

The effect of LED on blood microcirculation during chronic wound healing in diabetic and non-diabetic patients-a prospective, double-blind randomized study.

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Chronic wounds, especially in diabetic patients, represent a challenging health issue. Since standard treatment protocols often do not provide satisfactory results, additional treatment methods-like phototherapy using low-level light therapy-are being investigated. The aim of our study was to evaluate the effect of phototherapy with light-emitting diodes on chronic wound treatment in diabetic and non-diabetic patients. Since a sufficient blood supply is mandatory for wound healing, the evaluation of microcirculation in the healthy skin at a wound's edge was the main outcome measure. Forty non-diabetic patients and 39 diabetics with lower limb chronic wounds who were referred to the University Medical Center Ljubljana between October 2012 and June 2014 were randomized to the treated and control groups. The treated group received phototherapy with LED 2.4 J/cm² (wavelengths 625, 660, 850 nm) three times a week for 8 weeks, and the control group received phototherapy with broadband 580-900 nm and power density 0.72 J/cm². Microcirculation was measured using laser Doppler. A significant increase in blood flow was noted in the treated group of diabetic and non-diabetic patients ($p = 0.040$ and $p = 0.033$), while there was no difference in the control groups. Additional Falanga wound bed score evaluation showed a significant improvement in both treated groups as compared to the control group. According to our results, phototherapy with LED was shown to be an effective additional treatment method for chronic wounds in diabetic and non-diabetic patients.

Lasers Med Sci 2017 May 32(4) 887-894

<http://www.ncbi.nlm.nih.gov/pubmed/?term=28342007>

Efficacy of Low Level Laser Therapy on Wound Healing in Patients with Chronic Diabetic Foot Ulcers—A Randomised Control Trial

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Abstract Foot ulcers are serious complications of Diabetes Mellitus (DM) and are known to be resistant to conventional treatment. They may herald severe complications if not treated wisely. Electromagnetic radiations in the form of photons are delivered to the ulcers in laser form to stimulate healing. This study was conducted to evaluate the efficacy of Low Level Laser Therapy (LLLT) in diabetic ulcer healing dynamics. To determine mean percentage reduction of wound area in study and control groups. Settings: KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum. Study Design: Randomized-Control Study. Methods: A total of 68 patients with Type 2 DM having Meggitt-Wagner Grade I foot ulcers of atleast more than 4 weeks duration, less than 6×6 cm² with negative culture were studied. Patients were randomized into two groups of 34 each. Patients in study group received LLLT with conventional therapy and those in control group were treated with conventional therapy alone. Healing or percentage reduction in ulcer area over a period of 15 days after commencement of treatment was recorded. Statistical Analysis: Unpaired Student T Test and Mann Whitney U test. Mean age of the patients was 50.94 years in control group and 54.35 years in study group ($p = 0.065$). There was no significant difference between control and study group with respect to mean FBS and HbA1c levels ($p > 0.05$), suggesting no biochemical differences between two groups. Initial ulcer area was 2608.03 mm² in study group and 2747.17 mm² in control group ($p = 0.361$). Final ulcer area was 1564.79 mm² in study group and 2424.75 mm² in control group ($p = 0.361$). Percentage ulcer area reduction was 40.24 ± 6.30 mm² in study group and 11.87 ± 4.28 mm² in control group ($p < 0.001$, $Z = 7.08$). **Low Level Laser Therapy is beneficial as an adjunct to conventional therapy in the treatment of diabetic foot ulcers (DFU).**

NOTE: despite the title and abstract referring to “Low Level Laser Therapy” this treatment was with a THOR LED cluster probe.

2012

<http://www.ncbi.nlm.nih.gov/pubmed/?term=24082586>

Efficacy of Light-Emitting Diode Photomodulation in Reducing Erythema After Fractional Carbon Dioxide Laser Resurfacing: A Pilot Study.

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BACKGROUND: The most common side effects of fractional carbon dioxide (CO₂) laser resurfacing are erythema and edema of the treated skin. Light-emitting diode (LED) devices have been shown to stimulate fibroblast activity and hasten wound healing. The current study was designed to evaluate the efficacy of such LED devices in treating post-laser therapy erythema. **OBJECTIVES:** To evaluate the clinical efficacy of LED photomodulation in reducing erythema resulting from ablative fractional CO₂ laser resurfacing. **MATERIALS AND METHODS:** Randomly selected facial halves of 10 Korean subjects (Fitzpatrick skin type III-IV) were treated using a 635-nm wavelength LED array immediately after full-face fractional laser skin resurfacing. Each participant was subsequently treated with LED daily for the following 7 days. Clinical photographs, subjective physician assessment, and chromometer erythema index were used to track the results, with clinical improvement assessed using a 5-point grading scale. **RESULTS:** The postlaser erythema resolved faster on the experimental side than the control side, with improvements noted according to physician assessment and chromometer erythema index. Statistically significant improvements between the two sides were first noted on day 4. **CONCLUSION:** Treatment using a 635-nm-wavelength LED array decreases the intensity and duration of post-fractional CO₂ laser treatment erythema.

