

THE INFLUENCE OF GREEN LOW LEVEL LASER (532 NM) IRRADIATION ON WOUND HEALING

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ABSTRACT

Background: Many workers indicating the ability of low level laser in accelerating wound healing. Two different doses (5.7, and 11.4 J/cm²) from a green laser light (532 nm) were employed on a superficial wound on rats daily. Wound healing evaluations were done after the 1, 3, and 7th irradiations. The aim of this study was to evaluate the green (532 nm) low level laser on wound healing in rats using two different energies. **Results:** The wound specimens indicated fast healing, the next day after the first irradiation, for both doses. A single dose of adequate amount of doses is active in handling the healing processes without wound scar formation. This study result pointed out

that a single dose of green light of wavelength 532 nm is sufficient to complete the healing of wound. But increasing the frequency of laser irradiations causes scarring. **Conclusion:** The day after the first irradiation for both used energies, wounds healed rapidly showing less scar formation. Increasing the irradiation frequency may cause additional stress, and enhance scar formation. Therefore Low-level green laser of wavelength 532 nm facilitates wound healing from the first irradiation dose.

KEYWORDS: Wound healing, laser therapy, skin, inflammation, histological examination.

INTRODUCTION

Background

Low level laser therapy (LLLT) containing numerous laser kinds. LLLT employed in different of actions and treatment procedures. Many workers ensure the aid of the LLLT in Wounds restorative, and tissue healing. Wounds healing are difficult procedures which

include a sequence of vascular and cellular changes actions, such as clotting, inflammation, granulation tissue creation, epithelization, collagen synthesis, and tissue remodeling.^[1,2,3]

Currently, many researchers proved that tissue restoration are more operative after treated with low level laser, which facilitate wound healing.^[4,5,6,7] Conversely, several studies have shown no advantage in healing with LLLT.^[8,9]

Laser therapy works through different mechanisms after skin injury including operating wounds, such as increasing fibroblast proliferation after irradiation. It is well known that fibroblasts play a critical part in healing, which may facilitate fibro genesis causes the formation of epithelialization and granulation tissue through the repair phase, plus the beginning to synthesize collagen and ground substances.^[10,11] But many effects are possible, owing to different action parameters, influencing healing developments, and then revealed a variation in results and conclusions: such as a variation in injury length and area, laser power, wavelength, irradiation time and frequency, laser intensity, plus the collimation or divergence of laser beam.^[12]

Increasing laser spot diameter, cause a distribution of a laser light on wound sides, which may enhance better blood supply through wound sides, and then accelerate the healing.^[13] Most of the previous works in wound healing extensively employed He-Ne laser conforming its best healing stimulation.^[14,15]

The aim of this study was to evaluate the green (532 nm) low level laser on wound healing in rats using two different energies.

MATERIALS AND METHODS

Fifty one young rats male, of age (2-3) months and weight ranged between 250 g-500 g, were used in this study. After general anesthesia and hair shaving, a superficial wound of 1 cm in length was made on one side of rat thigh. The wounds were left without dressing and the rats kept in cleaned mesh cage to avoid any contamination or infection. The rats were divided into (3) groups. Nine animals, non - irradiated, regarded as a control group. The other forty tow animals were exposed to laser irradiation, using green laser light (-IIIB, china) of wavelength 532 nm, output power of 100 mW and a large beam spot area of 2 cm in diameter. Each group was divided to three subgroups.

The wounds of twenty one of them (first group) were irradiated for 3 minutes; which is equal to energy of 18 Joule (or energy per unit area = $(18) / (3.14) = 5.7 \text{ J/cm}^2$). The other twenty one (second group) irradiated for 6 minutes; equal to energy of 36 Joule (energy per unit area = $(36) / (3.14) = (11.4) \text{ J/cm}^2$).

The treated wounds were exposed directly to laser irradiation one hour post surgery (before the inflammatory proliferative stage) and then continued daily.

The wound specimen was taken at the 1, 3 and 7 post-operative days. This means that the histopathological examination was taking from seven rats in each group at the frequency of the first, third and seventh irradiations. Changes in wound cell morphology were evaluated by light microscope and compared to the control specimen results from 3 rats, at the same relative days.

The histopathological examination evaluates the amount of inflammatory cells, the microscopic characteristics appearance of fibroblast and epithelial cells for each specimen.

RESULTS

Generally the observation marked out that the low energy green laser aid wound remedial and its effects were similar for the two used energies.

A positive response was initiated early by relative decrease of the inflammatory cells in treated groups than control.

The marks of wound healing were faster on the treated groups in comparable with control, started at the next day after operation.

The histopathological examination results showed a quicker epithelization and the presence of fibroblast at the first post-operative day. Plus a complete wound restorative with the repair of the epidermis in treated groups. While the control sections of the wound at the first post-operative day is filled with blood clots and with the indication of a full inflammatory cells, fig.1.

