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Role of Low-Level Laser Therapy (LLLT) in Healing of Electric Burns

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Abstract

The objective of this case study is to evaluate the effectiveness of low-level laser therapy (LLLT) in treating scalp wounds caused by electric burns. A thorough examination of the scalp wound was conducted both before and after administering LLLT. The findings suggest that LLLT plays a beneficial role in the healing process of superficial ulcers. Specifically, the application of LLLT demonstrated promising results in facilitating the healing of raw areas on the scalp following electric burn injuries. LLLT emerges as a promising modality for managing electric burn wounds on the scalp. Through clinical observation and analysis, it becomes evident that LLLT contributes positively to the healing process of superficial ulcers. The utilization of LLLT exhibits notable effectiveness in promoting the recovery of raw areas resulting from electric burns on the scalp. This case report aims to assess the effectiveness of LLLT in managing scalp wounds caused by electric burns. Through a comprehensive clinical assessment conducted before and after the application of LLLT, it is evident that this therapeutic approach holds significant potential in fostering the healing of superficial ulcers. Notably, the use of LLLT demonstrates promising outcomes in addressing raw areas on the scalp subsequent to electric burn injuries.

Keywords: low-level laser therapy (LLLT), electric burn, scalp

INTRODUCTION

Addressing electric burn wounds presents a multifaceted challenge, necessitating interventions to improve the patient's overall condition and ensure effective wound management. Particularly when faced with superficial to deep ulcers resulting from electric burns, selecting appropriate methods for donor site wound care becomes crucial. Among the available options, low-level laser therapy (LLLT) emerges as a promising approach, believed to exert beneficial effects on connective tissue cells, specifically fibroblasts [1]. By influencing the function of these cells, LLLT is thought to expedite connective tissue repair processes and exhibit anti-inflammatory properties. This case report aims to evaluate the efficacy of LLLT in the context of managing electric burn wound healing. Given the complex nature of electric burn injuries and the challenges they present in terms of wound management, exploring novel therapeutic modalities such as LLLT becomes imperative [2]. By assessing the role of LLLT in this specific context, valuable insights can be gained into its potential as a viable treatment option for electric burn wounds (Figure 1). The utilization of LLLT in

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managing electric burn wounds represents a paradigm shift in wound care practices, offering a non-invasive and potentially effective therapeutic approach. By targeting key cellular mechanisms involved in wound healing, such as fibroblast function and inflammatory responses, LLLT holds promise in promoting accelerated wound closure and enhancing overall healing outcomes [3]. Through comprehensive evaluation and analysis, this case report seeks to shed light on the clinical utility of LLLT in the management of electric burn wounds, ultimately contributing to the advancement of evidence-based practices in wound care as seen in Figure 1 [4].

MATERIALS AND METHODS

The research was conducted at a tertiary care hospital located in south India. The participant, an 8-year-old boy without any concurrent medical conditions, presented with reported electric burns resulting in a persistent ulcer on the scalp region. Standard debridement and dressing procedures were administered by the plastic surgery department [5]. Treatment for the raw area on the scalp, as depicted in Figure 2, included collagen scaffold dressing, LLLT, autologous platelet-rich plasma (APRP), and negative pressure wound therapy with instillation and dwell time (CNPWT). LLLT was given through LLLT comb every day for 10 minutes for 1 week (Figure 3). Bates Jansen Wound Assessment Tool (BJWAT) score was used pre laser usage and post laser usage to correctly check improvement in the wound [6].

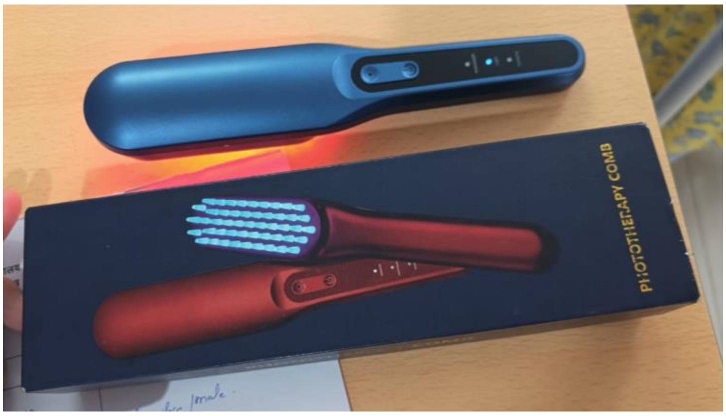

Figure 1. Low-level laser therapy (LLLT) comb.

