

Photobiomodulation (PBM) / Low Level laser Therapy (LLLT)

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Notes: A selection of papers covering healing of wounds by PBM

Low Level Laser Therapy in the Treatment of Pressure Ulcers in Spinal Cord Handicapped Veterans Living in Tehran

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Pressure ulcers result from immobility and continuous pressure on an area of body. Besides imposing further restriction of movements and thus creating a vicious circle in the healing process, these ulcers are of significant importance in decreasing the life quality and increasing the costs of treatment in these patients. In this study we compared the outcome of treatment of pressure ulcers with GA-AL-AS (Gallium- Aluminium -Arsenide) & Gal-AL-In-Ph (Gallium- Aluminium- Indium – Phosphate) - diode lasers, on contact, continuous emission mode at an every other day dose of 4-6 J/cm² for 3 weeks plus conventional treatments of pressure ulcers, with that of conventional treatment alone in two groups of veterans with spinal cord paralysis who reside in Tehran. The study was a triple blind clinical trial conducted among 16 veterans who were randomly divided into case and control groups. The diameter of the ulcers was measured and staged by one person who was unaware of the subjects' allocation. Digital photographs of the ulcers were initially taken and a combination of conventional treatment (wet dressing, irrigation) with Low Level Laser and conventional treatment alone was performed for the case and control groups respectively. After 3 weeks the subjects were evaluated again and photographed with the same method. The results demonstrated a statistically significant enhancement of the healing process by combination of Low Level Laser with conventional treatments of pressure ulcers.

Iran J Med Sci March 2008; Vol 33 No 1

<https://pubmed.ncbi.nlm.nih.gov/NA>

Low-laser light therapy in venous ulcer healing: a randomized clinical trial.

Bavaresco T, Lucena AF

Universidade Federal do Rio Grande do Sul. Porto Alegre, Rio Grande do Sul, Brazil., Universidade Federal do Rio Grande do Sul. Porto Alegre, Rio Grande do Sul, Brazil., Hospital de Clínicas de Porto Alegre. Porto Alegre, Rio Grande do Sul, Brazil.

Objectives: to compare the effect of adjuvant low-laser light therapy versus conventional treatment alone on venous ulcer healing.

Methods: this is a randomized clinical trial with 40 patients randomized equally to a control group (topical and compressive treatment) and intervention group (adjuvant low-laser light therapy). Outcomes of interest were Wound Healing: Secondary Intention and Tissue Integrity: Skin & Mucous Membranes, as described in the Classification of Nursing Outcomes/NOC.

Results: groups with similar sociodemographic and clinical characteristics. Eighty-two ulcers were assessed, with an average duration of 1 to 5 years, in 1,066 nursing consultations, with a statistically significant difference in the time and number of healed ulcers (intervention group). There was a significant improvement in the nursing outcomes under study and in eight clinical indicators.

Conclusions: low-laser light therapy improves and reduces tissue regeneration time, contributing to advances in wound treatment.

Rev Bras Enferm, 2021 11 75(3) E20210396

<https://pubmed.ncbi.nlm.nih.gov/34787240>

Effect of Light-Emitting Diode Irradiation on **Chronic Nonhealed Wound** After Below-Knee Amputation

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Chronic nonhealed wound after below-knee amputation is a serious problem that is faced by the health care team; therefore, there is a need to find an adjuvant therapy to address this problem. The aim of the study is to evaluate the therapeutic efficacy of light-emitting diode (LED) irradiation on chronic nonhealed wound after below-knee amputation using a digitalized method of evaluation by Adobe Photoshop CS5 aided by magnetic lasso tool. Thirty patients with chronic nonhealed wound (≥ 4 weeks) after below-knee amputation were randomly divided into 2 equal groups, with 15 participants in each. Group A received the LED irradiation for 24 sessions (3 sessions per week) in addition to the standard medical treatment, and the second experimental group (group B) received the standard medical treatment for 8 weeks. Methods of evaluation included the wound surface area: for tracing the wound perimeter using a computerized software. Results showed that **both LED irradiation therapy and standard medical treatment were effective in healing the chronic nonhealed wound, but the LED was more effective than standard medical treatment alone**. A clear improvement in the results of wound healing surface area was found in group A, with an improvement percentage of 50.63%, when compared with group B, which used the standard medical treatment alone, with an improvement percentage of 43.96%.

Int J Low Extrem Wounds. 2020 Apr 19;1534734620915108.

