

# Using the Dual Wavelength Low Level Laser Therapy on Split Thickness Skin Grafts in the Management of Third Degree Burns Versus the Conventional Tie-Over Method Without Laser Application, A Comparative Study

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## ABSTRACT

**Aim:** The golden standard treatment for patients with full thickness burn is split-thickness skin grafting (STSG). Dual wavelength low level laser therapy (LLLT) after grafting increases fibroblast proliferation, collagen synthesis, wound contraction and promotes wound healing.

**Methods:** The study was conducted at Cairo university hospitals (Kasr El-Ainy Burn Unit; KABU) over a period of six months from 1/1/2018 to 30/6/2018. 30 Patients with 3<sup>rd</sup> degree burn grafted after early excision were divided into two equal groups (study and control group) randomly. The study group was treated by low level laser over the graft while the control group was treated traditionally by tie-over dressings. The healed surface areas were measured and results were analyzed. The person who analyzed the results was blinded.

**Results:** The mean healed surface area of the laser group was higher than that of the control group.

**Conclusion:** Dual wavelength low level laser therapy is safe, effective and cheap technique that improves graft survival, wound healing and prevention of dehiscence in patients with full thickness burn.

**Keywords:** Burns, laser, tie-over, split-thickness, skin, graft.

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## INTRODUCTION

Early tangential excision of the burnt skin and grafting became the standard of care in the majority of burn centers all over the world<sup>1</sup>. The postoperative care of the grafted skin is very essential to achieve graft success. All phases of graft take including plasma imbibitions, revascularization and maturation depend upon this period. Close contact between the grafted skin and the recipient bed is important for vessels to cross the gap, to decrease graft movement and to prevent fluid accumulation. This could be accomplished by the tie-over dressings used in the conventional methods of care. However, recompression and fixation once sealing off occurs are difficult<sup>2</sup>. Low level laser therapy (LLLT) is an accelerating wound healing technique that promotes neovascularization and tissue perfusion<sup>3</sup>. The exact mechanism of LLLT in tissue repair is not clearly understood but there are several studies that described multiple molecular mechanisms by which low level lasers promotes wound healing, these includes: formation of reactive oxygen species<sup>4</sup>, ATPases activation<sup>5</sup>, protein synthesis, increased mRNA and cellular proliferation<sup>6,7</sup> accentuated inflammatory phase, collagen synthesis, increased granulation tissue formation and fibroblast proliferation. In this technique, infrared and/or red low level laser with less than 500mW power density is used to promote wound healing<sup>8</sup>. Meta-analysis and systematic reviews demonstrate that this method is a safe and highly effective therapeutic technique for wound repair<sup>3,9</sup>.

The aim of this work is to introduce a new combined therapy for full thickness burn wounds adding low level laser therapy to split thickness graft by comparing the results of the graft take with those of the conventional method.

## MATERIALS AND METHODS

The study was conducted at Cairo university hospitals (Kasr El-Ainy Burn Unit; KABU) over a period of six months from 1/1/2018 to 30/6/2018. Thirty patients with third degree (full thickness) burn in upper or lower extremities were selected for the study. Early excision and split thickness skin grafting were done for all patients within 2–4 days after admission after stabilization of their general conditions. Grafts were harvested using electric dermatome (Zimmer Biomet, UK) set at 0.4 mm. Patients with bleeding tendency, peripheral gangrene, renal failure, pregnancy, epilepsy or photosensitivity were excluded. Patients were divided into two equal groups (study and control group) randomly, numbers were given to patients and then odd numbers were enrolled in the study group and even numbers were enrolled in the control group. Photographs were taken from a 30 cm distance. The grafted burned surface areas were assessed by medical photographic records and J image software through measuring length and width. Study group was irradiated every day for 7 days with 632.8 nm low level red laser (Sun Medisys, India) through contact portable probe, 150mW, 2J/cm<sup>2</sup>, power density 0.6 W/cm<sup>2</sup>, continuous mode and radiation area 0.25 cm<sup>2</sup> at the bed of wound. 810 nm low level infrared laser, 200mW; spot size 1cm<sup>2</sup>; power density 0.2W/cm<sup>2</sup>, continuous, 6 J/Cm<sup>2</sup> for the margins of the wound. This is a suggested protocol for wound treatment in most studies<sup>10,11,12</sup>. Non-adherent dressing and paraffin gauze over the graft were placed on after each session. Control group was treated by the traditional method with cotton bolster and tie-over dressings for 7 days. Again, after 7 days, photographs were taken from the same distance and the healed surface areas were measured by the

same software. Patients with any wound complications such as infection etc. were excluded from the study to avoid any factors that may affect the results. The person who analyzed the results was blinded.

