Clinical evaluation of low level laser therapy in skin wound healing in maxillofacial surgery.

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Abstract

Background: Wound healing is a complicated, interactive, integrative process involving cellular and chemotactic activity, the release of chemical mediators and associated vascular response which includes number of phases: inflammatory phase, proliferative phase and remodeling phase. Low level laser therapy can be more effective in the three overlapping phases of wound healing. Biostimulation appears to have an effect on the cellular level, by increasing cellular function and stimulating various cells.

***Objective*:** To evaluate the efficacy of low level diode laser on wound healing of human skin clinically.

Patients and Methods: This study was performed on 20 patients (10 male, 10 female) age range between 5-75 years with oral and maxillofacial lesions underwent maxillofacial surgery with low level laser therapy. After the surgical intervention, the wounds were divided into two parts, one part was irradiated by 1.25 W/cm^2 power density, 50 sec. exposure time low level diode laser and other part was left as a control. The postoperative course was evaluated based on subjective scale of edema, redness at 2nd -5th day postoperatively.

Results: Clinical evaluation of edema and redness were recorded at 2nd -5th day. Edema was obviously reduced in laser treated wounds in 14 patients. Redness was slightly increased in laser treated wounds in 15 patients. Finer scar in laser treated wound appeared as compared with wide scar in control wound.

Conclusion: Low level laser therapy causes edema-reducing effects and a little effect on a neovascularization at 2nd day after surgical intervention and minimal or fine scar formation.

Key words: Wound healing, Biostimulation, Low level laser therapy.

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Introduction

Wound healing is a complicated, interactive, integrative process involving cellular and chemotactic activity, the release of chemical mediators and associated vascular response [(1)].

In any elective surgical intervention, there is a wound to gain access to treat or remove the underlying pathology while in the surgery of trauma ; the wound is the primary pathology [(2)].

Laser light has an important properties not found in light from any other source. These unique properties of laser light that make it useful in medicine are monochromaticity, coherence and directionality [(3)].

In beginning of 1970, open wound had been treated with laser especially chronic ulcers which had proved unresponsive to other treatment regimens and this work had been demonstrated considerable success depending on the type of lesion [(4)].

Biostimulation appears to have an effect on the cellular level, by increasing cellular function and stimulating various cells [(5)].

Low level laser irradiation from red and infrared range of spectrum can be more effective in the three

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overlapping phases of wound healing. By low level laser therapy (LLLT), the acute injuries and lesions had been healed rapidly and this healing can be induced in chronic lesions such as venous ulcers, pressure sores and diabetic ulcers.

LLLT has many different effects on biological tissue like anti-inflammatory, analgesic, anti-edematous effect; higher rates of ATP, RNA &DNA synthesis, and thus better tissue oxygenation and nutrition and increase in the absorption of interstitial fluid [6].The clinical effects of LLLT have been demonstrated by acceleration of wound healing, improvement of blood microcirculation and tissue regeneration [7].

Patients and Methods

This clinical trial comprised a total of 20 patients attending consultation clinic of the Oral and Maxillofacial Surgery Department in the Specialized Surgeries Hospital, Medical City, Teaching Hospital and requiring surgical intervention for different oral and maxillofacial lesions. This study included 20 patients 10 males and 10 females, the age ranged between 5-75 years.

Laser system

The characteristics of the laser device which was used in this study were class IV laser, infrared (Ga Al As) diode laser, its wavelength is 790-805 nm, mode of operation is modulated (chopped) cw and maximum cw power is 4 W.

Surgical procedure

The surgical operations were done by qualified surgeons under general anaesthesia in theatre hall of maxillofacial surgery department. Surgical operations irradiated by diode laser varied from prognathism of upper and lower jaws, hypertrophic scar in left side of neck, adenoid cystic carcinoma of submandibular gland and pleomorphic adenoma of parotid gland.

The incision and flap were designed according to site of the lesion. After removal of lesion, the site of surgery was irrigated, drains were put in some cases and flaps were repositioned and sutured.

Irradiation method

After suturing, each skin wound was divided into two parts, one part was irradiated by low level diode laser and the other part was left without irradiation as a control .The fiber optic of the laser device was located perpendicular to the wound. The operation mode of diode laser was cw mode, power density (power/spot size) was 1.25 W/cm^2, and exposure time was 50 sec. Figures (1, 2).

