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*Case Study*

# Role of Low-Level Laser Therapy as an Adjunct in the Management of Diabetic Ulcer

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## ABSTRACT

Diabetes mellitus (DM) is a chronic debilitating condition affecting people worldwide and diabetic foot ulcers are also a common problem. The treatment of diabetic ulcers requires a multimodal approach. Adjuvant low-level laser therapy (LLLT) may be useful in lesions with protracted healing course but the evidence is still limited. In this study, we share our experience regarding the use of low-level laser therapy as an adjuvant treatment modality in a patient with diabetic foot ulcer.

**Keywords**

Low-level laser therapy; Diabetic ulcer.

## INTRODUCTION

Diabetic foot ulcers (DFUs) cause morbidity and frequent visit to healthcare professionals and may lead to lower extremity amputation. A multimodality approach is recommended to address potential underlying problems. Proper clinical examination and shoe gear, gait, orthopaedic, neurologic, and vascular examination are also recommended. Appropriate offloading and continuing diabetes education are also an important aspect included in the treatment for all DFUs. Various treatment options are available. This article describes our experience regarding the use of low-level laser therapy (LLLT) as an adjunct in the treatment of diabetic ulcers.

## MATERIALS AND METHODS

This study was conducted in the plastic surgery department in a tertiary care center in the month of February-March 2020. Informed written consent was taken from the patient. Departmental ethics committee clearance was obtained. The study was a 70-year-old male with known case of hypertension, diabetes mellitus and dyslipidemia. The patient had a non-healing ulcer at the first web space of left foot for 3-months (Figure 1). Wound bed preparation was done by multiple surgical debridement and antibiotics were initiated according to culture sensitivity.

**Figure 1.** *Ulcer at the Time of Presentation*

As an adjunct treatment modality LLLT was applied over the ulcer (Figure 2) after debridement weekly twice for a period of 4-weeks. We used Gallium Arsenide (GaAs) diode red laser of wavelength 650 nm, frequency 10 kHz and output power 100 mW. It was a continuous beam laser with an energy density of 4 J/cm$^2$. The machine delivers laser in scanning mode (non-contact delivery) with a 60 cm distance between the laser source and wound. Wound was given laser therapy for duration of 125 seconds every time.

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**Figure 2.** *Low-Level Laser Therapy being Applied*

## RESULTS

Application of LLLT helped in achieving healthy granulation tissue over the wound bed, thus aiding in the process of wound healing in a chronic diabetic ulcer (Figure 3).

**Figure 3.** *Ulcer at the Time of Discharge*

## DISCUSSION

Diabetic foot ulcers are the most costly and devastating complication of diabetes mellitus which affects 15% diabetic patients in their lifetime.[1] Early effective management can reduce the severity of complications such as preventable amputations and reduce the mortality. More than 50% of non-traumatic lower-extremity amputations are related to diabetic foot ulcer infections and 85% of all lower-extremity amputations in patients with diabetes are preceded by an ulcer; up to 70% of diabetic patients with a DFU-related amputation die within 5-years of their amputation.[2]

The acronym LASER can be abbreviated as "*light amplification by stimulated emission of radiation*". Low-level lasers are defined by a power density at less than 500 mW/cm$^2$.[3,4] It is defined as low-level laser as the energy used is much less than that is used for cutting, ablation therapy. Low-level laser therapy (LLLT) has been used as an adjuvant to conventional therapy with promising results, especially in patients with acute and bloody ulcers.[5] LLLT is a form of phototherapy that employs electromagnetic radiation capable of generating enough energy to interact with living tissues. It produces photochemical and photophysical effects without generating heat, with the intention of re-establishing cell homeostasis. Essentially, light energy is delivered topically in a controlled, safe manner and it is absorbed by photo-absorbers (chromophores) that transform it into chemical energy.[6]

Positive effects include acceleration of tissue repair, increased formation of granulation tissue, wound contraction, inflammation, modulation, and pain reduction.[6]

According to the literature, low-energy photoemissions given at a wavelength range of 600 nm to 900 nm accelerates cell proliferation and wound healing processes.[7] Its action is thought to:

- Stimulate respiratory chain components such as flavin and cytochromes which increase adenosine triphosphate (ATP) synthesis,[8] thus enhancing the rate of mitoses and increasing fibroblast numbers.[8-13]
- Stimulate collagen and elastin production, leading to better re-epithelialisation.[14]
- Stimulate microcirculation and dilatation of the capillaries and neovascularisation to increase tissue oxygenation.[15]
- Liberate mediator substances such as histamine, serotonin and bradykinin to influence macrophages.
- Regenerate lymphatic vessels.

Laser therapy is painless, cost effective procedure which induces faster granulation, wound contraction and re-epithelialization, thus accelerates complete wound healing hence avoiding secondary procedures like split skin grafting in many cases. Control of infection is also better in patients whom low-level laser therapy was given.[16] In addition to reducing the lesion area and accelerating the healing process, laser therapy has the advantage of being easily administered. These benefits assist in promoting patient quality of life and minimizing possible complications.[17]

## CONCLUSION

In our study we found that LLLT was useful in promoting healthy granulation tissue and in expediting the process of wound healing in diabetic ulcer. The limitation of the study includes that it is a case report and a single centre study with no statistical analysis. Further randomised controlled studies are required to validate the efficacy of the LLLT in the treatment of diabetic ulcers.

## CONSENT

The authors have received written informed consent from the patient.

## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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