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Clinical Study of Laser Biomodulation (650 λ) After Free Gingival Grafts

Juliana P.P.G. Vieira[a], Cibelle B. Lopes[b], Andrea Carvalho DeMarco[c], Antonio Braulino de Melo Filho[c], Maria Aparecida Neves Jardini[c]

[a] *Dentist, Paulista Association of Dentists, São José dos Campos, SP, Brazil.*
[b] *Professor, Laser Center, IP&D, FCS, UNIVAP, São José dos Campos, SP, Brazil.*
[c] *Professor, School of Dentistry, UNESP, São José dos Campos, Brazil.*

Purpose: Free gingival grafts (FGGs) are used to increase keratinized tissue; however, this technique causes patients discomfort in the donor area. A biomodulation laser has been used in both in vivo and in vitro experiments to accelerate the healing process and modulate cellular metabolism. The purpose of this study was to investigate the intensity of pain as well as wound-healing chronology and quality in FGGs using laser radiation after surgery.

Materials and Methods: Ten patients with insufficient keratinized gingival tissue were randomly divided into two groups: control and laser (LED, 5 W, λ = 650 nm, and 8 J/cm^2 at 0 h, 48 h and 72 h after surgery). The intensity of pain was evaluated using a numerical scale ranging from 0 to 10, where 0 is no pain and 10 is severe pain, on each of the 7 postoperative days. The wound healing of all patients was evaluated by visual inspection (7, 14 and 21 days after surgery).

Results: Statistically significant differences in pain level were found between the control and laser groups on days 1 and 2 after surgery ($p < 0.05$). The wound healing analysis showed that 80% of the irradiated patients and 40% of patients in the control group were healed 14 days after surgery.

Conclusion: The use of laser therapy improved the initial discomfort after FGG surgery. The results of this preliminary study have minor statistical significance because only a limited number of patients were included.

Keywords: wound healing, pain intensity, laser biomodulation.

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Although several studies have shown that the absence of keratinized gingiva may not negatively influence the health and maintenance of the periodontium, there are clinical situations in which mucogingival therapy should be considered, because a thin gingiva does not protect against inflammation and gingival recession. Orthodontic treatment, inadequate plaque control, high frenum attachment and shallow vestibular depths possibly cause mucogingival problems.[1]

Gingival recession is defined as the partial denudation of the root surface due to apical migration of the gingival margin. While several mucogingival procedures are successful, the most common is the pedicle graft technique with or without the addition of free connective tissue.[2]

Postoperative pain commonly occurs after periodontal surgery. Many factors could influence the pain intensity, including the nature, duration, and extent of the surgery and psychological aspects, such as stress and anxiety. Many chemical mediators of inflammation are released as a consequence of periodontal tissue injury caused by surgical trauma.[3]

Diverse techniques have been used to reduce inflammation and pain while improving wound healing. Recently, nonsurgical laser biomodulation (LB) has been used to improve gingival healing after surgery and nonsurgical treatment of periodontal tissues.[4-7]

For dental surgeons, improving clinical practices can provide effective pain relief and improve patient comfort following surgery. The dental application of lasers

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Table 1 Evaluation of the epithelial barrier

Epithelial barrier	Oxygen bubbles	Wound healing
Incomplete	Positive (+)	Incomplete
Complete	Negative (-)	Complete

is a developing field with great promise. Lasers have been used in oral surgery, endodontics, periodontics, and restorative dentistry.[4]

Tissue repair is a combination of dynamic interactive processes that involve soluble mediators, blood components, the production of extra-cellular matrix, and mesenchymal cells. Several studies have demonstrated that a visible laser is the most appropriate for wound healing due to its photochemical effects.[8,9]

LB is extensively used for tissue stimulation and to promote anti-inflammatory and analgesic effects, reduce edema, and prevent infection. Its effects on nerves and tissue healing were attributed to increased neo-vascularization and collagen deposition. It has been proposed that the healing acceleration may be due to a reduction in acute inflammation.[9-11] When the activation of gingival fibroblasts was observed, LB showed potential for early wound healing in periodontal treatments.[12] In vivo animal studies have shown better healing with laser-irradiation after surgery compared to controls.[9,10]

The purpose of this study was to evaluate in the differences between the pain levels and wound healing of the laser and control groups of 10 patients submitted to free gingival graft surgery.

