Research performed using a K-LASER®

Diabetes Care. 2015 Oct;38(10):e152-3. doi: 10.2337/dc15-0774.

A pilot study to evaluate the efficacy of class IV lasers on nonhealing neuroischemic diabetic foot ulcers in patients with type 2 diabetes.

Maltese G[1], Karalliedde J[2], Rapley H[3], Amor T[3], Lakhani A[3], Gnudi L[2].
Author information

- [1]Cardiovascular Division, Faculty of Life Sciences & Medicine, King's College London, London, U.K. giuseppe.maltese@kcl.ac.uk.
- [2]Cardiovascular Division, Faculty of Life Sciences & Medicine, King's College London, London, U.K.
- [3]Diabetes and Endocrinology Service, Guy's and St Thomas' Hospital NHS Foundation Trust, London, U.K

Diabetic foot ulcers (DFUs) represent a disabling complication of diabetes that has a devastating impact on the quality of life and predict lower-limb amputa- tion and premature mortality (1). De- spite best practice, 30–40% of DFUs do not heal within 12–20 weeks (2). Novel therapeutic agents have been tested in clinical trials, and it has been estimated that ;30–50% of patients with neuro- pathic DFUs receiving these new treat- ments have healed by 12–20 weeks (3). Laser therapy, delivered with devices emitting one or two wavelengths, has been reported as an adjunctive proce- dure that promotes the healing of chronic diabetic wounds by increasing the blood flow and the release of growth factors and by reducing the inflammation (4).

In this pilot study, we have been the first to investigate the efficacy of an ad- vanced class IV laser (emitting four wave- lengths) on Wagner stage 1 and 2 neuroischemic DFUs of five patients with type 2 diabetes who were nonresponsive to conventional treatment for at least 12 weeks. Laser treatment was delivered once a week prior to standard care and dressing. As a control we selected patients with similar DFUs and clinical character- istics treated within our department with standard care. In the laser-treated group, age was 58.2 6 3.6 years (mean 6 SEM; range 47–66) and mean dura- tion of diabetes was 20.4 6 2.1 years.

At the time of enrollment, glycosylated hemoglobin (HbA_{1c}) was 9.0 6 0.8% (74.6 6 8.4 mmol/mol). All laser-treated patients had preserved renal function (es- timated glomerular filtration rate [eGFR] 72 6 8.3 mL/min/1.73 m^2) and moderate to severe peripheral artery disease, de- fined as 20–49% and 50–99% diameter reduction in at least one of the arterial segments from aorto-iliac to popliteal seg- ments on an arterial duplex scan. The mean size of the ulcers was 2.4 6 1.0 cm^2. The control group of six patients with type 2 diabetes received standard care and had similar ulcer duration and size; comparable glycemic control, age, dia- betes duration, and eGFR; and similar degree of peripheral artery disease (Table 1). Standard care for DFUs, in- cluding antibiotic treatment, dressing, and off-loading, was similar in both groups. Within the 12-week follow-up, four of five laser-treated patients (80%) had a com- plete ulcer resolution (most ulcers healed after 4.6 weeks). In the control group, no ulcer healing occurred by week 12.

A limited number of small clinical trials and case studies evaluating the effects of laser devices with lower power and one or two wavelengths on DFUs have previously reported positive outcomes (4). However, because of the heterogeneity in the meth- odology, findings from these studies have not been consistent. The laser used in this pilot study is the first example of a high- powered device with four wavelengths concomitantly acting on multiple meta- bolic processes that accelerate the wound healing: stimulation of cytochrome-C oxi- dase, an increase in angiogenesis, and im- provement in blood perfusion (5).

Taking into consideration the limitations of this proof-of-concept study, our findings indicate that laser therapy delivered by a class IV laser can significantly impact the healing process of neuroischemic DFUs re- fractory to standard treatment. Random- ized controlled clinical trials with this new laser device in larger populations are re- quired to confirm our results.

Research performed using a K-LASER®

Acneiform rash due to epidermal growth factor receptor inhibitors: high-level laser therapy as an innovative approach

M Gobbo & G Ottaviani & G Mustacchi & R Di Lenarda & M Biasotto

Division of Oral Pathology, Dental Science Department, University of Trieste, Ospedale Maggiore, Piazza dell'Ospitale 2,

34100 Trieste, Italy e-mail: m.biasotto@fmc.units.it

G. Mustacchi Department of Oncology, University of Trieste, Azienda Servizi Sanitari, Via Pietà 19, 34100 Trieste, Italy

Received: 7 June 2011 / Accepted: 3 November 2011 # Springer-Verlag London Ltd 2011