<https://pubmed.ncbi.nlm.nih.gov/32308074>

Photobiomodulation Improved the First Stages of Wound Healing Process After Abdominoplasty: An Experimental, Double-Blinded, Non-randomized Clinical Trial.

Ramos RM, Burland M, Silva JB, Burman LM, Gelain MS, Debom LM, Bec JM, Alirezai M, Uebel CO, Valmier J

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Seventeen Caucasian women (aged 18-55) who underwent an abdominoplasty were enrolled in this double-blinded, controlled clinical trial. The postoperative scars were divided into two areas; the right side of the scars was treated with ten sessions of photobiomodulation (consisting in three types of wavelengths). The other part of the scars was used as control and did not receive any additional treatment. Clinical assessments of both parts of the scars were scheduled at 1, 6 and 12 months postoperative.

Within six months following surgery, significantly improved quality of the scars on the treated side compared with the untreated side was reported by patients and experienced professionals according to Vancouver Scar Scale, Patient and Observer Scar Assessment Scale ($p < 0.05$) and standardized photographs ($p < 0.05$). At 1 year of follow-up, patients observed no differences between the treated and untreated sides of the scars. This suggests that photobiomodulation appears to play an early role in the wound healing process, accelerating the first stages of cicatrization.

This study statistically validates the positive impact of photobiomodulation treatment on the first stages of the postoperative healing process. Carried out on Caucasians participants only, this study should, however, be performed on a more heterogeneous population to definitively confirm these effects on an international population.

Registro Brasileiro de ensaios clínicos: [http://www.ensaiosclinicos.gov.br](http://www ensaiosclinicos.gov.br) , Trial RBR-49PK78.

This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266 .

Low-level laser therapy as an adjunct to conventional therapy in the treatment of diabetic foot ulcers.

Mathur RK, Sahu K, Saraf S, Patheja P, Khan F, Gupta PK

Foot ulcers are serious complications of diabetes mellitus (DM) and are known to be resistant to conventional treatment. This study was conducted to evaluate the efficacy of low-level laser therapy (LLLT) for the treatment of diabetic foot ulcers in a tertiary care centre (Department of Surgery, Mahatma Gandhi Memorial Medical College and Maharaja Yashwantrao Hospital, A.B. Road, Indore). A total of 30 patients with type 2 DM having Meggitt-Wagner grade I foot ulcers of more than 6 weeks duration with negative culture were studied. Patients were randomized into two groups of 15 each. Patients in study group received LLLT (660, \pm ,20nm, 3J/cm²) along with conventional therapy and those in control group were treated with conventional therapy alone. The primary outcome measure was the absolute and relative wound size reduction at 2 weeks compared to the baseline parameter. Percentage ulcer area reduction was 37, \pm ,9% in the LLLT group and 15, \pm ,5.4% in the control group ($p < 0.001$). For ,75% of wounds of the treatment group, wound area reduction of 30-50% was observed. In contrast, for the control group, 80% of wounds showed a wound area reduction of <20% on day 15. Further, the wounds with initial wound area 1000-2000mm² seems to have better final outcome than the groups with larger areas. The treated groups showed higher amount of granulation than the control group. The results suggest that LLLT is beneficial as an adjunct to conventional therapy in the treatment of diabetic foot ulcers.

Lasers Med Sci 2016 Nov 29

<https://pubmed.ncbi.nlm.nih.gov/27896528>

Phototherapy with LED Shows Promising Results in **Healing Chronic Wounds in Diabetes Mellitus Patients: A Prospective Randomized Double-Blind Study.**

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OBJECTIVE: The study examined the influence of phototherapy with light-emitting diodes (LEDs) on chronic diabetic wound healing. **BACKGROUND:** Chronic diabetic wounds are very difficult to treat due to underlying conditions such as angiopathy and neuropathy, resulting in slow healing rates. Conventional treatment options are often insufficient and do not provide satisfactory outcomes. Phototherapy with LED enhances the healing processes through mechanisms of energy exchange between incoming photons and their target, the main one being cytochrome-c oxidase in mitochondria. **METHODS:** A double-blind, randomized study included 60 patients with a chronic diabetic wound treated at the University Medical Center Ljubljana between October 1, 2012 and December 1, 2014. Patients were randomized into either an active group (LED group) or a control group (Co-group). The active group was treated with LED 2.4J/cm **RESULTS:** The average baseline wound surface before treatment was 1315 mm **CONCLUSIONS:** According to our results, **LED significantly improves healing of chronic diabetic wounds and prepares the wound bed for further coverage options.**

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<https://pubmed.ncbi.nlm.nih.gov/29668397>

Use of polarised light as a method of **pressure ulcer prevention** in an adult intensive care unit.