**Outcome measures:** The primary outcome measure was the healed surface area.

**Ethics:** The procedures followed were in accordance with ethical standards of the latest (2008) version of Helsinki Declaration of 1975. The study was approved by Ethical Committee of faculty of physical therapy , Cairo University. Clear instructions were given to all patients and they were asked to sign a detailed informed consent to be enrolled in the study.

**Statistics:** The data were analyzed using An independent samples t-test conducted by PSS v22, to compare between the control group and the laser therapy

group in the healed burn surface area, *P* value of 0.05 or less was considered for statistical significance.

**RESULTS**

The mean healed surface area (cm<sup>2</sup>) of the laser group was higher than that of the control group.

Table 1 shows mean and standard deviation of control group and laser therapy while table 2 shows the independent sample t test result. There was significant difference in the healed burn surface area between the control group (Mean= 34.038, Standard deviation=5.988) and laser group (Mean=40.853, Standard deviation=10.083); *t* (28) = 2.251; *p*=0.032. The results are summarized in figures: 1 and 2

Table 1: Mean and standard deviation of control group and laser therapy

|  | Treatment type | N  | Mean   | Std. Deviation | Std. Error Mean |
|--|----------------|----|--------|----------------|-----------------|
| Healed surface area (cm <sup>2</sup> ) | Control        | 15 | 34.038 | 5.988          | 1.546           |
|  | Laser          | 15 | 40.853 | 10.083         | 2.603           |

Table 2: Dependent sample t test result

|  | t     | Df | Sig. (2-tailed) | Mean Difference |
|--|-------|----|-----------------|-----------------|
| Healed surface area (cm <sup>2</sup> ) | 2.251 | 28 | .032            | 6.815           |

Figure 1: Error bar chart representing healed surface area in control and laser groups.