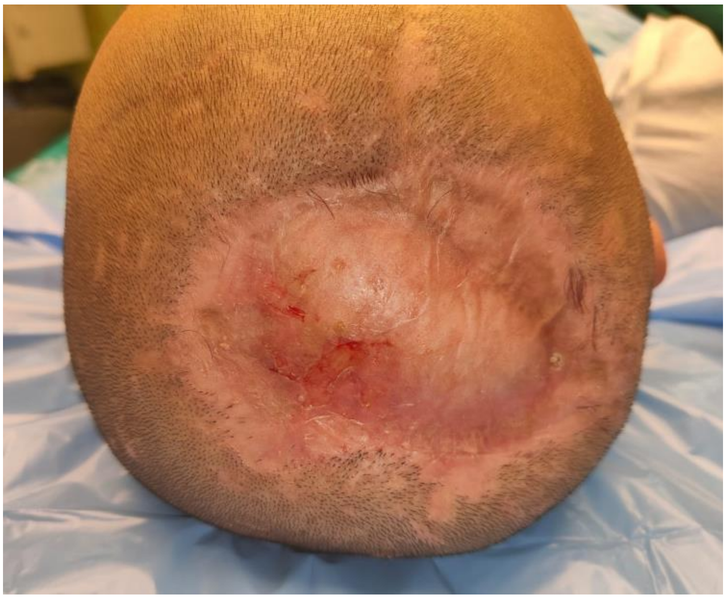

Figure 2. Skin graft donor site before low-level laser therapy (LLLT) (Bates Jansen Wound Assessment Tool [BJWAT] score–19).

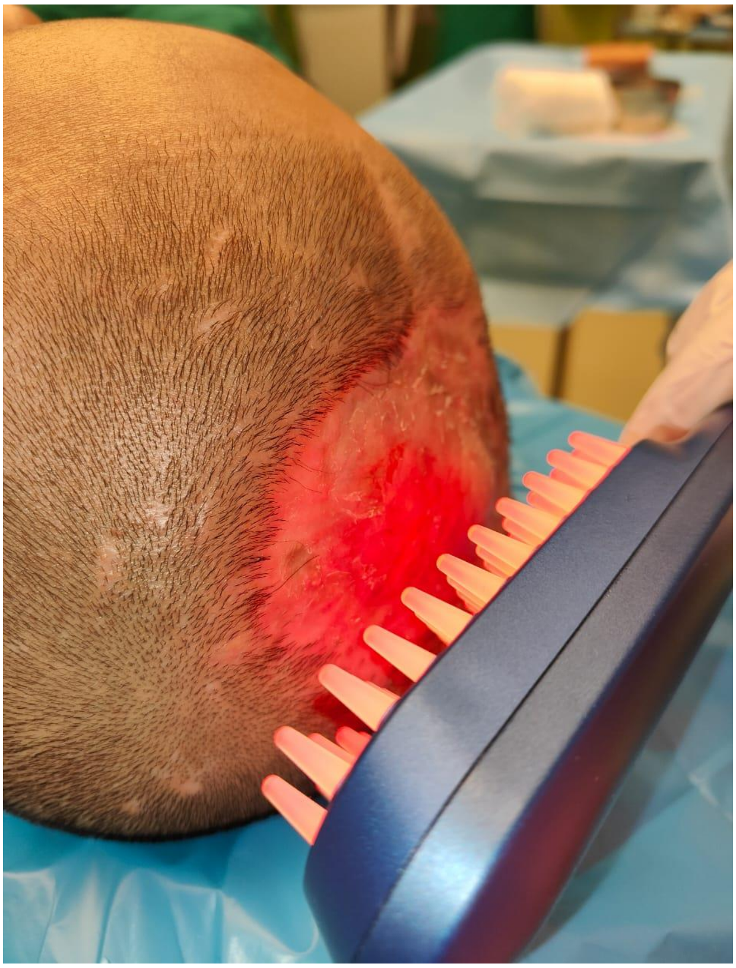

Figure 3. Low-level laser therapy (LLLT) applied over scalp raw area.