Dermatol Surg 2013 Apr 3

<http://www.ncbi.nlm.nih.gov/pubmed/?term=23551853>

Phototherapy promotes healing of chronic diabetic leg ulcers that failed to respond to other therapies.

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OBJECTIVE: We tested the hypothesis that combined 660 and 890 nm LED phototherapy will promote healing of diabetic ulcers that failed to respond to other forms of treatment. **RESEARCH DESIGN AND METHODS:** A double-blind randomized placebo controlled design was used to study 23 diabetic leg ulcers in two groups of 14 patients. Group one ulcers were cleaned, dressed with 1% silver sulfadiazine cream and treated with "placebo" phototherapy ($<1.0 \text{ J cm}^{-2}$) twice per week, using a Dynatron Solaris 705(R) device. Group two ulcers were treated similarly but received 3 J cm^{-2} dose. **RESULTS:** At each of 15, 30, 45, 60, 75, and 90 days of healing, mean ulcer granulation and healing rates were significantly higher for group two than the "placebo" group ($P < 0.02$). While "placebo" treated ulcers worsened during the initial 30 days, group two ulcers healed rapidly; achieving 56% more granulation and 79.2% faster healing by day 30, and maintaining similarly higher rates of granulation and healing over the "placebo" group all through. By day 90, 58.3% of group two ulcers had healed fully and 75% had achieved 90-100% healing. In contrast, only one "placebo" treated ulcer healed fully by day 90; no other ulcer attained $\geq 90\%$ healing. **CONCLUSION:** Combined 660 and 890 nm light promotes rapid granulation and healing of diabetic ulcers that failed to respond to other forms of treatment.

Lasers Surg Med 2009 Aug 41(6) 433-41

<http://www.ncbi.nlm.nih.gov/pubmed/?term=19588536>

Improvement of Postfractional Laser Erythema with Light-Emitting Diode Photomodulation.

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BACKGROUND The most common side effects of fractional laser skin treatment are erythema and edema. Low-level light therapy and light-emitting diode (LED) devices have been used to stimulate fibroblast activity and hasten wound healing. **OBJECTIVE** To determine whether LED treatment immediately after fractional laser skin resurfacing affects the severity and duration of postoperative erythema. **MATERIALS AND METHODS** Twenty patients received treatment with a 590-nm wavelength LED array to randomly selected facial halves immediately after undergoing full-face fractional laser skin resurfacing with a 1,550-nm erbium-doped fiber laser. Differences in erythema between LED-treated and untreated facial halves were recorded at 24, 48, and 96 hours post-treatment. **RESULTS** The LED-treated facial halves were less erythematous in all 20 patients 24 hours postoperatively. The six patients who received the highest mean energy densities during fractional laser treatment continued to exhibit decreased erythema in the LED-treated areas at 48 hours. At 96 hours post-treatment, no discernible differences between facial halves were observed in any patient. **CONCLUSIONS** Photomodulation with a 590-nm-wavelength LED array can decrease the intensity and duration of postfractional laser treatment erythema. The authors have indicated no significant interest with commercial supporters.

Dermatol Surg 2009 Apr 2

<http://www.ncbi.nlm.nih.gov/pubmed/?term=19397672>

Phototherapy Improves Healing of Chronic Venous Ulcers.