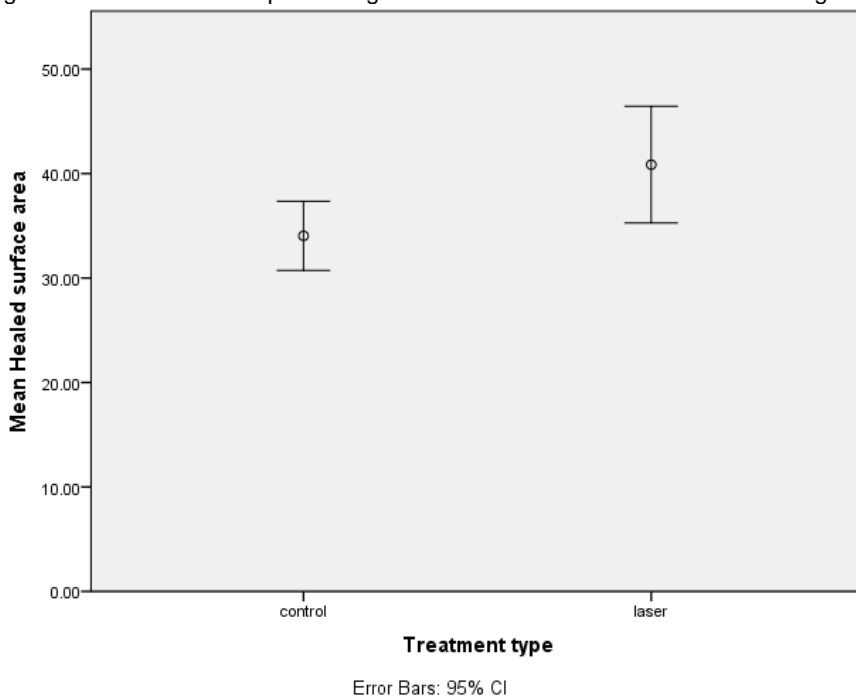
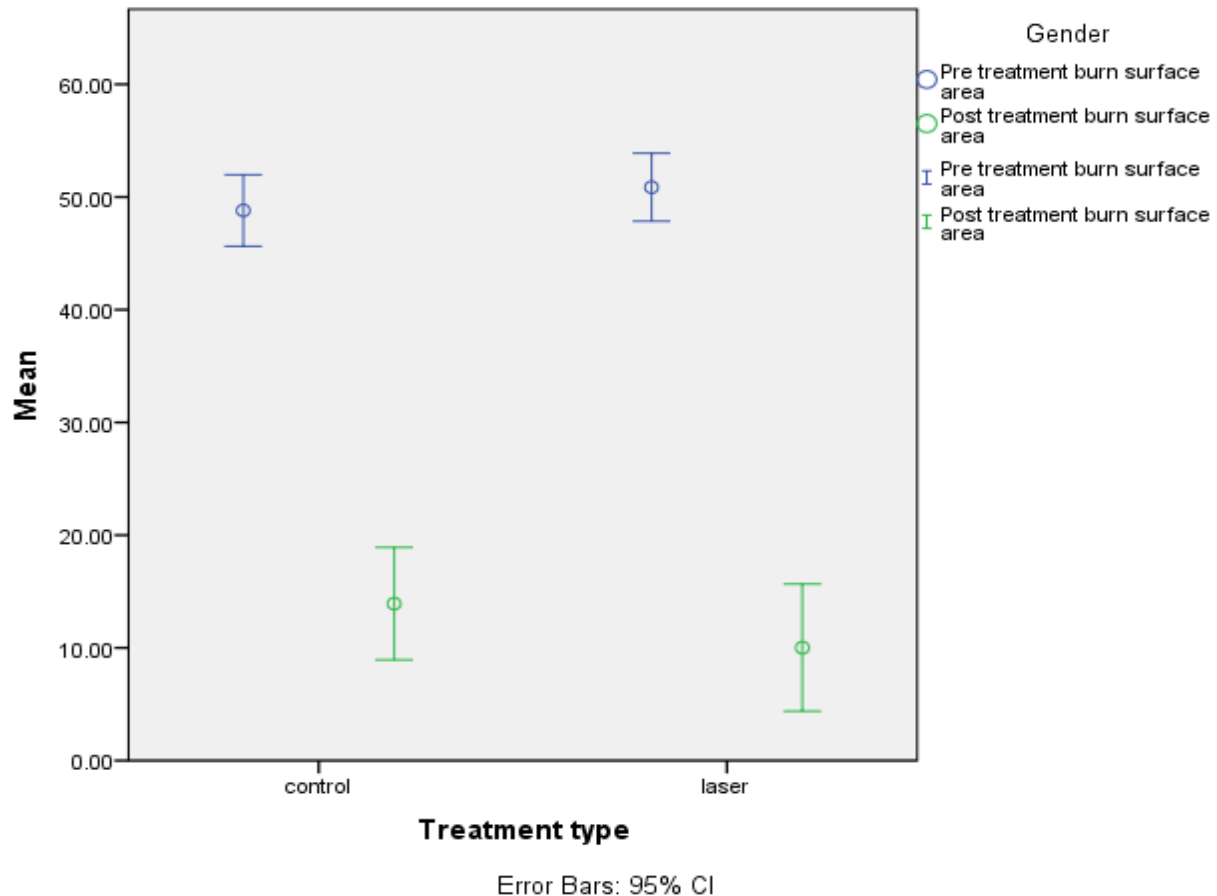


Figure 2: Error bar chart representing pre treatment and post treatment burn surface areas in control and laser groups.



## DISCUSSION

In the present study, we evaluated the effects of dual wavelength low level laser therapy on the healing process post split thickness skin graft in patients with full thickness burn. Low level red and infra-red laser radiation significantly decreased the rate of graft failure ( $p=0.032$ ).

Cury et al., demonstrated that LLLT improved angiogenesis by effecting on VEGF, HIF-1 and MMP-2 in rat skin flap<sup>13</sup>. Many in vitro and in vivo studies reported that laser therapy improved wound healing by encouraging epithelialization, revascularization, fibroblasts activity, improving tissue perfusion, and the tensile strength of scars<sup>14, 15, 16</sup>. Schindl et al, recommended laser therapy as an effective adjuvant treatment method in wound healing<sup>3</sup>.

Also, Laser therapy improved epithelial formation in burned mice as reported by Mester et al.,<sup>17</sup> and LLLT improved repair of third degree burn ulcer in rats as mentioned by Ezzati et al<sup>18</sup>.

LLLT is safe, effective, not expensive method (the machine price is almost 500\$ only) which may be used as an adjunctive technique with STSG for healing of full thickness burn. On the other hand modern techniques such as negative pressure wound therapy may be effective as mentioned by many studies<sup>2, 19</sup>, but still the cost is very high.

## CONCLUSIONS

Dual wavelength low level laser therapy is safe, effective and cheap technique that improves graft survival, wound healing and prevention of dehiscence in patients with full thickness burn in comparison with conventional tie-over method without low level laser application

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