**Evaluation the Effects of Low Level laser Therapy on the Healing Process after Skin Graft Surgery in Burned patients (A randomized clinical trial)**

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**Abstract:**

**Background:** Skin graft is standard therapeutic technique in patients with deep ulcers but as every surgical procedure has complications. Although several modern dressings are available to enhance comfort of donor site, using techniques that accelerate wound healing may enhance patient’s satisfaction.

Low Level Laser Therapy (LLLT) has been used in several medical fields, especially for wound healing but for treating large ulcers, it may last several months to heal completely.

**Materials and Methods:** The protocols and informed consent were reviewed according to Medical Ethics Board of Shahid Beheshti University of Medical Sciences (IR.SBMU.REC.1394.363) and Iranian Registry of Clinical Trials (IRCT2016020226069N2). Nine patients with bilateral similar grade 3 burn ulcer in both hands or both feet, candidate for Split Thickness Skin Graft (STSG) were selected. One side was selected for laser irradiation and the other side as control, randomly. Laser area was irradiated by red, 655 nm laser light, 150 mW, 2 J/Cm2 for the bed of the ulcer and infra red 808 nm laser light, 200 mW for the margins, every day for 7 days.

**Results:** The rate of wound dehiscence after skin graft surgery was significantly lower in laser treated group in comparison to control group which received only classic dressing (P=0.019).

**Discussion:** In the present study for the first time we evaluate the effects of LLLT on the healing process of skin grafted area in burn patients. The results showed LLLT is a safe effective method which improves graft survival and wound healing process and decreases the rate of wound dehiscence in patients with deep burn ulcer.

**Key Words:** Low Level laser Therapy, Skin transplantation, Wound Healing, Regenerative medicine, Wound dehiscence.

**Introduction:**

One of the principal tools for covering skin defects in deep burn ulcers is Split-Thickness skin graft (STSG). Successful graft transplantation needs 3 phases: 1- Capillary revascularization, 2- Lymphatic revascularization, 3- reinnervation. Failure in each step may result in graft failure ([1](#_ENREF_1)). Using therapeutic methods for improving these steps may increase success in skin grafting and decrease the rate of repeated surgery ([2](#_ENREF_2)).

Low level laser Therapy (LLLT) as an effective wound healing method may be affect on these steps and accelerate healing. Several reviews and meta-analysis introduce this technique as a safe and effective therapeutic modality ([3-5](#_ENREF_3)). It seems that laser therapy induces neovascularization and increases tissue perfusion ([4](#_ENREF_4), [6](#_ENREF_6)).

Clinical studies report the significant effects of LLLT in the healing of different kind of ulcers including venous, pressure and diabetic foot ulcers. The efficacy of this method in burn ulcers is studied only on animals ([7-10](#_ENREF_7)). The only report of using LLLT in burn patients is our previous study, Using LLLT along with skin graft surgery in grade 3 burn of diabetic ulcer ([11](#_ENREF_11)).

In the present study for the first time we evaluated the effect of LLLT on the healing of split-thickness skin graft in patients with grade 3 burn ulcer as a randomized clinical trial.

**Materials and Methods:**

The study was conducted in Motahari specialized burn hospital. The protocols and informed consent were reviewed according to the Iranian Registry of Clinical Trials (IRCT2016020226069N2). 9 patients with bilateral full thickness burn on both hands or both feet were selected for the study. Early excision and grafting was done for all patients within 3-4 days of admission. When the patients were resuscitated and became stable, they were prepared for STSG. To harvested donor sites, electric dermatome (Humaca Instruments, Poland) was set at 0.4 mm. One side (one hand or one foot) was selected as laser group (A) and one as control (B). Photography was done using iphone 5s camera from both sides. After excision of burned skin, only side A was laser irradiated and STSG was done for both sides. Similar dressing (Vaseline gauze) was done for both sides. After 3 days, when dressing was changed routinely, laser irradiation was done for side A and photography was done. Laser irradiation was continued every day for 7 days and again photography was done. The situation for all photographs was the same and a ruler within the photograph was used for calibration. Wound surface area was evaluated by Pictzar software.

**Laser irradiation:**

Portable Laser Probe (PLP), 650nm; 150mW, radiation area: 0.25 cm2, power density: 0.6 W/cm2, contact, continuous mode, 2 J/Cm2, (Canadian Optic Laser Center, COL laser, Canada) was used for irradiation to the bed of the ulcers and portable 3L Therapy probe, for irradiation the margins. This is a suggested protocol for wound treatment in most studies ([12-14](#_ENREF_12)).

Sterile transparent cover was used for contact laser irradiation. Output laser power after passing through the cover was calculated using dosimeter.



Figure1: Consort diagram



**A2**

**A1**



**B2**

**B1**

Figure 2: A1, A2: Skin graft for bilateral grade 3 burn ulcer.

 B1: After 10 session of LLLT. B2: Control side.

