is taken by a molecule that can transfer energy to other molecules and thereby activate chemical reactions [18].

In literature, some reviews and meta-analysis concluded that therapy

with low power laser was effective in treating pain, regardless of its etiology [20,21]. However, mostly studies have reported the use of low intensity laser in the treatment of chronic pain; few studies show their use in acute pain [22-24]. It is noteworthy that the therapy helps the symptomatic treatment of pain, however, the etiology should always be treated, not just the pain process alone.

Anxiety, pain and distress are situations of great tension in everyday dental practice, especially in endodontic. [25]. From histological point of view, pulpitis is represented by a large inflammatory infiltrate. Clinically, pain is diffused, irradiated, spontaneous and do not stops after stimulus removal and also with the use of analgesics [25]. The acute inflammatory response is the first body reaction owing some aggressive. It is translated in a short period of approximately 48-72 hours. From exudative nature, it manifests itself as an automatically and nonspecific reaction, for example, its expression does not depend on the nature of the aggressive agent but on its intensity and frequency [25]. The connective tissue of the pulp reacts to aggression stimuli though an acute inflammation equally as other parts of the body. The typical signs of acute inflammation are: pain, heat, tumor and flushing. However, the manifestation of an acute inflammation in the pulp will show an additional obstacle in pulp chamber, once the pulp tissue has the peculiar characteristic of being surrounded by dentin, a hard tissue barrier that may complicate inflammatory clinical course concerning peculiar vascular changes in this process. Additionally, due to inflammation installed, the pH of the medium is acidified and the anesthetic agent is not always able to promote full analgesia. Commonly, during endodontic treatment in irreversible pulp inflammation, there is a need of complimentary anesthesia. Consequently, when anesthetics failed, the anxiety and stress suffered from patient also grow.

OBJECTIVE

As low power laser irradiation has been shown significant ability of pain modulation, this clinical case reported the application of low power laser irradiation, prior to urgency endodontic treatment, in a patient suffering from acute dental pain due to irreversible pulp inflammation, with the aim of a comfort gain by the patient before and during treatment.

DESCRIPTION OF CLINICAL CASE

Female Patient, with 40 years old, with no systemic pathology, searched for dental care in Dental Urgency Clinic in School of Dentistry, University of São Paulo. The patient complained of acute pain in tooth number #45. According to patient description, acute pain persisted since 3 days. In clinical exam it was noticed caries cavity in distal surfaces of tooth #45. In radiographic exam it could be confirmed the presence of deep caries cavity in tooth #45 (Figure 1).

Figure 1 – Radiography of tooth #45 with caries cavity on distal surface

Thermal tests also confirmed the diagnosis of irreversible pulp inflammation. After signing the consent form, patient was submitted to the following procedures:

1 – Initial measurement of tooth pain through Visual Analogue Scale (VAS).

For pain quantification, the Visual Analogue Scale (VAS) was applied. The Visual Analogue Scale has been applied worldwide and is easily understood by patient. This scale consists of a line of 100 mm in length and marked "no pain" and "unbearable pain" at their ends [26,27]. The patient easily indicates the intensity of the pain through the cursor of the scale. In the back, a millimeter scale numerically indicates the pain level (Figure 2).

Patient was instructed to indicate through VAS the level of tooth pain in that moment, prior to any clinical intervention. As described above, in the back of the scale, dentist could quantify from 0 to 10 cm the level of pain indicated by patient. Before the beginning of the treatment, patient indicated through VAS a level of pain corresponding to 10.

2 – Low Power Laser Irradiation

The informations concerning low power laser irradiation are described in Table 1. Two points of irradiation was performed on tooth as illustrated in Figure 3. The first point was held perpendicular to the occlusal surface of the tooth (Figure 3A) and the second was held perpendicular to the dental periapex region (Figure 3B). Both points of irradiation were applied through contact mode.

