Original Article

Journal of Plastic Surgery and Transplantation
Volume 1 Number 1, January–June 2020

Role of Low Level Laser Therapy (LLLT) Inamputation Stump

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How to cite this article:

Neljo Thomas, Ravi Kumar Chittoria, Saurabh Gupta *et al*. RRole of Low Level laser Therapy (LLLT) Inamputation Stump. Journal of Plastic Surgery and Transplantation. 2020;1(1):19–21.

Abstract

Non healing wound is a common problem encountered by plastic surgeon. There various causes due to which the wound becomes non healing and fails to heal. However there is no well-established method that can acceleratethe wound healing rate. Various modalities are used to accelerate the rate of healing, like platelet rich plasma, local infiltration of insulin, irritant substances, laset therapy et al. This article highlights the role of low level laser therapy in management of amputation stump.

Keywords: LLLT; Amputation Stump.

Introduction

Adult wound healing comprises of three stages: the inflammatory phase, the proliferative phase, and the remodelling phase. These 3 stages have to occur in sequentially to result in healing of wound. Wound bed preparation is a new concept and can be summarized with the acronym T.I.M.E, T for tissue: non-viable or deficient. I for infection/ inflammation, M for moisture balance. E for epidermis which was changed later to E for edge. Chronic wounds are difficult to manage and forms an important part of plastic surgery practice. They often lack growth factors, are deficient in vascularity and granulation tissues and have to be supplemented with adjuncts to aid in wound healing. The wound bed preparation is an important part of wound healing in a chronic wound and includes supplementation of growth factors and facilitating vascular growth into the wound for a faster healing. The modality chosen here is low level laser therapy. It is said to facilitate wound healing by improving granulation tissue formation, collagen synthesis, neovascularization etc.

Materials and methods

This study was conducted in the department of Plastic Surgery at tertiary care center after getting the departmental ethical committee approval. Informed written consent was taken from the patient. The details of the patient in study are as follows: 37 year old female with no known co morbidities with h/o road traffic accident 4 months back and underwent right below knee amputation due to vascular injury and degloving injury of the left lower limb for which serial debridement was done in cardiothoracic and general surgery department. Now, the patient presented to plastic surgery department with extensive raw area over the left lower limb and non-healing ulcer over the right below knee amputation stump. (fig. 1)

After debridement, LLLT (fig. 2,3) was given to the wound bed in each session. Gallium Arsenide (GaAs) diode red laser of wavelength 650 nm, frequency 10 kHz and output power 100 m W was used as a source of LLLT. It is a continuous beam laser with an energy density of 4 J/cm^2. 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 dressing. Regular LLLT was given once every three days for a total of 6 session. It was also supplemented with various modalities like prolotherapy, autologous platelet rich plasma, insulin therapy

Results

The wound bed showed good granulation tissue (fig. 4). LLLT is found feasible as adjuvant modality of wound bed preparation.

Fig. 1: Wound over the amputation stump

Fig. 2: LLLT Machine

Fig. 3: LLLT given to the Amputation Stump

Fig. 4: Healing Wound Bed

Discussion

LASER can be abbreviated as "light amplification by stimulated emission of radiation". Low-level lasers has a power density at less than 500 mW/ cm 21.[2] It is defined as low level laser as the energy used is very much less than that is used for cutting, ablation therapy. Low-level laser therapy (LLLT) is used as an adjuvant to available therapy, especially in patients with acute and bloody ulcers.[3] LLLT is a form of phototherapy that uses electromagnetic radiation capable of generating energy to interact with living tissues. It produces photochemical and photophysical effects and does not produce heat, with the intention of reestablishing cell homeostasis. Essentially, light energy is delivered topically in a controlled manner and is absorbed by photo-absorbers (chromophores) that transform it into chemical energy.[4]

Positive effects include acceleration of tissue repair, improved formation of granulation tissue, accelerated wound contraction, decreased inflammation, modulation, and pain reduction.[5]

According to the literature, low-energy photo missions given at a wave length of 600 nm to 900 nm can accelerate cell proliferation and the wound

healing processes.[6] It is thought to: Stimulate respiratory chain components such asflavin and cytochromes which increase adenosinetri phosphate (ATP) synthesis,[7] thus increasing the rate of mitoses and increasing fibroblast numbers,[8-12] promote collagen and elastin production, leading to better re-epithelialisation,[13] Stimulates microcirculation and dilatation of the capillaries and neovascularisation to increase tissue oxygenation,[14] release mediator substances such as histamine, serotonin and bradykin in to influence macrophages, rejuvenate lymphatic vessels.