But at the third post-operative day (after the third irradiation) the histopathological examinations demonstrated un pleasing results for the treated groups. The same results were obtained at the seventh day post-operative. Figure 2 illustrated an increase in the fibroblasts,

and granulation tissue on the third day after surgery and clearing the formation of scar. The scar formation increased at the seventh day, figures3. The section of the control wounds at the third - seven post-operative days were still filled with blood clots, inflammatory cells, and with the creation of fibroblasts, and granulation tissues.

This study result pointed out that a single dose of green light of wavelength 532 nm is sufficient to complete the healing of wound. But increasing the frequency of laser irradiations causes scarring.

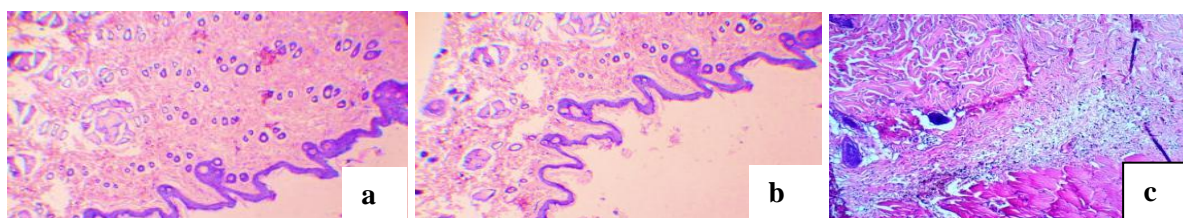


Fig. 1: The section of wounds at the first post-operative day, (a), and (b) represent the irradiated group 1 and 2 respectively, revealed a complete wound healing with restoration of epidermis. But (c) was filled with blood clots, with the indication of inflammatory cells.

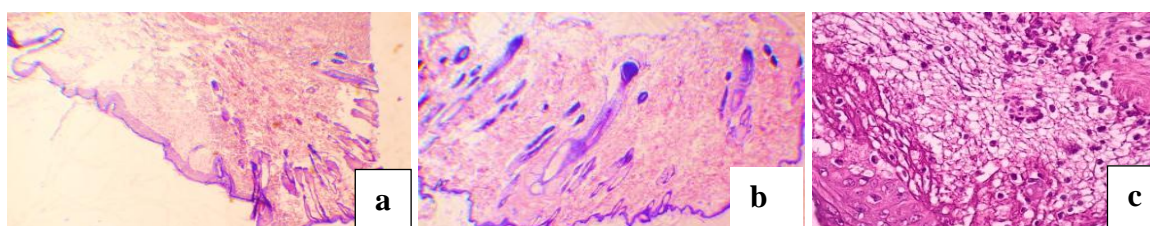


Fig. 2: The section of the wounds at the third post-operative day. (a) and (b) for groups 1 and 2 consequently, indicating a complete wound healing and restoration of epidermis, but with the appearance of scars. (c) was filled with blood clot, indication a full of inflammatory cells and more the creating of fibroblasts and granulation tissue.

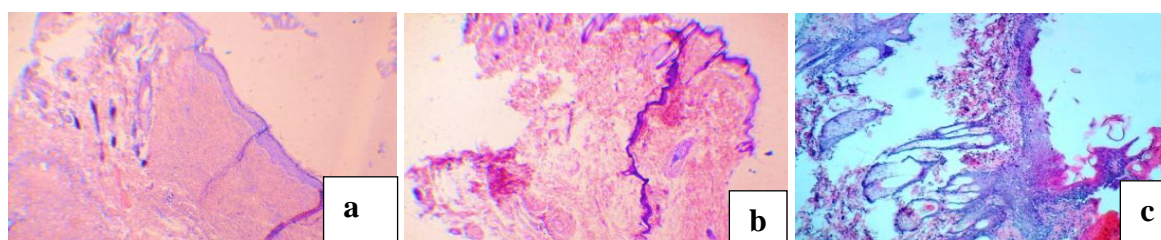


Fig. 3: The section of the wound the irradiated groups at the seven day illustrated the appearance of scars.

DISCUSSION

The results showed a complete wound tissue healing after the first laser-irradiation and there was no significant difference in the healing between the two used irradiation energies. Therefore wound healing may be enhanced by a threshold amount of energy which aid to increase blood flow rate, stimulated cellular activity and control the inflammation.

Accelerating wound healing by laser irradiation is thought to work through different biomodulation mechanisms, but its exact effects are still not understood. In numerous studies, with animal models, indicated that low-level laser adjuvant healing by the generation of adenosine triphosphate (ATP) for the repair cells, and fibroblast proliferation.^[16,17]

Furthermore this work results showed that wound healing after the first irradiation was better than the multiple irradiation wounds. Multiple exposures at energy doses of 18 and 36 Joule causes extra stress, which may reduce cell migration and viability.

CONCLUSION

The day after the first irradiation for both used energies, wounds healed rapidly showing less scar formation. Increasing the irradiation frequency may cause additional stress and enhance scar formation.

Therefore Low-level green laser of wavelength 532 nm facilitates wound healing from the first irradiation dose.

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