MATERIALS AND METHODS

Study Population and Free Gingival Grafts

Ten patients (9 women and 1 man) from 32 to 58 years old (mean age: 42 years) were selected for periodontal treatment at the APCD, São José dos Campos, SP, Brazil, from April 2006 to October 2007. Patients with a history of systemic disease, such as diabetes mellitus or uncontrolled hypertension, who were pregnant or lactating, or who had high a risk for infective endocarditis were excluded from this study. The nature of the study was explained to each patient, who signed an informed consent form approved by the Ethics Committee on Human Research of the School of Dentistry, UNESP (São José dos Campos, Brazil). All patients had generalized moderate to advanced chronic periodontitis. Presurgical preparation was performed in all cases, which consisted of scaling and root planing; oral hygiene and postoperative care instructions were given. After administration of local anesthesia (2% mepivacaine with epinephrine), the patients received the free gingival grafts. The protocol used in this study was based on Wennstrom and Pini Prato.[13] All participants were instructed to take 500 mg of paracetamol, if necessary.

Evaluation of Pain after Surgery

Patients were instructed to rate their pain levels every 7 days after surgery with the visual analog scale (VAS).[3] The pain intensity on a numerical scale ranged from 0 to 10, where 0 is no pain and 10 is severe pain.

Evaluation of Wound Healing

All patients were evaluated by visual inspection (7, 14 and 21 days after surgery) using the peroxide test. The area was dried with a gauze sponge, and 3% hydrogen peroxide was applied to the wound surface according to Marucha,[14] and shown in Table 1.

Laser Biomodulation

The patients were laser irradiated transcutaneuosly applying 4 J/cm^2 at two points around the donor and recipient regions. The first session was performed immediately after surgery and repeated every 48 h for 7 days (0 h, 48 h and 72 h; 16 J/cm^2 per session); the total treatment dose was 48 J/cm^2 (Table 2).

Table 2 Groups, irradiation protocol, and measurements after free gingival grafts

Group	Total dose	N	Time of irradiation (hours after surgery)	Pain evaluation (days)	Healing evaluation (days)
Laser	16 J/cm^2	5	0 h, 48 h, 72 h	1, 2, 3, 4, 5, 6, and 7	7, 14, and 21
Control	0 J/cm^2	5	n.a.	1, 2, 3, 4, 5, 6, and 7	7, 14, and 21

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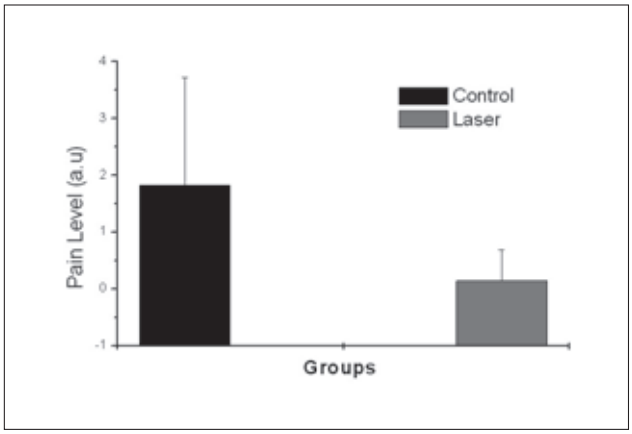

Fig 1 Pain levels indicated in the laser and control groups seven days postoperatively. *Significance level $p < 0.05$.

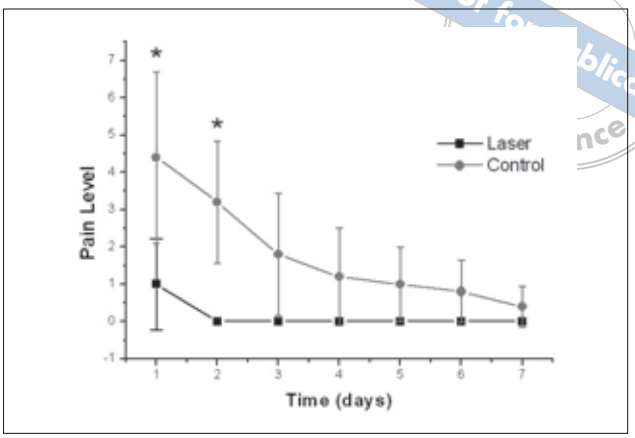

Fig 2 Averages of the pain level in both groups (control and laser) 7 days postoperatively.

Statistical analysis was performed with the t-test and ANOVA using the Origin 6.0 (Northampton, MA, USA) software. For all tests, significance was set at $p = 0.05$.