Assessment of wound healing

The edema and redness of wound were considered to evaluate the effect of low level diode laser on mucosal and skin wounds. The edema and redness were evaluated subjectively by reduced or present.

Results

The current clinical trial had been performed on 20 patients (10 males and 10 females) who required surgical intervention in oral and maxillofacial region. Clinical data was collected from the patients at the 2nd -5th day postoperatively.

The edema and redness had been evaluated subjectively by clinical inspection from 2nd day postoperatively.

In the laser treated wounds, the edema was reduced in 14 wounds and present in 6 wounds while the redness was present in 15 wounds and reduced in 5 wounds. Table no.(1)

In control wounds the edema was present in 13 wounds and reduced in 7 wounds while the redness was present in 13 wounds and reduced in 7 wounds. Figure (3)

In some cases scar was evaluated subjectively by fine or wide line of scar, there were 3 cases; in each case

the scar in laser treated site was fine line scar while in control site there was wide line scar. These observations were seen 3 -4 weeks postoperatively. Figures (4, 5)

Table 1: show subjective evaluation of the laser treated and control wounds.

	Laser		Control	
	Present	Reduced	Present	Reduced
Edema	6	14	13	7
Redness	15	5	12	8

Figure 1: Irradiation of the wound after removal of the Squamous cell carcinoma of floor of the mouth

Figure 2: Irradiation of the wound after removal of the Squamous cell carcinoma of alveolus of mandible.

Figure 3: Two days postoperatively show reduced edema and more redness in laser site.

A.Control site **B. Laser site**

Figure 4: Four weeks postoperatively show fine scar in laser site and wide scar in control site

Figure (5): Four weeks postoperatively show fine scar in laser site and wide scar in control site.

Discussion

Wound healing is a complex, physiological multisteps process including number of phases which follow injury including inflammatory, proliferative and remodeling phases; it relies on the integration and coordination of many cellular and humeral elements [8].

Biostimulation is the application of a narrow spectral width of red and near infrared radiation over injuries or lesion to stimulate healing within those tissues and relive pain [9].

When the cells have absorbed the photons, a cascade of biochemical events occurs whose ultimate result is accelerated wound healing like increased collagen synthesis, increased fibroblast proliferation, increased cell function / activity, modulation of the production of growth factors (including transforming growth factor and platelet derived growth factors)and development of new blood vessels [5].

One possible mechanism by which LLLT may enhance wound healing in vivo is via stimulation of epithelial cells [10].

Clinical observation of the wound in maxillofacial region had shown the edema in the laser treated wound was less compared with that in control wound which showed more edema 2nd day post operatively. These results agree with Fiszerman R, ND Rozenbom CY, 1995 and Amano A. 1994 who had shown the edema-reducing effects of the low level laser results from vasodilatation and increased microvascularization accelerated lymphatic flow and enhanced tissue oxygen uptake. In LLLT, immune modulation and mitigation of inflammatory response occurred because the mononuclear phagocytes cells, mast cells and leukocytes were stabilized preventing the release of harmful inflammatory chemical mediators [11, 12].Clinical observation of wounds show that the redness of wound is slightly more in laser treated wound compared with

control wound. This result is in agreement with Hickman, Dyson, 1988, Kubota, 2004 and Hawkins, Abrahamse, 2007 who had shown that the angiogenesis had been increased following laser irradiation of wounds. The low level laser irradiation has been shown to increase the blood flow rate and volume and to accelerate the wound healing process [13-15].

Clinical observations revealed fine scar formation in laser treated wound after 3-4 weeks compared with that in control wounds. This result is in agreement with Hopkins et al., 2004, and Nicoleta Herascu et al., 2005 who had shown LLLT enhances collagen synthesis characterized by enhanced glycine and proline content in collagen fibrile and this result in more organized tissue, decrease adhesion, minimal keloid formation and lighter colored scars. LLLT is an effective modality to facilitate wound contraction [16, 17].

In the present study, it is concluded that laser dose (1.25 W/cm^2, 50 sec.) has edema-reducing effects and a little effect on a neovascularization and cause minimal or fine scar.

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