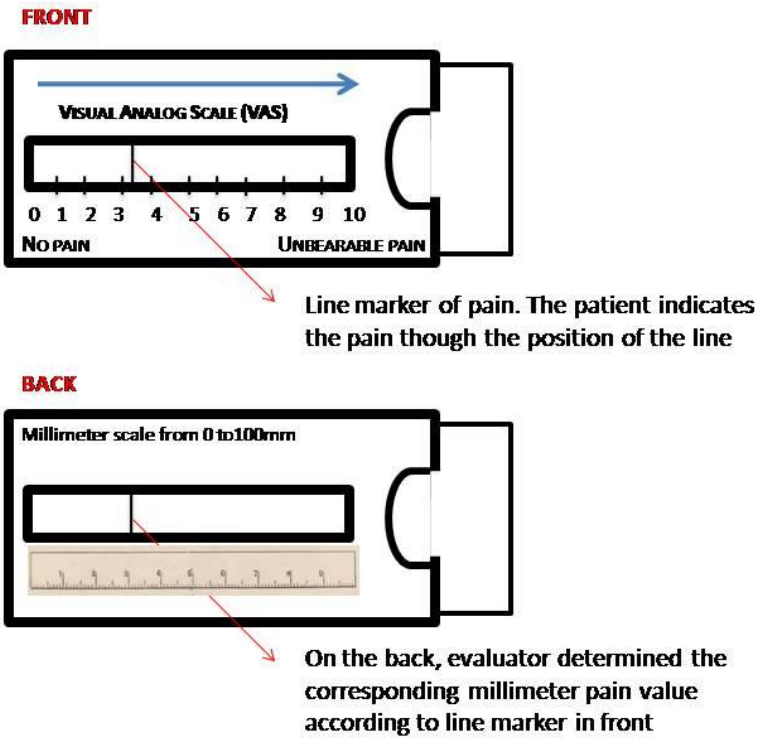

Figure 2 – Visual Analogue Scale (*Adapted from de Aranha et al., 2009; 2012*

Before irradiation, power range was measured through a power meter to confirm the power output.

3 – Second measurement of tooth pain through Visual Analogue Scale (VAS).

Immediately after laser irradiation patient was over again instructed to indicate through VAS the level of tooth pain. In the second evaluation, patient indicated a level of pain in VAS scale that was quantified as 6.7.

3 – Third measurement of tooth pain through Visual Analogue Scale (VAS).

After laser irradiation, patient waited approximately 15 minutes before starting urgency endodontic treatment applied in dental urgency sector of Dentistry School, University of São Paulo. So, 15 minutes after laser irradiation patient was instructed to indicate through VAS the level of tooth pain. In the third evaluation, patient indicated a level of pain quantified as 1.

Table 1. Parameters applied during laser irradiation	
Area of Spot Size	0.04 cm^2
Wavelength	780nm
Power	40 mW
Duration of Irradiation / point	40 sec
Number of Irradiation points	2
Total duration of irradiation	80 sec
Energy density / point	40J/cm^2
Energy / point	1.6 J
Total Energy applied	3.2 J

3 – Endodontic Urgency Procedures for management of Acute Pain.

Inferior alveolar nerve block was performed using Prilocaine 3% and felipressin 0,03 UI/ml (Citanest – Dentisply™, Brasil). The pulp chamber was accessed using a spherical diamond bur. Pulpectomy was proceed and disinfectant irrigation was done using Sodium Hypochlorite (1%). Root Canal medication was done with PRP Solution (Formula e Ação®) and pulp chamber was sealed with composition based on zinc oxide eugenol (IRM – Dentisply ™, Brasil). Patient was instructed to look for an endodontic treatment as soon as possible.

All the endodontic urgency treatment was done without the need of complementary anesthesia.

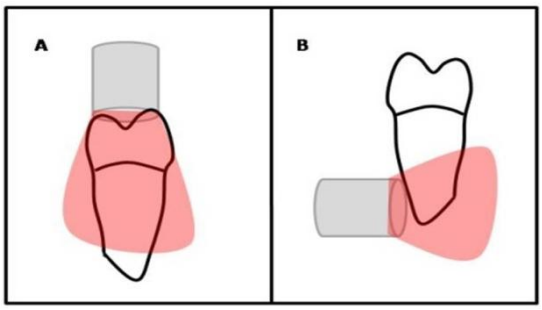

Figure 3 – Illustration of laser irradiation points. The first point was held perpendicular to the occlusal surface of the tooth (A), the second was held perpendicular to the dental periapex region (B).

