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Effect of Low-Level Laser Therapy on Wounds in Intra-Oral Surgery

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Abstract

During the last two decades, much has been written in both the scientific literature and the popular press about lasers and their use in dentistry. Both soft- and hard-tissue applications have been discussed, including frenectomy, gingival contouring, caries removal and bleaching. The aim of this study is evaluate and compare the effects of laser therapy on the surgical wound repair process and painful symptoms in patients undergoing bilateral teeth extractions at the Department of Dentistry, State University of Paraiba. Three sessions of laser therapy (GaAlAs) were performed for each patient. The first session was immediately after the surgical procedure, the second occurred 48-72 h after the first session, and the third and final at 7 days after surgery, coinciding with the removal of the sutures. Of the patients examined, 65.5% at the first assessment (after the second laser therapy session) and 75% at the second assessment (after the third session) exhibited a better degree of repair on the side treated with laser (STL) compared to the side not treated with laser (SNTL). There was no difference in edema between the STL and SNTL. Regarding pink tissue colour, there was an increase in its frequency, from 25%-62.5% of cases, on the STL between the first and second assessments. Bleeding also showed an increased frequency on the STL and decreased on the SNTL in the second assessment. Regarding painful symptoms, the results revealed that, on the STL, they decreased, from 62.5%-0% between the first and second assessments, and on the SNTL, from 87.5%-12.5%. Hence, low-power laser use appeared to be effective for the repair of intraoral surgical wounds, accelerating the degree of repair, improving tissue colour and reducing pain symptoms.

Keywords: Low-level laser; Wounds; Intra-oral surgery; Laser therapy

Introduction

Undoubtedly, one of the great advances in medicine in the twentieth century was the development of laser devices [1-4]. Laser radiation has been used in surgical procedures with the objective of increasing surgical benefits and improving clinical outcome [5,6]. It has some advantages such as disinfection of the operative field, the absence of vibration, the vaporisation of lesions, tissue destruction accuracy, minimal damage to adjacent tissues, a haemostatic effect, anti-inflammatory and biostimulation properties, reduced pain and edema, and greater comfort for patients [7-10]. Lasers commonly used in dentistry have gallium arsenide and aluminium (GaAlAs) as the active medium, with wavelengths ranging from 790 and 850 nm, outside the visible range of the light spectrum (infrared) and aluminium-gallium-indium phosphate (InGaAIP), with a shorter wavelength, within the visible range (red) [11-14]. The desired therapeutic effects on irradiated tissues are obtained when there is absorption of the laser beam.

Low-power lasers have analgesic effects, stimulating the release of endorphins; inhibiting nociceptor signs; and reducing painful symptoms, antiinflammatory effects, edema and hyperemia [3,5,9,11,13]. They also have biostimulation properties, accelerating wound healing, stimulating bone repair and remodelling, recovering neural function after injury and modulating immune system cells, promoting repair [3,5,10,15,16]. The biological effects (analgesic, anti-inflammatory and biostimulant) that lowpower lasers have on tissues are primarily due to light energy, which is absorbed and turned into primary (direct), secondary (indirect), and general therapeutic effects. These effects control the production of substances released during pain and inflammation, such as prostaglandins, prostacyclins, histamine, serotonin, bradykinin, and leukotrienes [13,17-20]. Furthermore, they modify normal enzymatic reactions, excitation and inhibition, as well as ATP production and the synthesis of prostaglandins. Of the many phenomena that characterise the living organism, wound healing is one of the most interesting. Low-power laser treatment has been effective for wound healing, accelerating the physiological repair process and reducing pain [13,21-23]. This type of treatment is still little known by many professionals, but it is a promising new tool.