RESULTS

The statistical analysis demonstrated a significant difference between the laser and control groups only on days 1 and 2 ($p < 0.05$).

The pain intensity measurements of the irradiated and control groups after surgery can be seen in Figs 1 and 2.

As a measure of wound healing, the peroxide test indicates the quality of the epithelial barrier and is based in the fact that connective tissue contains catalase, which produces oxygen and water from hydrogen peroxide. If the epithelial barrier is intact, then the hydrogen peroxide does not diffuse into the connective tissue. If the barrier is incomplete, then bubbles of oxygen are visible on the wound surface, as shown in Tables 3 and 4.

DISCUSSION

The purpose of this study was to investigate the degree of pain and wound healing after free gingival graft

Table 3 Presence (+) or absence (-) of bubbles, to verify the epithelial barrier in the periods of study groups

		7 days	14 days	21 days
LASER	Patient 1	+	-	-
	Patient 2	+	-	-
	Patient 3	+	+	-
	Patient 4	+	-	-
	Patient 5	+	-	-
CONTROL	Patient 1	+	-	-
	Patient 2	+	-	-
	Patient 3	+	+	-
	Patient 4	+	+	-
	Patient 5	+	+	-

Table 4 Percentage of epithelial barrier in the groups

Groups	7 days	14 days	21 days
Laser	0%	80%	100%
Control	0%	40%	100%

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(FGG) surgery with or without irradiation with a low intensity laser.

Gingival recession is defined as the partial denudation of the root surface due to apical migration of the gingival margin. Although several mucogingival procedures have been successful, the most commonly used is the pedicle graft technique with or without the addition of free connective tissue.[2]

FGG is used for reducing gingival recession and increasing keratinized tissue, but this technique causes discomfort in the donor area. Postoperative pain after periodontal surgical procedures is common. The perception of pain is highly subjective and varies considerably among individuals,[3] and many medications to control pain are used after periodontal surgery.[15]

Complete wound healing is obtained after about 2 to 4 weeks,[16] and the healing process after gingivectomy is characterized as secondary intention and takes about 5 weeks to re-establish normal gingival epithelialization. Several studies have shown that the topical application of medications, antibiotics, or amino acids improved the healing of wounds by secondary intention.[4]

Laser radiation can reduce inflammation in periodontal tissues by eliminating bacteria or other possible mechanisms. In a previous study, the clinical signs of inflammation were significantly reduced in the lased side compared with the placebo side of a wound, suggesting that low-level laser energy enhances the healing of the gingiva.[6]

This study revealed the potential of laser therapy to reduce the occurrence of postoperative pain, which was observed as a significant difference on days 1 and 2 ($p < 0.05$) after surgery. In terms of wound healing, 80% of the irradiated patients and 40% in the controls were healed 14 days after surgery, and no differences were observed 7 and 30 days after surgery between the groups. The laser protocol used in this study demonstrated better results in terms pain after surgery and chronology and quality of wound healing compared with the control group.[4]

Laser radiation possesses the wavelength-dependent ability to alter cellular behavior in the absence of significant heating. Mitochondrial changes have also been hypothesized to be responsible for the positive results of laser therapy.[17] The biological response may result from the absorption of a specific wavelength by an unknown molecular photoreceptor that participates in metabolic reactions in the cell. Many studies have indicated that laser therapy is more effective if the treatment is administered in early stages of healing when cellular proliferation is high.[17] The mechanism of the positive effects of laser light on different tissues is not fully understood, and many possibilities have been considered, such as the stimulation of porphyrins and cytochromes that increase cellular activity and the concentration of ATP.[17]

Additional research is needed to evaluate the long-term effects of LB as a periodontal treatment.[7] There is insufficient evidence to suggest that any specific wavelengths of laser radiation are superior to traditional therapeutic methods. Given the inherent expense, time requirements, and number of clinicians required to conduct these studies, multicenter collaborative studies may be necessary.[18] The effects of laser therapy are still controversial because previous reports have shown different or conflicting results.[17]

CONCLUSION

The use of laser therapy ameliorated the initial discomfort after FGG surgery. The results of this preliminary study have minor statistical significance because only a limited number of patients were included, but they represent an important basis for a comparative study. This pilot study shows the need for further investigation of the use of lasers in clinical practice.

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Contact address: Maria Aparecida Neves Jardini, Av Francisco Jose Longo 777, São Dimas, São Jose dos Campos, SP, Brazil. Tel: +55-12-3947-9046. e-mail: jardini@fosjc.unesp.br