DISCUSSION

Studies have shown that patients with irreversible pulpitis had an 8-fold higher failure of local anesthetic injections in comparison to normal control patients [28,29]. There are some theories that explain the difficulty in achievement pulpal anesthesia in symptomatic irreversible pulpitis teeth. One theory described that the inflamed tissue has a lowered pH, which reduces the amount of anesthetic base form needed to penetrate the nerve sheath and membrane. Consequently, there is less ionized form of anesthetic within the nerve to produce anesthesia. Another

theory described that the nerve arising from the inflamed tissue have altered resting potentials and reduced thresholds of excitability [30]. Substances released from inflamed tissue have two major effects on nociceptive: They change the functional activity of these neurons and change the synthesis of several proteins in nociceptors, leading to an increase in neuropeptides. These neuropeptides play important roles in regulating pulpal inflammation [31]. In addition, tissue injury may alter the composition, distribution or activity of sodium channels expressed on nociceptors [32,33]. The effect of inflammation on these sodium channels may also have profound implications in local anesthetic failures [34].

Patient anxiety may also contribute to local anesthetic failure [34]. First, the clinician should establish a positive and confident relationship and avoid exposing the patient to obvious fear-producing stimuli [34]. So, the control of anxiety and fear from patient seems to contribute for pain control. In the present case report, low power laser was applied in acute dental pain due to irreversible pulpitis and endodontic treatment was proceed with no stress and fear by the patient. According to patient report there was reduction of 90% of the pain, before local anesthesia was proceeding.

Recent studies have suggested the use of oral medication prior to local anesthesia in patients suffering with irreversible pulpitis. Ianiro et al (2007) [35] administered acetoaminophen or ibuprofen and compared with placebo in patients of acute irreversible pulpitis scheduled for root canal therapy and reported 71 to 76% success in comparison to only 46% with placebo. Lindermann et al (2008) [36] used sublingual sedative agent to reduce anxiety and increase pain threshold but found it ineffective. They concluded that profound pulpal anesthesia was still required to eliminate pain during root canal treatment of a tooth with painful pulp having acute irreversible pulpitis. Drugs cause undesirable side effects and because of that, other therapies are being investigated for treatment of the inflammatory pain [24]. Among those new treatments, low power laser therapy seems to be promising. Although different studies have shown the efficacy of low power laser in pain control, particularly of inflammatory pain, the mechanism by which radiation produces analgesia and anti-

inflammatory effects remains elusive. At the present time, most of the studies are based on the photochemical and photophysical theories proposed by Karu (1988). [37] This photophysical theory suggests that laser radiation could produce analgesia acting on the K^+ channel. On the other hand, Breitbart et al (1996) concluded in their work that the He-Ne laser does not induce a photophysical effect, acting directly on the mitochondria without any effect on the cell membrane [38]

It has been shown in studies that therapy with low power laser increases the release of endorphins [39,40]. It was also proposed that laser radiation could produce biomodulation of enzymatic, photochemical, and photophysical activities [37] Additionally, it has been postulated that low power laser induced photochemical reactions in cells that alter the pain threshold of nociceptors [41,42]. Evidences also shown that treatment with low power laser can modulate inflammatory processes by reducing the concentration of PGE_2 [43], thereby inhibiting COX_2 in vitro *[43,44]*, similar to the action of non-steroidal and steroidal anti-inflammatory agents, as well as reducing TNFα [45,13]. Probably, these actions do not occur in isolation, but concurrently. Between the theories described, in the present case report, it could be speculated that low power laser seemed to act through an analgesic effect.

FINAL CONSIDERATIONS

The application of low power laser during acute dental pain in the present case report brought comfort and decrease anxiety of patient during dental attendance. Additionally complementation of local anesthesia was not needed. It's important to point out that this procedure was applied as complementary to standardize urgency endodontic treatment, in any moment the conventional treatment was changed or excluded. The findings of the present case report proved interesting, however, future studies should be performed though randomized controlled clinical trials in order to investigate and scientifically prove any real beneficial of the application of low power laser in acute dental pain.

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