Laser therapy has been assessed over the last 10 years, being the focus of numerous studies [1,2,5,9,20,23-25]. The use of laser in the tissue repair process was first studied by Mester and since then the concern of researchers has been to evaluate the biostimulation effect of the laser beam on the tissue repair process [4,26]. The biological effects of laser radiation on tissues occur in different ways: specifically, by inducing mitotic activity of epithelial and endothelial cells, modifying the capillary density, stimulating the local microcirculation and, especially, increasing collagen synthesis in vitro or in vivo [3,5,11,17]. Statistical data on the clinical effects of laser radiation on humans are still very scarce and its cost-benefit ratio requires confirmation before laser therapy use can be extended to the general population [6,12].

Extractions of teeth are invasive surgical procedures that cause postoperative discomfort to patients, often disabling their social life at least temporarily. However, a large number of patients need to undergo extractions [13-21]. Most of these patients are workers and need biopsychosocial balance to continue to accomplish their activities. Thus, minimizing postoperative problems is important for a faster reintegration of the patient into society and a fast return to normal activities. In this context, we evaluated the efficacy of laser therapy in the repair process of intra-oral surgical wounds, including the following variables: degree of repair or closure of wounds, edema, bleeding, erythema, and pain symptoms.

Materials and Methods

Study protocol

According to Resolution 196/96, this experiment was duly registered with the National System of Research Ethics-SISNEP: 0240.0.133.000-07 and submitted to the Ethics Research Committee of the State University of Paraíba (UEPB), Campina Grande, Brazil. This was an experimental study using a laser device and was a blinded in vivo, prospective, descriptive, intervention study, with a clinical randomised, controlled, split-mouth type trial. The study universe consisted of all patients between 18 and 64 years old, followed at the clinics of the Department of Dentistry, UEPB, with indications for extractions from July 2008 to May 2009. The sample was composed of eight patients undergoing bilateral extractions, who met the following inclusion criteria: indications for bilateral extractions of teeth from the same group and same surgical etiology, who underwent drug therapy based only on analgesics (dipyrone), and who signed the informed consent form. Patients with systemic diseases and conditions that could affect the repair process, allergies to the selected medication, and those requiring antibiotic therapy were excluded.

Experimental model

The laser application was performed in a timely manner in three regions of the edges of surgical wounds: central, mesial, and distal. The laser used was an infrared type, at a wavelength of 808 nm, and a dose of 100 J/cm², adopting the area of the laser pointer for fluency calculation, with gallium arsenide and aluminium (GaAlAs) as the active medium. In each session, three applications of 22 s and 2.2 J of energy were performed (Table 1).

Each patient underwent three sessions of laser therapy: the first was performed on the day of surgery, soon after it. The second occurred 48-72 h after the first session and the third and final occurred 7 days after surgery, coinciding with the removal of the sutures. The side of laser application was randomly chosen by the operator and called the STL, while the opposite side, which was not treated with the laser, was called the SNTL.

Low-level laser therapy analysis

Pain symptoms were analysed using a questionnaire that asked the patient about the presence or absence of pain in the STL and SNTL after the second and third sessions of laser treatment. Assessments of surgical wounds, including the degree of repair or closure of wounds, edema (absent or present), erythema (reddish/bluish tissue colouration), and bleeding (absent or present in mild, moderate, or severe form) were performed by an examiner (blinded) using digital photographs taken by the laser equipment operator at the end of the last two sessions of laser therapy. Only the degree of repair or closure of wounds and edema, when present, were evaluated comparatively between the test (STL) and control (SNTL), being classified as superior or inferior to the other side.

Device information	
Manufacturer	DMC
Model identifier	Whitening Lase II
Emitter type	GaAlAs
Irradiation parameters	
Center wavelength (nm)	808 nm
Operating mode	Continuous
Pulse on duration (sec)	60 ns
Beam shape	Circular
Treatment parameters	
Beam spot size at target (cm2)	1 mm^2
Exposure duration (sec)	22 sec
Radiant exposure (J/cm2)	100 J/cm^2
Radiant energy (J)	2.2 J
Number of points irradiated	3
Area irradiated (cm2)	1 cm^2
Application technique	Without skin contact
Number and frequency of treatment sessions	3 sessions, performed in 1 week
Total radiant energy (J)	18 J per session, 54 J over all sessions

Table 1: Specification for laser parameters.

