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Research Article

Comparative Study: Topical Application of Zinc Oxide and Low-Level Laser Therapy in Subcutaneous Wound Repair of Rats

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Abstract

Objective of the Study: To evaluate the Healing effects with topical application of zinc oxide and Low laser therapy in subcutaneous wound of rats.

Study Design: Experimental study.

Place and Duration of the Study: The study was done from March 2018 to November 2018 at Isra Institute of rehabilitation Sciences, Isra University Karachi Campus.

Materials and Methods: After taken an ethical consideration of concerned institute, total 27 numbers of male rats were selected on the basis of randomized sampling. Total numbers of male albino rats with a weight between 150 to 250 gms were equally divided into three groups based on the topical application of therapeutic agents. Group A (Control Group) received normal saline topically once daily. Group B was given a topical application of 20% Zinc oxide once daily for 14 days. Group C was subjected to Low-level laser therapy 4 j/cm2 once daily for 30 seconds. The wound was created on the dorsal surface of rats 2 x 2 cm2 after giving anesthesia with ethanol, and the size of the wound measured with the help of normal scale. For assessment, the photograph of the wound was taken by a DSLR camera. Data were analyzed by applying One-way ANOVA to evaluate the differences between the Mean of wound size among the different groups. P =0.05 took the level of significance.

Results: Low-level Laser Therapy showed rapid healing effects as compared to zinc oxide with significant anti-inflammatory response.

Conclusion: Low-level Laser Therapy evidenced the rapid healing effects on different days of sampling as compared to other therapeutic groups.

Keywords: *Wound; Zinc Oxide; Low-Level-Laser*

Introduction

The skin comprises two tissue covers: a keratinized sheet of the epidermis and a basal layer of dense irregular connective tissue that provides support and nourishment [1]. Skin is the chief structure of our body, helping as the major portion of forming the shield against

external antigens [2,3]. The auto repairing function treats the skin as a special structure with unusual biological properties and composition [4]. The wound will fill with granulation and epithelialization, proceed through the maturation phase, and heal from the "bottom-up" [5]. Healing is a multifaceted process, happens in the production of scar tissue. The traditional model of healing shares several vibrant progressive stages, such as (1) Homeostasis, (2) inflammation, (3) proliferation and (4) remodeling. Homeostasis starts immediately after the wound formation. The proliferative phase begins once the wound is covered by re-epithelium, which will migrate to the wound's central region to cover the wound defect [6]. The abbreviation LASER has its beginning in the English language, abbreviating "light amplification by stimulated radiation emission." The word laser is established by usage and defines a source of monochromatic, intense, coherent, and collimated light whose radiation emission is done by stimulating the external field. The use of lasers is varied and growing in applications such as industry, engineering, and in medicine for the removal, cutting and coagulating of tissues. While the low-power ones are more commonly applied in tissue repair processes, such as muscle, joint, nerve, bone, and skin injuries [7]. Low-level laser therapy (LLLT) increases to the use of red-beam or near-infrared lasers with a wave-length 600 and 1000nm, power from 5 - 500 million watts. Lasers that are used in surgical procedures utilized 300 watts of power. Low-level laser therapy has shown improved scar formation and overall cosmetic appearance [8]. More than 300 enzymes are dependent on zinc for matrix metalloproteinase; (MMPs) and DNA and RNA polymerase. Zinc members belong to a huge group of zinc-containing proteins [9]. The essential part is related to its biological composition regarding its action in repairing the defected skin tissue either in normal or zinc-deficient persons [10]. The topical administration of zinc appears to be superior to oral therapy due to its action in reducing superinfections and necrotic material via enhanced local defense systems and collagen lytic activity. The sustained release of zinc ions stimulates the epithelialization of wounds. It helps the patient treatment with a good option that helps minimize the duration, patient compliance and beneficial results.

