

# The Case Report on the Effectiveness of Infrared Light on Acid Burn Victim

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## Abstract

Burn injuries are common in Pakistan. However, most people are reluctant to have infrared treatment for their wounds. This study investigated the efficacy of infrared treatment on burn wounds. The procedure involved a burn victim who had sustained acid burns to the neck and face. Nectrotomy was done to remove dead tissue from the burn wound, and after treatment, Low-Level Light was used to reduce pain and enhance healing in the patient. Initial results showed mild hypertrophic scars, no stiffness. Post-operation therapy included physical training regimens and massage. The patient showed satisfactory results and felt less tightness in neck movements by the following treatment. The article concludes by showing that infrared light promoted repair and regrowth at a cellular level.

## Keywords

Infrared Therapy, Acid Burns, Photobiomodulation, Low Light Laser Therapy, Red Light

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## 1. Introduction

Every year, burns drive tens of thousands of individuals to the hospital's emergency unit and can seriously harm the skin. To a certain degree, burns take longer to heal and result in skin scarring, formation of neck contractures and may limit the Daily activity of life, if not treated properly. Appropriately intervention is, therefore, crucial to lessen the potential damage that a burn could cause. Full-thickness skin burns benefit from earlier excision and wound grafting, while partial burns must not need much intervention. Since the severity of the injury is concealed under the skin, choosing the right course of action can be challenging. To boost accuracy, imaging techniques such as forward-looking infrared (FLIR) look promising.

## 2. Low-Level Light Therapy in Burns Treatment

Clinical evaluation has a poor degree of accuracy when estimating burn severity. Infrared light is initially used to map the depth of a burn wound. Previous studies have found a link between the burn's lowest temperature and the final scar depth, but they only take a small portion of the burn into account [1]. Other studies have also established the effectiveness of photobiomodulation in cell re-growth and healing in burn wounds [2]. Studies were carried out on infrared therapy in dermatology and hair restoration, where the light was used to stimulate cell regeneration and hair growth [3]. Other studies have investigated how infrared light promotes skin microcirculation and healing while preventing scarring [4] in acid burns.

In this study, the patient was a burn victim that sustained acid burn Pseudo-Escher wound (**Figure 1**). However, before any rehabilitation, the patient underwent multiple surgical procedures for the removal of dead tissue to the affected areas. Therefore the duration of his stay at the Hospital for recovery was approximately 1 month period. As for the proceeding of the treatment goes, the patient was referred for rehabilitation for maintaining the range of motion and prevention of contracture formation. Patient underwent 10 minutes of infrared therapy per session, accompanied with 15 minutes of massage on the scared areas of the face and neck and 15 - 20 min session of stretches and exercise, four times a week during six months of period, resulting in less formation of hypertrophic scars and no stiffness. After the therapy was done, the patient could efficiently perform neck movements. There was less inflammation and stiffness, which we attributed to infrared therapy. Photobiomodulation has been used to reduce inflammation, improve wound healing (**Figure 2, Figure 3**), and relieve pain in diabetic patients [2]. The process refers to inducing reactions at the cellular level by exposing the cells to "low-level or near-infrared light" [3]. According to Erin Dodd *et al.* (2017), introducing this red light has therapeutic effects, such as reducing pro-inflammatory cytokines. This therapy reduces inflammation which



**Figure 1.** (Pre-operations) At E.R acid burn at the occipital, lateral side of the face, neck and shoulder.



**Figure 2.** (Post Operation) Recovery of reconstructive surgery of the skin by placing skin graft on the face area all the way to the ear socket and neck.



**Figure 3.** (Post-operation) affected areas of the left shoulder to the upper back was healed by dressing regularly.

would delay healing in wounds. The heating process promotes the repair of tissues hence enhancing healing. For many decades, infrared treatment has been employed in various settings. It is one of several cutting-edge treatments that aid individuals who are experiencing pain and injury. Many light wavelengths, around 780 nm, and 1000  $\mu\text{m}$ , are used in infrared therapy and focus on the body's wounded or inflamed areas.

Focusing on inflamed areas, we used infrared light on skin tissue since it can reach deep within the layers of the skin. Photo-biostimulation occurs when living flesh is subjected to light energy through the absorption of respiratory chain components. The advantage of infrared light is that it will not harm the skin, unlike ultraviolet light. In reality, infrared light promotes cell regeneration as well as blood circulation. The heat that individuals experience when subjected to the sun's rays is infrared light, and human bodies radiate it too. Acid burns result in facial disfigurement and scarring to the victims (**Figure 2**) [5]. In burn victims,

treatment using infrared light has shown lower loss of energy, lower infection rates, and shorter healing time [6].

However, it is not only the low infection rates and shorter healing time that make IR favorable. For example, infrared therapy has been utilized for decades to treat wounds due to its calming properties. Numerous studies have demonstrated that this kind of therapy speeds up the healing of wounds. According to research, infrared can enhance circulation in numerous human tissues and organs, including the skin. It can promote healthy sleep, guard against oxidative stress, and lessen inflammation and pain. Infrared's inflammation-reducing properties have led to its use in several treatment regimens, including the treatment of COVID-19 [7]. Red light, in this case, provides a non-invasive and affordable method to treat various inflammatory conditions. The authors demonstrate that the TLR-4-reliant pathway for inflammation response, which is thought to be responsible for the initiation of cytokine storms among COVID-19 patients, is significantly reduced due to subjection to two 10-min high-frequency bouts of infra-red light every day. The treatment, which happened over 48 hours, reduced inflammation at a cellular level. Besides reducing inflammation, IR therapy encourages tissue regeneration and wound healing, speeding the recovery of sores and slow-healing of wounds. People have used electricity and magnetism with a variety of outcomes. Transcutaneous electrical stimulation (TENS) was created in 1975 to alleviate chronic pain [8]. Infrared treatment was recently found to enhance wound healing, lessen arthritis pain, increase endorphin levels, and bio-activate neuromodulators.

