Content available at: https://www.ipinnovative.com/open-access-journals

IP Journal of Surgery and Allied Sciences

Journal homepage: https://www.jsas.co.in/

Original Research Article

Role of low-level laser therapy (LLLT) on skin graft donor site

Jackson Nuli[1], Barath Kumar Singh P[1], Ravi Kumar Chittoria[1,*]

[1] *Dept. of Plastic Surgery, Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry, India*

ARTICLE INFO

Article history:
Received 18-09-2022
Accepted 26-09-2022
Available online 17-10-2022

Keywords:
low level laser therapy (LLLT)
Skin graft
Donor site

ABSTRACT

The management of wound starts from acute stage and extends up to augmentation of scar tissue remodeling. The clinician seeks to optimize wound care to promote healing. Many authors of clinical studies have reported the benefits of LLLT on tissue healing. We report the use of Low-level Laser Therapy (LLLT) on skin graft donor site as a regenerative therapy for augmenting the wound healing.

1. Introduction

The skin grafts are the common surgical treatment for wound cover in Plastic surgery. The donor site of the skin grafting site expected to be healed without any complication or abnormal scarring. Low-level laser therapy (LLLT) or Photo biomodulation (PBM) is a form of medicine that applies low-level (low-power) lasers or light-emitting diodes (LEDs) to the surface of the body.[1] The data suggests that LLLT facilitates collagen synthesis,[2] keratinocyte cell motility,[3] growth factor release[3] and transforms fibroblasts to myofibroblasts.[4] In this article we report the use of Low-Level Laser therapy in augmenting the wound healing of the skin graft donor site.

2. Materials and Methods

This study was conducted in the Department of Plastic Surgery in a tertiary care institute. Informed consent was obtained from the patient under study. Department scientific committee approval was obtained. It is a single center, non-randomized, non-controlled study. LLLT was applied to the skin graft donor site in two patients.

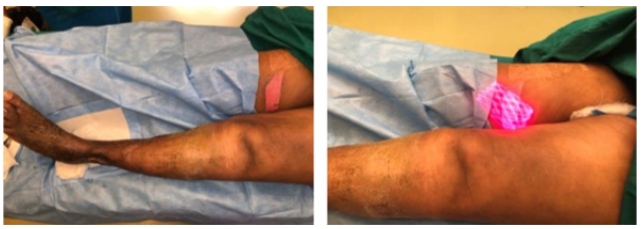

Fig. 1: Low level laser therapy applied to the skin graft donor site on patient 1

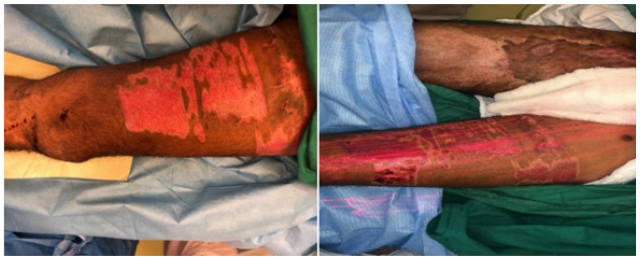

Fig. 2: Low level laser therapy applied to the skin graft donor site on patient 2

* *Corresponding author*.
E-mail address: drchittoria@yahoo.com (R. K. Chittoria).

https://doi.org/10.18231/j.jsas.2022.020

The patient 1 under study was a 63-year-old female, with no other known co morbidities presented with a non-healing venous ulcer on the right leg. Her wound was managed according to international standard guidelines. A split thickness skin graft was harvested on her right upper thigh for closure of the wound. Low level laser therapy was applied to the skin graft donor site to facilitate wound healing (Figure 1).

The patient 2 under study was a 45-year-old male, with no known comorbidities had electrical burns over chest, abdomen, right thigh. His wound was managed according to guidelines. A split thickness skin graft was taken from his left thigh for wound cover. Low level laser therapy was applied to the skin graft donor site to facilitate wound healing (Figure 2).

LLLT was given to the wound bed in four sessions once in 5 days for a total of four session, after each session of wound inspection and dressing. Gallium Arsenide (GaAs) diode red laser (wavelength 650 nm, frequency 10 kHz and output power 100 mW) was used as a source of LLLT. It is a continuous beam laser with an energy density of 4 J/cm2. Machine delivers laser in scanning mode (non-contact delivery) with 60 cm distance between laser source and wound. In each session, the wound was given laser therapy for duration of 125 second followed by non-adherent absorbent dressing.

3. Results

Donor site healed well after low level laser therapy session (Figures 1 and 2). Post therapy period was uneventful.