Materials and Methods

An experimental study was designed at Isra Institute of rehabilitation Sciences, Isra University Karachi Campus. The study was done from March 2018 to November 2018. After institutional ethical consideration, a total of 27 albino rats were taken through a randomized sampling technique. Total numbers of male albino rats with a weight between 150 to 250 gms were equally divided into three groups based on the topical application of therapeutic agents. Group A (Control Group) received normal saline topically once daily. Group B was given a topical application of 20% Zinc oxide once daily for 14 days. Group C was subjected to Low-level laser therapy 4 j/cm^2 once daily for 30 seconds. The wound was created on the dorsal surface of rats 2 x 2 cm^2 after giving anesthesia with ethanol, and the size of the wound measured with the help of normal scale. After creating a wound, the animals were kept in separate cages. Animals were fed normally by the marinating day and light cycle. The wound was measured on days 0, 3, 7, and 14 to evaluate the healing rate among the different groups. For assessment, the photograph of the wound was taken by a DSLR camera. Data were analyzed by applying One-way ANOVA to evaluate the differences between the Mean of wound size among the different groups. P = 0.05 took the level of significance.

Results

Figure 1 shows the size of the wound among the different groups on separate days of sampling through photographs.

Figure 2 shows the graphical presentation of Mean wound size among the different groups on separate days of sampling.

Table 1 shows level of significance among the different groups according to days of sampling.

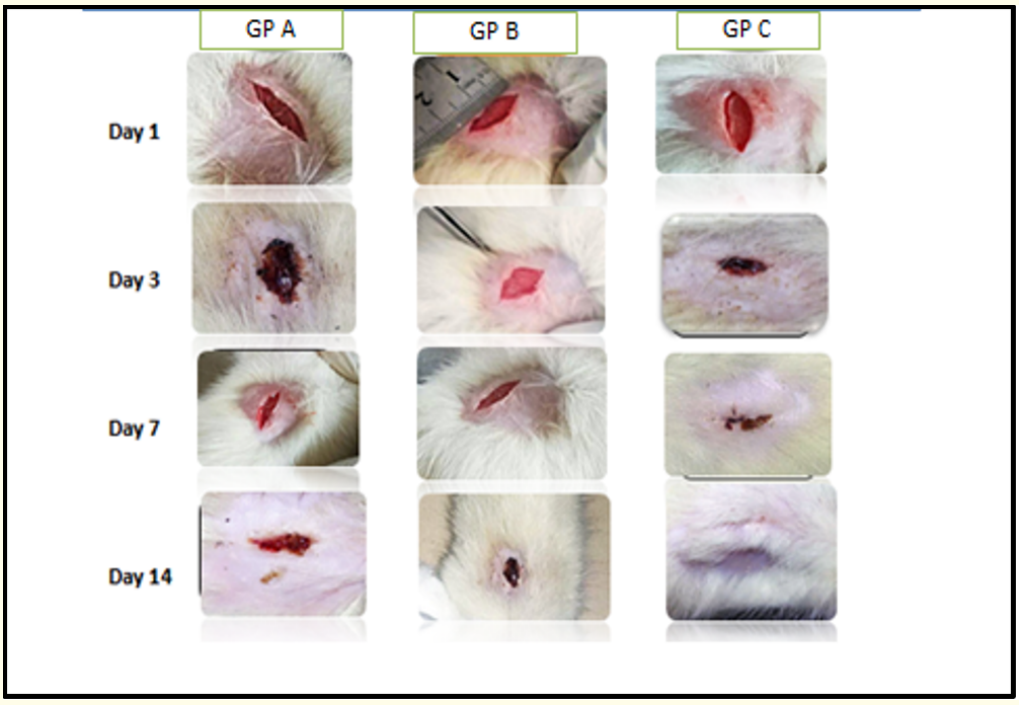

Figure 1: *Shows the size of the wound among the different groups on separate days of sampling through photographs.*