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Abstract Objective: We tested the hypothesis that LED phototherapy with combined 660-nm and 890-nm light will promote healing of venous ulcers that failed to respond to other forms of treatment. **Background Data:** A variety of dressings, growth factors, and adjunct therapies are used to treat venous ulcers, but none seems to yield satisfactory results. **Materials and Methods:** We used a randomized placebo-controlled double-blind study to compare a total of 20 patients divided with 32 chronic ulcers into three groups. In group 1 the ulcers were cleaned, dressed with 1% silver sulfadiazine (SDZ) cream, and treated with placebo phototherapy ($<.03 \text{ J/cm}^2$) using a Dynatron Solaris 705((R)) phototherapy research device. In group 2 the ulcers were treated similarly but received real phototherapy (3 J/cm^2) instead of placebo. In group 3 (controls), the ulcers were simply cleaned and dressed with SDZ without phototherapy. The ulcers were evaluated with digital photography and computer image analysis over 90 d or until full healing was attained. **Results:** Ulcers treated with phototherapy healed significantly faster than controls when compared at day 30 ($p < 0.01$), day 60 ($p < 0.05$), and day 90 ($p < 0.001$), and similarly healed faster than the placebo-treated ulcers at days 30 and 90 ($p < 0.01$), but not at day 60. The beneficial effect of phototherapy was more pronounced when the confounding effect of small-sized ulcers was removed from the analysis. Medium- and large-sized ulcers healed significantly faster with treatment ($\geq 40\%$ rate of healing per month) than placebo or control ulcers ($p < 0.05$). **Conclusion:** Phototherapy promotes healing of chronic venous ulcers, particularly large recalcitrant ulcers that do not respond to conventional treatment.

Photomed Laser Surg 2009 Jan 16

<http://www.ncbi.nlm.nih.gov/pubmed/?term=19196110>

Effects of phototherapy on pressure ulcer healing in elderly patients after a falling trauma. A prospective, randomized, controlled study.

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BACKGROUND: The effects of infrared and red pulsed monochromatic light, with varied pulsations and wavelengths, on the healing of pressure ulcers were evaluated in this prospective, randomized, controlled study. **METHODS:** 59 elderly patients (> or =65 years) with Stage 2 or 3 skin ulcers were enrolled and assigned to one of two groups. Both groups were given the same standard ulcer therapy. One group was also given phototherapy with pulsed monochromatic infrared (956 nm) and red (637 nm) light. Treatments lasted 9 min each time using a regimen with pulse repetition frequency varied between 15.6 Hz and 8.58 kHz. Patients were followed for 10 weeks or until the ulcer was healed, whichever occurred first. The ulcer surface area was traced weekly. **RESULTS:** Patients treated with pulsed monochromatic light had a 49% higher ulcer healing rate, and a shorter time to 50% and to 90% ulcer closure compared with controls. Their mean ulcer area was reduced to 10% after 5 weeks compared with 9 weeks for the controls. **CONCLUSION:** The results are encouraging as pulsed monochromatic light increased healing rate and shortened healing time. This will positively affect the quality of life in elderly patients with pressure ulcer.

Photodermatol Photoimmunol Photomed 2001 Feb 17(1) 32-8

<http://www.ncbi.nlm.nih.gov/pubmed/?term=11169174>

The use of low energy photon therapy (LEPT) in venous leg ulcers: a double-blind, placebo-controlled study.

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BACKGROUND: Venous ulcers are estimated to be present in 0.2 to 0.4% of the population. Although new therapies have significant promise, nonhealing ulcers still represent a significant problem.

OBJECTIVE: To evaluate the efficacy of low energy photon therapy (LEPT) in the treatment of venous leg ulcers.

METHODS: A placebo-controlled, double-blind study using low energy photon therapy was performed in nine patients with 12 venous ulcers. Treatment was given three times a week for 10 weeks, using two monochromatic optical sources. One source provided a wavelength (λ) of 660 nm (red) while the second source delivered a wavelength of 880 nm (infrared). Two optical probes were used, one consisted of an array of 22 monochromatic sources, operating at a wavelength of 660 nm and covering an area 6 x 10 cm². The second probe had seven infrared sources, operating at a wavelength of 880 nm and covering an area of 4 cm². The above configuration of optical probes was selected to cover the majority of the ulcer area being treated. The patients who were randomized to placebo treatment received sham therapy from an identical-appearing light source from the same delivery system.

RESULTS: Nine patients with 12 venous ulcers were randomized to receive LEPT or placebo therapy. At the conclusion of the study, the percentage of the initial ulcer area remaining unhealed in the LEPT and placebo groups was 24.4% and 84.7%, respectively ($P = 0.0008$). The decrease in ulcer area (compared to baseline) observed in the LEPT and placebo groups was 193.0 mm² and 14.7 mm², respectively ($P = 0.0002$). One patient dropped out of the study, complaining of lack of treatment efficacy; he was found to be randomized to the placebo group. There were no adverse effects. **CONCLUSION:** In this placebo-controlled, double-blind study LEPT was an effective modality for the treatment of venous leg ulcers.

Dermatol Surg. 1998 Dec 24(12) 1383-6

<http://www.ncbi.nlm.nih.gov/pubmed/?term=9865208>