4. Discussion

Low levelLaser uses energy much less than that is used forcutting, ablation therapy.[4] By definition Low-levellasers are one with power density less than 500 mW/cm.[2] LLLT is used as an adjuvant to conventionaltherapy with promising results, in patients withulcers.[5] LLLT is a form of phototherapy that useelectromagnetic radiation. LLLT does not generateheat but produces photochemical and photophysicaleffects, with the intention of re-establishing cellhomeostasis. Essentially, light energy is deliveredtopically in a controlled, safe manner and it isabsorbed by photo-absorbers (chromophores) thattransform it into chemical energy.[6]Positive effects of LLLT are: It accelerates tissue repair, increases the formation of granulation tissue, helps in wound contraction, decreases inflammation, modulation, and it also helps in pain reduction.[6–9] According to the literature, low-energy photoemissions given at a wavelength range of 600nm to 900nm accelerates cell proliferation and wound healing processes.[9] Its action is thought to: Stimulate respiratory chain components such as flavin and cytochromes which increase adenosine triphosphate (ATP) synthesis, thus enhancing the rate of mitoses and increasing fibroblast numbers, stimulate collagen and elastin production, leading to better reepithelialisation, stimulate microcirculation and dilatation of the capillaries and neovascularisation to increase tissue oxygenation, liberate mediator substances such as histamine, serotonin and bradykinin to influence macrophages, regenerate lymphatic vessels.

Numerous case reports and clinical trials with humans have shown impressive wound healing outcomes using LLLT. Further work with animals has also supported the use of LLLT to facilitate wound healing.[10,11] The exact mechanism by which LLLT facilitates wound healing is largely unknown. However, several theories may help explain the enhanced wound contraction observed here. In vitro studies have shown an increase in fibroblast proliferation after therapy.[11,12] suggesting that LLLT therapy may facilitate fibroplasia during the repair phase of tissue healing. Pourreau-Schneider et al,[4] who reported that laser irradiation transforms fibroblasts into myofibroblasts. Myofibroblasts are directly involved in granulation tissue contraction, and increased numbers could lead to facilitated wound contraction. A myofibroblast is a modified fibroblast with ultrastructural and functional properties of fibroblasts and muscle cells. Cytoplasmic fibrils of actomyosin allow for contraction of myofibroblasts, pulling on the borders of the wound and reducing the size during the repair phase of soft tissue healing.[13] LLLT may have caused release of tissue growth factors into circulation, which may have affected surrounding tissues or entire systems. Indirect healing could be a very beneficial effect of this modality in treating tissue damage of large size or at multiple locations. It might also suggest that deeper tissues could be affected by light therapy.

5. Conclusion

The LLLT is an effective treatment for enhancing wound contraction of partial-thickness abrasions. In this study we showed that LLLT can be used to facilitate wound healing in skin graft donor site.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Abergel RP, Meeker CA, Lam TS, Dwyer RM, Lesavoy MA, Uitto J. Control of connective tissue metabolism by lasers: recent developments and future prospects. *J Am Acad Dermatol*. 1984;11(6):1142–50.
2. Haas AF, Isseroff RR, Wheeland RG, Rood PA, Graves PJ. Low-energy helium-neon laser irradiation increases the motility of human keratinocytes. *J Invest Dermatol*. 1990;94(6):822–6.

3. Pierce GF, Mustoe TA, Lingelbach J, Masakowski VR, Griffin GL, Senior RM. Platelet-derived growth factor and transforming growth factor-beta enhance tissue repair activities by unique mechanisms. *Lasers Surg Med Suppl*. 1994;109(1):429–40.
4. Schneider NP, Soudry AA. Helium-neon laser treatment transforms fibroblasts into myofibroblasts. *Am J Pathol*. 1990;137(1):171–8.
5. Baxter. Therapeutic Lasers: Theory and Practice. Edinburgh, UK: Churchill Livingstone; 1994.
6. Allendorf JD, Bessler M, Huang J. Helium-neon laser irradiation at fluences of 1, 2, and 4 J/cm2 failed to accelerate wound healing as assessed by wound contracture rate and tensile strength. *Lasers Surg Med*. 1997;20(3):340–5.
7. Chromey PA. The efficacy of carbon dioxide laser surgery for adjunct ulcer therapy. *Clin Podiat Med Surg*. 1992;9(3):709–19.
8. Lundeberg T, Malm M. Low-power HeNe laser treatment of venous leg ulcers. *Ann Plastic Surg*. 1991;27(1):537–9.
9. Hunter J, Leonard L, Wilson R, Snider G, Dixon J. Effects of low energy laser on wound healing in a porcine model. *Lasers Surg Med*. 1984;3(4):285–90.
10. Dyson M, Young S. Effect of laser therapy on wound contraction and cellularity in mice. *Lasers Med Sci*. 1986;1(3):126–30.
11. Mester E, Nagi EJ. The effect of laser radiation on wound healing and collagen synthesis. *Studia Biophys*. 1973;35(2):227–30.
12. Boulton M, Marshall J. He-Ne laser stimulation of human fibroblast proliferation and attachment in vitro. *Lasers in Life Sci*. 1986;1:125–34.
13. Spector TD, Axford JS. An Introduction to General Pathology. Edinburgh, UK: Churchill Livingstone; 1999. p. 352.

Author biography

Jackson Nuli, International Visitor

Barath Kumar Singh P, Senior Resident

Ravi Kumar Chittoria, Professor & Registrar (Academic)

Cite this article: Nuli J, Singh P BK, Chittoria RK. Role of low-level laser therapy (LLLT) on skin graft donor site. *IP J Surg Allied Sci* 2022;4(3):106-108.