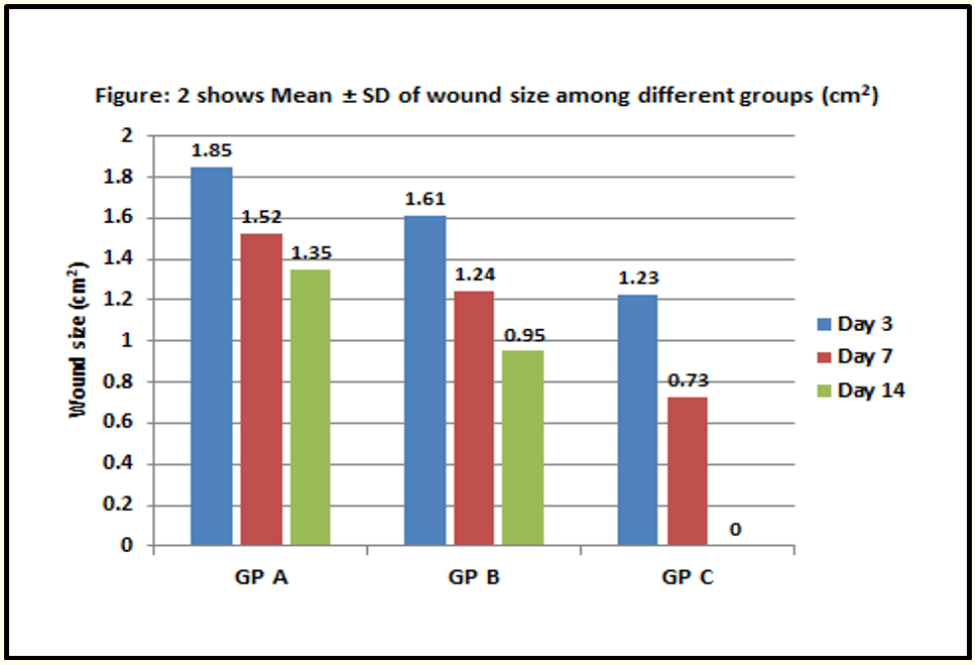

Figure 2: *Shows mean ± SD of wound size among different groups (cm²).*

Groups	Day 3	Day 7	Day 14
Group C vs A	< 0.001	< 0.001	< 0.001
Group C vs B	< 0.001	< 0.001	< 0.001

Table 1: *Show the (P value) the differences between the wound sizes among different groups.*

Discussion

According to the results of a study conducted by de Medeiros., *et al*. (2017), the use of Low-Level Laser Therapy over the skin and its surrounding tissue showed significantly increased skin and significantly increased scar tissue recovery stimulated by increased vascular perfusion and through induction of anti-inflammatory activities. However, low-intensity laser application can potentiate vascular perfusion; the same can be seen in our study that showed the fastest healing pattern was by applying low laser therapy. Similar results were found in the present study that low-level laser therapy can potentiate the fastest repair of wound [11]. As evidence, the results of Ahmed., *et al*. (2018) showed that the low-energy laser application, along with Quercetin, showed significant bio stimulating effects on epidermal wounds in rats. It minimizes the time duration of the inflammatory phase and boosts the cell proliferation, and within a minimal period, the maturation stage had begun. Same as in the present study, the early decreased size of wound in the group of low intensity of laser showed its efficient part to minimize the period during inflammation that results in the early phase of granulation had begun. A similar finding was observed in the present study, the fastest availability of fibroblast at the site of the wound that initiates the process of granulation and enhances the rate of healing [12]. One of the study results shows the significant effects of diode laser with the dose of 5 J/cm^2 with different power used to treat the wound, the groups of animals with steroid and non-steroid treatment, and the topical application of laser. The fastest wound repair was found in the non-steroid treated group and laser application, while the steroid-treated group with laser application showed no significant effects in wound repair. The same results were found in the recent study [13]. Histological assessment of wound repair was assessed in animal-based study after application of low-level laser therapy; the results show on comparison with the group without laser irradiation, the laser therapy accelerates the healing process with reduced duration of inflammatory phase and in turn stimulate the granulation process and fastens the rate of healing. The following effects were found in the present study that low-level laser therapy reduces the inflammatory phase and accelerates healing phases [14]. Zinc oxide topical application showed a beneficial role in the healing process in comparison with platelet-rich plasma. Both therapeutic groups significantly accelerated the healing effects, while in the recent study, the results showed laser-treated group evidence a significant role in comparison with zinc oxide [15,16]. Under the study results that showed a significant role of zinc oxide in wound repair, either it covers different types of wounds. The micronutrients are the essential components of zinc oxide, and these accelerate the potential environment for healing. In the present study, laser therapy showed significant results compared to zinc oxide [17,18].

Conclusion

Both therapeutic groups showed beneficial results when it came to wound healing. However, Low-Level Laser Therapy showed much more profound results than Zinc Oxide, indicating it to be a better option in treating wounds. Low-Level Laser Therapy inhibited inflammatory activity, increased vascular proliferation, and increased granulation tissue formation, which resulted in a favorable and much better healing process. More studies can be done to compare how Low-Level Laser Therapy is effective compared to other therapeutic options done in wound healing.

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