### 3. Methods

The patient came for 1 scheduled hour of rehabilitation management four times in a week for six months after sustaining an acid burn on the left side of the face, neck (**Figure 1**) and the posterior shoulder as well as the back area (**Figure 4**) and was treated using infrared therapy, with massage on the face, neck and shoulder and stretching exercises on the neck. The burn was caused by acid,



**Figure 4.** (Pre-operation)At E.R, acid burn covering posterior shoulder, neck and back area.

which had been introduced and burned several sections of the skin on the neck face and shoulder. The patient underwent general cardiovascular and respiratory organs examination as well as functions of other vital organs. The specialists performed several surgical procedures when the patient arrived at the hospital. First, a debridement was performed on the wounds to avoid secondary necrosis and hasten the rejection of necrotic issues. Once it was done, the wound was covered with chemotherapeutic substances. During that time period range of motion was being performed after patient was discharged, his rehabilitation session included infrared light treatment, the lamps were placed between 45 and 75 centimeters from the patient's skin, and each session lasted between 10 - 15 minutes. The neck's range of motion was measured by Hand-Held Goniometer every week.

Apart from IR light treatment, we searched for articles using online databases such as EBSCO, Google Scholar, and ProQuest to be used in discussing the case. Comparing and evaluating polarized light's benefits on musculoskeletal, cutaneous, and burns produced results that are both on par with our case and treatment.

#### 4. Results

The treatment resulted in less hypertrophic scars and no stiffness. Post-operation (**Figure 2**, **Figure 3**) therapy included physical training regimens and massage. The patient showed satisfactory results and felt less stretched in neck movements following the treatment. On the assessment of neck ranges, the results were documented as follows: there was a 75-degree flexion, 80-degree extension, 45-degree lateral rotation on both sides, and 80 degrees on both sides.

#### 5. Discussion

The technologies of infrared radiation are being used in multiple treatments worldwide. The management of acid burns in patients remains a challenge in Pakistan. Even though infrared is used in treating burn victims, using red light on burn wounds is still met with resistance in the country since people are scared it might burn the victim. Several studies have shown the efficacy of infrared therapy on burn victims. Acid burns and related injuries continue to cause disability and death globally. For example, infrared light has been used to treat musculoskeletal burns and skin issues [9]. The patient showed improvements in healing with no hypertrophic scars. Infrared therapy aids healing in the skin by preventing inflammation.

Indeed, IR therapy prevents inflammation since it works on acid burns at a cellular level. In biological systems, the photoreceptor or molecular chromophores absorb photons from the infrared "using electron absorption bands" in the cells [10]. Accordingly, scattering and absorption of infrared light depend on its wavelength, determining its absorption, as well as chromosomes of the tissue. For instance, melanin and hemoglobin have higher absorption rates with shorter wavelengths than 600 nm. The patient showed cell regeneration through infra-

red therapy in red and near-infrared lighting. The mechanism of light absorption depended on visible monochromatic as well as NIR radiation of the cell respiratory chain (4).

According to Tsagkaris *et al.* (2022), infrared works at a molecular level through “tissues, body fluids, and the molecules that circulate in them” (335) [11]. Thus the effect of this therapy depends on the tissue’s composition as well as the molecules found within the body fluids (ibid). When the cells are subjected to heat, IR interacts with molecules to alter cell membranes through increasing intracellular  $\text{Ca}^{2+}$  levels [11]. Consequently, this permeability and alteration promotes growth, thus promoting cellular repair in acid burns. Thus, working at a molecular level, this therapy suits acid burn victims, particularly in Pakistan.

## 6. Strength of the Study

As far as we know, this is one of Pakistan’s first studies on the infrared treatment of acid burn victims. The study period was sufficient (6 months) to gain enough data from the patient and was integrated with an available scholarship for the conclusions. The outcomes of this study present a new avenue and perspective on the treatment of acid burns since IR is an effective therapy for acid burns.

## 7. Limitations of the Study

The study’s main limitation is that it has no provision for counseling burn victims as they go through lots of depression, motivating them for the treatment, and working on their self-esteem plus the lack of awareness among society about the rehabilitation process and lack of resources. Lack of funding creates difficulty in the treatments. Given societal attitudes about red lights in the country, such study findings might take a long time to be adopted. In addition, the study relies on data from a single patient and thus does not offer comparative or controls. Future studies would therefore involve a high number of patients that present different variables.

## 8. Conclusion

Although many people are still skeptical about IR therapy in Pakistan, research shows it to be an effective therapy for acid burn treatment. This treatment promotes repair at a cellular level, thus preventing scarring. The light helps restructure cell membranes, thus helping circulate molecules within tissue fluids. Healing following this therapy also resulted in less stiffness in the patient. The therapy helps in reducing inflammation, which aids in rapid healing in patients. Since acid burns are hard to heal and can lead to much scarring, regimens such as infrared are recommended for burn patients. Using this regimen led to less scarring in the patient and easy movement following healing. Given the effectiveness of the therapy, further research is necessary, especially in promoting a change of attitudes toward such treatments.

## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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