**Results:**

Nine patients were recruited for the study (Age (mean ± SD): 40.11 ± 9.07 years, Burn surface percentage (mean ± SD): 34.80 ±18.30). The mean of burn ulcers before and after treatment and in control and laser groups were compared by ANOVA test using IBM-SPSS software version 21.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | age | Burn surface | Control pre treatmentUlcer surface/Cm2 | Control post treatment Ulcer surface/Cm2 | Laser pre treatment | laser post treatment |
| 1 | 40 | 45% | 83.477 | 18.343 | 70.564 | 2.993 |
| 2 | 53 | 10% | 70.543 | 8.718 | 81.857 | 0 |
| 3 | 41 | 40% | 86.337 | 14.594 | 64.286 | 3.031 |
| 4 | 50 | 11% | 74.438 | 0 | 124.910 | 0 |
| 5 | 35 | 50% | 124.523 | 14.527 | 68.256 | 0 |
| 6 | 30 | 55% | 126.553 | 4.457 | 130.352 | 3.1 |
| 7 | 32 | 45% | 93.175 | 81.0 | 167.105 | 14.833 |
| 8 | 30 | 45% | 76.893 | 14.414 | 99.165 | 4.684 |
| 9 | 50 | 12% | 30.169 | 6.595 | 49.396 | 0 |

Table 1: Patients’ parameters of nine participants

|  |  |  |  |
| --- | --- | --- | --- |
|  | Laser group | Control group | P-value |
| Before  | 95.10± 38.52 | 85.12± 29.05 | 0.931 |
| After  | 3.18± 4.72 | 18.07± 24.31 | 0.019 |

Table2: mean ± SD (cm2) of ulcer surfaces in two study groups before and after treatment.

**Discussion**

In the present study, for the first time, we evaluate the effects of LLLT on the healing process after skin graft surgery in patients with deep burn ulcers. Local irradiation of red and infra red laser light reduced the rate of dehiscence of grafted area significantly (P=0.019).

In a similar study we used LLLT along with skin graft surgery in diabetic patients with grade 3 burn ulcer who were candidate for amputation. The results showed significant effect of LLLT on the prognosis of surgery and all patients who were candidate for amputation, healed completely ([11](#_ENREF_11)). Our previous finding showed the significant effects of laser therapy on growth factors involved in wound healing including fibroblast growth factor (FGF) ([15](#_ENREF_15)) on wound healing process and neuropathy the of diabetic patients ([12](#_ENREF_12), [16](#_ENREF_16)), pressure ulcer ([17](#_ENREF_17)), after skin graft surgery in diabetic patients ([11](#_ENREF_11)) and post cesarean surgery ([18](#_ENREF_18)).

Several in-vitro and in-vivo studies demonstrate that laser therapy accelerates wound healing by enhancing epithelialization, fibroblasts activity, revascularization, increasing the perfusion and improving the tensile strength of scars ([10](#_ENREF_10), [19-21](#_ENREF_19)). In a review by Schindl et al, they reported laser therapy as a valuable adjuvant treatment in wound healing ([4](#_ENREF_4)). In another review by Chukuka et al. they mentioned LLLT as a highly effective treatment for accelerating tissue repair and pain management ([22](#_ENREF_22)). Although LLLT have been used successfully for treatment of different kinds of ulcers including post surgery ([18](#_ENREF_18)), diabetic ([4](#_ENREF_4), [12](#_ENREF_12)) and pressure ulcer ([23](#_ENREF_23)), the efficacy of this technique on burn ulcers is studied only on animal models. Bayat et al. reported that LLLT decreased the rate of infection with Staphylococcus aureous and epidermis in deep burn of rats ([8](#_ENREF_8)).Mester et al concluded that laser therapy accelerate epithelial formation in burned mice ([24](#_ENREF_24)). Ezzati et al reported that LLLT improve healing of third degree burn ulcer in rats ([9](#_ENREF_9)). Dantas et al suggested that using Low level laser and Sodium alginate/chitosan film accelerate neovascularization epithelialization, and collagen formation of burn ulcer in mice ([7](#_ENREF_7)).

Several techniques are accompanied by STSG for improving the surgery prognosis. Scherer et al used vacuum assisted closure device for improving graft survival. They reported that this technique is a safe and effective method for securing STSG ([2](#_ENREF_2)) but this technique is an expensive therapy in compression with LLLT. Modern dressings including Alginate dressing are also used to accelerate wound healing. Steenfos et al studied the efficacy of these dressing after STSG in a randomized controlled study. They reported that although this dressing increased initial blood absorption and faster homeostasis, but they did not find significant effect on epithelialisation, in comparison with conventional dressing ([25](#_ENREF_25)).

**Conclusion:**

In the present study, for the first time in a randomized clinical trial, we used LLLT for improving the prognosis of skin graft surgery and prevention of dehiscence in patients with grade 3 burn ulcer. Our results showed that using LLLT significantly decrease the rate of dehiscence in these patients.

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**Conflict of interests:** None

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