Statistical analysis

For decision-making, the Mann-Whitney U-test for independent samples and the Wilcoxon test for dependent or paired samples were used, adopting a significance level of 5%. Data were analysed using the SPSS software (ver. 13.0).

Results

In the first evaluation, performed after the second session of laser therapy (48-72 h after surgery), edema was found in 50% of the wounds on the STL, which was lower than that on the SNTL. In addition, of the wounds on the STL (SNTL), 37.5% (12.5%) were not associated with painful symptoms and 37.5% (50%) had bleeding. Moreover, the degree of repair or closure of wounds was higher in the laser-treated group than in the control in 62.5% of cases (Figures 1 and 2). Figure 2B showing points at which the laser was applied. Erythema (reddish/bluish colour) was more evident in the untreated group, corresponding to 87.5% of cases.

Figure 1: Degree of wound repair-SNTL-48 h after surgery.

Figure 2A: Degree of wound repair-STL-48 h after surgery.

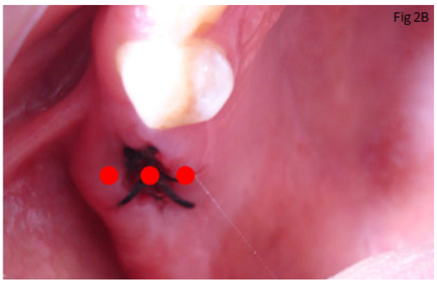

Figure 2B: Points of application of laser in STL.

However, when the Mann-Whitney U-test was applied at a significance level of 5%, there was no statistically significant difference in pain (p=0.264), bleeding (p=0.626), or erythema (p=0.535) between the groups 48-72 h after the surgical procedure (Tables 2 and 3).

1st Avaliantion	Edema	Absence of pain	Positive bleeding	Tissue repair	Erythema
Laser	50	37.5	37.5	62.5	13.5
No Laser	50	12.5	50	37,5	87.5

Table 2: Statement of the results in first avaliantion, in %.

2nd Avaliation	Edema	Absence of pain	Positive bleeding	Tissue repair	Erythema
Laser	25	100	62.5	75	37.5
No Laser	75	12.5	25	25	50

Table 3: Statement of the results in second avaliantion, in %.

In the second evaluation, performed after the third session of laser therapy (7 days after surgery), all patients in both groups (100%) showed edema. However, 7 days after surgery, there was less edema on the treated than on the untreated side in 75% of the wounds. None of the wounds of the laser-treated group showed pain symptoms, while 12.5% of those of controls did. Bleeding was more common in the test group, present in the majority (62.5%) of cases, while only 25% of the untreated group showed bleeding. There was greater repair on the treated than on the untreated side in 75% of the wounds (Figures 3 and 4).

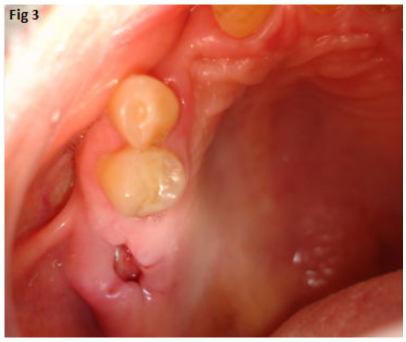

Figure 3: Degree of wound repair-SNTL-7 days after surgery.

Figure 4: Degree of wound repair-STL-7 days after surgery.

Regarding erythema, the majority (62.5%) of wounds exhibited pink tissue colouration in the test group, while in the control group, half (50%) of the cases exhibited a pink colour and the other half had a reddish/bluish colour. Applying the Mann-Whitney U-test at a significance level of 5%, there was also no statistically significant difference in pain (p=0.317), bleeding (p=0.143), or tissue colouration (p=0.626) between the groups 7 days after surgery (Tables 2 and 3).