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OBJECTIVE: This single-centred randomised pilot study aimed to examine whether the wound-healing properties of polarised light are effective in preventing grade II or above pressure ulcers in patients admitted to an adult intensive care unit. **METHOD:** Standard pressure ulcer prevention techniques were applied in both research groups. Patients allocated to the test group received supplementary treatment with polarised light once daily for 10 minutes (sacral area and both heels) starting on the first day after admission. The control group received no polarised light. **RESULTS:** A control group of 13 patients and an intervention group of 10 patients were included in the study between 1 March and 1 May 2006. There was no statistically significant difference between the groups for composition, standard pressure ulcer prevention or pressure ulcer risk. Observations revealed a statistically significant difference ($p = 0.019$) between the groups when comparing development of grade II or above sacral or heel pressure ulcers. **CONCLUSION:** **Patients treated with polarised light developed significantly ($p = 0.019$) fewer grade II or above sacral or heel pressure ulcers when compared with a control group receiving no polarised light.** Further research is required.

J Wound Care 2007 16(4) 145-50

<https://pubmed.ncbi.nlm.nih.gov/17444378>

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

<https://pubmed.ncbi.nlm.nih.gov/11169174>

Low-intensity LED therapy ($\lambda 640 \pm 20$ nm) on saphenectomy healing in patients who underwent coronary artery bypass graft: a randomized, double-blind study.

de Barros Araújo Júnior R, Gonzaga ICA, Fernandes GA, Lima ACG, Cortelazzi PST, de Oliveira RA, Nicolau RA

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Myocardial revascularization surgery (CABG) is the most appropriate treatment for coronary artery disease. Currently, the great challenge is to reduce postoperative complications, such as wound infections, dehiscence, pain, and patients' quality of life. The saphenectomy is the target of complications in 10% of cases, which can cause greater morbidity, time, and cost of hospitalization. Studies show that low-intensity laser or light-emitted diode (LED) therapy promotes positive biomodulation of the tissue repair process, culminating in a lower incidence of dehiscence, pain reduction, and improvement in quality of life. The objective of the present study was to evaluate clinically the saphenous tissue repair after LED therapy. Forty subjects of both genders who underwent CABG with extracorporeal circulation were randomly divided into two groups: the placebo (PG) and experimental (EG). The experimental group underwent low-intensity LED therapy ($\lambda 640 \pm 20$ nm, 6 J/cm²) on saphenectomy. The tissue repair was analyzed by digital photogrammetry on the first and fifth postoperative day. The border closure was blindly evaluated by three researchers. The hematoma and hyperemia area was quantitatively analyzed using ImageJ© software. The results showed that in the experimental group, there were less bleeding points and no dehiscence in saphenectomy, as compared to the placebo group. There was also a smaller area of hematoma and hyperemia in the experimental group ($p < 0.0009$). These data lead to the conclusion that the type of phototherapy protocol employed can assist in tissue repair.

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<https://pubmed.ncbi.nlm.nih.gov/29027034>

Photobiomodulation (Laser and LED) on **Sternotomy Healing** in Hyperglycemic and Normoglycemic Patients Who Underwent Coronary Bypass Surgery with Internal Mammary Artery Grafts: A Randomized, Double-Blind Study with Follow-Up.

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120 volunteers were electively submitted to CABG and were randomly allocated into four different groups of equal size (n=30): control, placebo, laser (λ of 640 nm and spatial average energy fluency [SAEF] of 1.06 J/cm²), and LED (λ of 660 ± 20 nm and SAEF of 0.24 J/cm²). Laser and LED groups were irradiated from the second to eighth day postsurgery, and sternotomy incision was photographically registered. Then, participants were also separated into hyperglycemic and normoglycemic groups, according to their fasting blood glucose test before surgery. Three researchers blindly analyzed the incision photographs to determine hyperemia and wound closure at the first day of hospital discharge (eighth postoperative day).

LLLT and LED groups had similarly less hyperemia and less incision bleeding or dehiscence ($p \leq 0.005$) and the outcomes were also analogous between hyperglycemic and normoglycemic patients, which indicates no difference observed in an intragroup analysis ($p \geq 0.05$).

With the present therapy parameters, it may be assumed that both coherent light (laser) and non-coherent light (LED) are effective in promoting sternotomy and healing acceleration, which are evident on the eighth day postsurgery.

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<https://pubmed.ncbi.nlm.nih.gov/27564925>

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