Limitations: The study was done on a single patient and needs large population based study to apply in practice.

References

1. Avci P, Gupta A, Sadasivam M, Vecchio D, Pam Z, Pam N, Hamblin MR. Low-level laser (light) therapy (LLLT) in skin: stimulating, healing, restoring. InSeminars in cutaneous medicine and surgery 2013 Mar (Vol. 32, No. 1, p. 41). NIH Public Access.
2. Lubart R, Wollman Y, Friedmann H, Rochkind S, Laulicht I. Effects of visible and near infrared lasers on cell cultures. J PhotochemPhotobiol B. 1992;12(3):305–310. [PubMed] [Google Scholar]
3. Wu W, Naim JO, Lanzafame RJ. The effect of laser irrafiation on the release of bFGF from 3T3 fibroblasts. PhotochemPhotobiol. 1994;59(2):167–170. [PubMed] [Google Scholar]
4. Vinck EM, Cagnie BJ, Cornelissen MJ, Declercq HA, Cambier DC. Increased fibroblast proliferation induced by light emitting diode and low power laser irradiation. Lasers Med Sci. 2003;18(2):95–99. [PubMed] [Google Scholar]
5. Frigo L, Fávero GM, Lima HJ, Maria DA, Bjordal JM, et al. Low-level laser irradiation (InGaAlP-660 nm) increases fibroblast cell proliferation and reduces cell death in a dose-dependent manner. Photomed Laser Surg. 2010;28(Suppl 1):S151–S156. [PubMed] [Google Scholar]
6. Basso FG, Oliveira CF, Kurachi C, Hebling J, Costa CA. Biostimulatory effect of low-level laser therapy on keratinocytes in vitro. Lasers Med Sci. 2013;28(2):367–374. [PubMed] [Google Scholar]
7. Szymanska J, Goralczyk K, Klawe JJ, Lukowicz M, Michalska M, et al. Phototherapy with low-level laser influences the proliferation of endothelial cells and vascular endothelial growth factor and transforming growth factor-beta secretion. J PhysiolPharmacol. 2013;64(3):387–391.
8. Moore P, Ridgway TD, Higbee RG, Howard EW, Lucroy MD. Effect of wavelength on low-intensity laser irradiation-stimulated cell proliferation in vitro. Lasers Surg Med. 2005;36(1):8–12.
9. Agaiby AD, Ghali LR, Wilson R, Dyson M. Laser modulation of angiogenic factor production by T-lymphocytes. Lasers Surg Med. 2000;26(4):357–363.
10. Stadler I, Evans R, Kolb B, Naim JO, Narayan V, et al. In vitro effects of low-level laser irradiation at 660 nm on peripheral blood lymphocytes. Lasers Surg Med. 2000;27(3):255–256.
11. 40. Saygun I, Nizam N, Ural AU, Serdar MA, Avcu F, et al. Low-level laser irradiation affects the release of basic fibroblast growth factor (bFGF), insulin-like growth factor-I (IGF-I), and receptor of IGF-I (IGFBP3) from osteoblasts. Photomed Laser Surg. 2012;30(3):149–154.
12. Esmaeelinejad M, Bayat M. Effect of low-level laser therapy on the release of interleukin-6 and basic fibroblast growth factor from cultured human skin fibroblasts in normal and high glucose mediums. J Cosmet Laser Ther. 2013;15(6):310–317.
13. de Sousa AP, Paraguassú GM, Silveira NT, de Souza J, Cangussú MC, et al. Laser and LED phototherapies on angiogenesis. Lasers Med Sci. 2013;28(3):981–987.
14. Chen CH, Tsai JL, Wang YH, Lee CL, Chen JK, et al. Low-level laser irradiation promotes cell proliferation and mRNA expression of type I collagen and decorin in porcine Achilles tendon fibroblasts in vitro. J Orthop Res. 2009;27(5):646–650.