RESULTS

LLLT proved to be beneficial in facilitating the healing process of the wound and expediting wound closure in our patient. The application of LLLT resulted in significant improvements, as evidenced by changes observed in the BJWAT score [7]. Prior to the initiation of LLLT, the BJWAT score was recorded at 19, indicating the severity of the wound. However, following the implementation of LLLT, there was a notable decrease in the BJWAT score to 13, signifying a marked improvement in the wound condition. The utilization of LLLT yielded favorable outcomes in terms of wound healing progress and overall wound status. These improvements were quantitatively assessed using the BJWAT score, which serves as a reliable tool for evaluating various parameters associated with wound healing, including size, depth, and presence of necrotic tissue [8]. The significant reduction in the BJWAT score following LLLT administration indicates enhanced wound healing and a more favorable wound environment. Furthermore, the observed decrease in the BJWAT score highlights the efficacy of LLLT in promoting tissue regeneration and remodeling processes. By stimulating cellular metabolism, increasing collagen synthesis, and modulating inflammatory responses, LLLT contributes to accelerated wound closure and improved wound healing outcomes [9]. Additionally, the use of BJWAT allows for objective monitoring of wound progress, enabling healthcare providers to assess the effectiveness of interventions and tailor treatment approaches accordingly. In summary, the incorporation of LLLT into the management of the patient's wound led to noticeable improvements in wound healing and overall wound status. The quantifiable reduction in the BJWAT score underscores the efficacy of LLLT as a therapeutic modality for enhancing wound healing outcomes. This underscores the potential of LLLT as a valuable adjunctive treatment option for patients with various types of wounds, including those resulting from traumatic injuries such as electric burns as seen in Figure 4.

Figure 4. Scalp raw area healed after low-level laser therapy (LLLT) (Bates Jansen Wound Assessment Tool [BJWAT] score–13).

DISCUSSION

The term “LASER” stands for “light amplification by stimulated emission of radiation.” Low level lasers operate at a power density below 500 mW/cm². These lasers are categorized as “low level” because their energy output is significantly lower compared to lasers used for cutting or ablation therapy. LLLT is used as an adjuvant to available therapy, especially in patients with acute and bloody ulcers.

LLLT, a type of phototherapy, utilizes electromagnetic radiation to interact with living tissues, generating energy without producing heat. Its aim is to restore cell equilibrium through photochemical and photophysical effects [10]. Essentially, light energy is applied externally in a controlled manner and absorbed by chromophores, transforming it into chemical energy [11]. The beneficial effects of LLLT include hastening tissue repair, enhancing granulation tissue formation, accelerating wound contraction, reducing inflammation, modulating pain, and promoting cell proliferation and wound healing processes [12]. Studies suggest that low-energy photons with wavelengths between 600 nm and 900 nm can stimulate cellular activities such as ATP (adenosine triphosphate) synthesis by components of the respiratory chain like flavins and cytochromes [13]. This increase in ATP production boosts cell division and fibroblast numbers, promotes collagen and elastin synthesis for improved re-epithelialization, enhances microcirculation and capillary dilation, fosters neovascularization to enhance tissue oxygenation, and mediates the release of substances like histamine, serotonin, and bradykinin to influence macrophages and rejuvenate lymphatic vessels [14].

CONCLUSION

LLLT emerges as a valuable adjunctive therapy in enhancing wound healing within the raw areas of the scalp resulting from electric burns. Its effectiveness lies in its ability to expedite the repair of connective tissue, thereby promoting overall healing processes. When employed alongside other therapeutic interventions, LLLT demonstrates notable efficacy in addressing the complex challenges presented by electric burn injuries. The mechanism through which LLLT accelerates wound healing involves various biological processes. Firstly, it stimulates cellular metabolism within the affected tissues, leading to LLLT leads to elevated levels of ATP, which serves as the primary energy source for cells. This heightened metabolic state boosts the performance of fibroblasts, the key cells involved in producing collagen and essential components of the extracellular matrix necessary for tissue restoration. As a result, LLLT promotes the development of granulation tissue, which acts as a framework for the integration of new collagen fibers and aids in wound contraction. Moreover, LLLT has been shown to modulate inflammatory responses, thereby promoting a more controlled and efficient healing process. By reducing levels of pro-inflammatory cytokines and enhancing the activity of anti-inflammatory mediators, LLLT helps mitigate excessive inflammation, which can otherwise impede wound healing and lead to complications such as hypertrophic scarring. Furthermore, LLLT exhibits vasodilatory effects, improving microcirculation and oxygenation of the wound bed. The increased circulation facilitated by LLLT aids in transporting essential nutrients and immune cells to the injured area, thereby bolstering tissue repair mechanisms. Moreover, LLLT has been noted to trigger the secretion of growth factors like transforming growth factor-beta (TGF-β) and vascular endothelial growth factor (VEGF). These growth factors are instrumental in processes such as angiogenesis, collagen production, and tissue renewal. In conclusion, the integration of low-level laser therapy into the management of electric burn scalp wounds represents a promising approach to enhance wound healing outcomes. By accelerating connective tissue repair and modulating inflammatory responses, LLLT contributes to a more efficient and robust healing process, ultimately improving patient outcomes and reducing the risk of complications.

Conflicts of Interest

This study does not require any institutional approval.

DECLARATIONS

Authors' Contributions

All authors made contributions to the article

Availability of Data and Materials

Not applicable.

Financial Support and Sponsorship

None.

Consent for Publication

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