A slight increase in the degree of repair or closure of wounds in the laser-treated group compared to the untreated group was observed, because in the first evaluation, 62.5% of wounds in the test group showed a higher degree of repair than the control group; this percentage increased to 75% in the second evaluation. Between 48 and 72 h after surgery, only 12.5% of wounds showed no edema; however, at postoperative day 7, all wounds showed some degree of edema. It was also observed in the first assessment that 25% of the edema cases were in the laser-treated group than in the untreated group, while in the second evaluation, only 12.5% of edema cases were in the test group. Also, in the second evaluation, 75% of edema on the side treated with the laser were inferior to those on the side not treated with the laser and this value was 50% in the first assessment. However, applying the Wilcoxon test at a 5% significance level, there was no statistically significant difference in the degree of surgical wound repair (p=0.317) or edema intensity (p=0.334) between the two evaluation periods.

Discussion

GaAlAs laser therapy showed effectiveness in tissue repair of surgical wounds in the first evaluation (48-72 h after bilateral extractions), showing superiority over wounds not subjected to laser therapy in 62.5% of cases. In the second evaluation (at day 7 after surgery), the comparative frequency of the repair of surgical wounds increased to 75% of cases, indicating that low-power laser treatment seemed to improve the healing of surgical wounds when used immediately after surgery, and 48-72 h and 7 days after surgery. However, we found no statistical evidence that the degree of wound repair differed significantly between the assessment periods.

Patients who exhibited edema in the regions of surgical wounds were submitted to a comparative analysis of the intensity of this variable on both sides. However, the degree of edema did not differ between the groups at the first assessment, although it showed improvement in the treated group but not the untreated group at the second evaluation. This suggests that low-power laser treatment improved edema, but this result was not statistically significant. In the first assessment, erythema was rosy (compatible with a normal state) in 25% of wounds in the treated group and in 13.5% of wounds in the untreated group. In the second evaluation, the values were 62.5% and 50%, respectively, reinforcing the results regarding the efficacy of low-power laser in improving tissue colouration, as reported previously [3-7,11-13,17]. However, as untreated wounds also showed improvement, it would appear that the repair process was unrelated to laser treatment. The presence of bleeding was found in only 37.5% of wounds in the treated group and in 50% of wounds in the untreated group at first assessment. However, at the second assessment, the wounds of the test group showed increased bleeding in 62.5% of cases, while those of the control group showed less bleeding in 25% of cases. These results may be explained by the low-power laser stimulating local microcirculation [5].

Patients with the presence of bleeding on either side were also tested to assess the intensity of this variable, which at first assessment was mild in 100% of cases in the treated group and in 75% of cases in the untreated group; the rest of the sample (25%) showed moderate bleeding. In the second evaluation, the test group showed mild and moderate bleeding intensity in 33.3% and 67.7% of cases, respectively, which may also be explained by the laser activating local microcirculation, while in the wounds of the control group, bleeding was mild in 50% of cases and intense in the other 50%. Low-power lasers exhibit analgesic effects, because they stimulate the release of endorphins and inhibit nociceptor signs, thus reducing painful symptoms [3,6,7,11-13, 17]. In the present study, 37.5% (12.5%) of patients reported no pain in treated (untreated) wounds at first assessment, whereas 100% (87.5%) of cases reported no pain at second assessment, consistent with other reports [9,10,18]. Based on previous literature and the results of the present study, laser therapy is an important method for the rehabilitation of the maxillofacial complex and healing of wounds in soft tissues [2-6,8-12,17,18,25,26]. Furthermore, low-power laser seems to help control pain [10]. However, there is as yet no consensus on the ideal laser protocol for use in oral surgery.

Conclusions

Low-power laser irradiation has a positive effect on the repair of intraoral surgical wounds, accelerating the degree of repair, improving erythema, and reducing painful symptoms. However, further studies are needed to confirm its clinical efficacy.

References

1. Brugnera A Jr, Pinheiro AL (1998) Lasers in modern dentistry. Sao Paulo: Pancast 99-120.
2. Brugnera A Jr (2003) Atlas of laser therapy applied to the dental clinic. Sao Paulo: Santos.
3. Almeida-Lopes L, Massini RJ (2000) Lasers and their applications. Sao Paulo: DMC Equipment 31.
4. Conlan MJ, Rapley JW, Cobb CM (1996) Biostimulation of wound healing by low-energy laser irradiation. J Clin Periodontol 23: 492-496.
5. Garcia EG, Okamoto T, Kina JR (1996) Repair of skin wounds undergoing treatment with the laser beam. Histological study in rats. Rev. Odontol. UNESP 25(1): 37-48.
6. Lopes LM, Eduardo CP (1999) Laser therapy in periodontics. ln: Compendium periodontal therapy. Sao Paulo: Medical Arts. Cap 14: 293-307.
7. Neiburger EJ (1995) The effect of low-power lasers on intraoral wound healing. Scientific 40-43.
8. Genovese JW (2000) Low level laser therapy: therapeutic applications in dentistry. Sao Paulo: Lovise 175
9. Shafer WG, Hine MK, Levy BM (1987) Oral pathology (4thedn), Rio de Janeiro: Inter 549-550.
10. Vieira SAL (2006) Effect of low level laser therapy on the healing of experimental skin wounds. Thesis submitted as partial requirement for obtaining a Master's Degree in Health Promotion University of France.
11. Masse JF(1993) Effectiveness of soft laser treatment in periodontal surgery. Inter Dental J 43(2): 121-7.
12. Myers TD (2000) The future of lasers in dentistry. Dental Clin North Amer 44:4:971-980.
13. Neiburger EJ (1997) Accelerated healing of gingival incisions by the helliunneon diode laser: a preliminary study. Gen Dent 45:2:166-170.
14. Pinheiro ALB, Marzola C, Toledo Filho JL, Klug RJ (2005) The Non-Surgical Laser In Oral and Maxillofacial Surgery. Paper presented to the completion of the Residency Program in Surgery and Maxillofacial sponsored by AH Bauru and Brazilian College of Surgery and Traumatology BMF. Residency Program in Surgery and Maxillofacial sponsored by AH Bauru.
15. Damante CA (2003) Clinical and histological evaluation of the effects of low intensity laser (GaAlAs) on gingivoplasty healing in humans.
16. Siqueira FCHN (2004) Use of low intensity laser, AsAlGa, 830 nm, in patients with pressure ulcers. Work completion of the physiotherapy course - University of Parana.
17. Walsh LJ (1997) The current status of low level laser therapy in dentistry. Part 1. Soft tissue applications. Austr J Dental, 2:4:247-254.
18. Laureano Filho JR, Camargo IB, Firmus ACB (2008) The influence of low intensity laser therapy in reducing swelling, pain and trismus in the

postoperative surgical third molar: preliminary results in 13 cases. Rev Cir Traumatol Maxillo-fac, Recife 8(1): 47-56.

19. Boschi ES (2008) Anti-inflammatory Effect of Low Power Laser Therapy (660 nm) in Peurisia in Rats.

20. Yoshiyasu RYA (2001) An in vitro study on the effects of irradiation by Er: YAG laser therapy combined with fluoride on acid resistance of the enamel of teeth subjected to orthodontic braces.

21. Pugliese LS (2003) The influence of low-level laser therapy on bio modulation of collagen and elastic fibers. Pesq.Odontol Bras 17: 307-313.

22. Torres MARO (2007) Influence of low level laser therapy (GaAlAs-830nm) on bone formation in smooth and textured implants: A histomorphometric analysis.

23. Neiburger EJ (1999) Rapid healing of gingival incisions by the hellium-neon laser diode. J Mass Dent Soc 48:1:8-13.

24. Pecora JD, Brugnera Junior A (2007) Brief History of the Laser.

25. Gomes ASL, Lopes MWF, Ribeiro CMB (2007) Laser radiation: applications in oral surgery. International Journal of Dentistry, Recife 6:1:17-20.

26. Coelho RCP (2008) Low level laser therapy: use in postoperative third molar surgery. Completion of course work. Rio de Janeiro: School of Army Health.