Abstract Acneiform rash associated with epidermal growth factor receptor inhibitors frequently presents facial manifestations. The treatment modality for such lesions still needs to be elucidated. The aim of this original report was to evaluate the effectiveness of high-level laser therapy in reducing the severity of facial acneiform rash induced by cetuximab, an epidermal growth factor receptor inhibitors. Four patients with metastatic colorectal cancer and two patients with head and neck cancer showing cetuximab- induced facial rash were treated by high-level laser therapy in two 8-min-long consecutive sessions/day over a 4-day treatment. Patients wore protective glasses to prevent eye damage related to laser light. Subsequently, patients were seen once a week for up to 21 days and after 180 days. During each day of treatment and each follow-up recall, patients were asked to complete a questionnaire about the onset and progression of their acneiform rash (for a total of eight sessions). Cetuximab-related toxicity and general discomfort visual analogue scales were also recorded in each of these eight sessions in the treated and control areas in each patient. After the fourth session of high-level laser therapy, the patients showed a noteworthy decrease in both cetuximab-related toxicity and visual analogue scales, up to a complete regression of the lesions at the end of the ollow-up in all treated areas. The high-level laser therapy was effective in the healing of acneiform rash associated with epidermal growth factor receptor inhibitors with no side effects.

Wound Repair Regen. 2016 Jan 7. doi: 10.1111/wrr.12399. [Epub ahead of print]

A Systematic Review of Low-Level Light Therapy For Treatment of Diabetic Foot Ulcer.

Tchanque-Fossuo CN[1,2], Ho D[1], Dahle SE[2,3], Koo E[1], Li CS[4], Rivkah Isseroff R[1,2], Jagdeo J[1,2,5].
Author information

- [1]Dermatology Service, Sacramento VA Medical Center, Mather, CA, USA.
- [2]Department of Dermatology, University of California Davis, Sacramento, CA, USA.
- [3]Department of Surgery, Podiatry Section, Sacramento VA Medical Center, Mather, CA, USA.
- [4]Department of Public Health Sciences, Division of Biostatistics, University of California Davis, Davis, CA, USA.
- [5]Department of Dermatology, State University of New York Downstate Medical Center, Brooklyn, NY, USA.

Abstract

Diabetes mellitus (DM) is a significant international health concern affecting more than 387 million individuals. A diabetic person has a 25% lifetime risk of developing a diabetic foot ulcer (DFU), leading to limb amputation in up to one in six DFU patients. Low-level light therapy (LLLT) uses low-power lasers or light-emitting diodes to alter cellular function and molecular pathways, and may be a promising treatment for DFU. The goal of this systematic review is to examine whether the clinical use of LLLT is effective in the healing of DFU at 12 weeks and 20 weeks in comparison with the standard of care, and to provide evidence-based recommendation and future clinical guidelines for the treatment of DFU using LLLT. On September 30th 2015, we searched PubMed, EMBASE, CINAHL, and Web of Science databases using the following terms: "diabetic foot" AND "low level light therapy," OR "light emitting diode," OR "phototherapy," OR "laser." The relevant articles that met the following criteria were selected for inclusion: randomized control trials (RCTs) that investigated the use of LLLT for treatment of DFU. Four RCTs involving 131 participants were suitable for inclusion based upon our criteria. The clinical trials used sham irriadiation, low dose, or non-therapeutic LLLT as placebo or control in comparison to LLLT. The endpoints included ulcer size and time to complete healing with follow-up ranging from 2 weeks to 16 weeks. Each article was assigned a level of evidence (LOE) and graded according to the Oxford Center for Evidence-based Medicine Levels of Evidence Grades of Recommendation criteria. Limitations of reviewed RCTs include a small sample size (N<100), unclear allocation concealment, lack of screening phase to exclude rapid healers, unclear inclusion/exclusion criteria, short (<30 days) follow-up period, and unclear treatment settings (wavelength and treatment time). However, all reviewed RCTs demonstrated therapeutic outcomes with no adverse events using LLLT for treatment of DFU. This systematic review reports that LLLT has significant potential to become a portable, minimally invasive, easy-to-use, and cost effective modality for treatment of DFU. To enthusiastically recommend LLLT for treatment of DFU, additional studies with comparable laser parameters, screening period to exclude rapid healers, larger sample sizes and longer follow-up periods are required. We envision future stringent RCTs may validate LLLT for treatment of DFU. Systematic review registration number: PROSPERO CRD42015029825. This article is protected by copyright. All rights reserved.

Photodermatol Photoimmunol Photomed. 1999 Feb;15(1):18-21.

Induction of complete wound healing in recalcitrant ulcers by low-intensity laser irradiation depends on ulcer cause and size.

Schindl M[1], Kerschan K, Schindl A, Schön H, Heinzl H, Schindl L.
Author information

- [1]Institute for Laser Medicine, Vienna, Austria.

Abstract

Chronic skin ulcers still represent a therapeutic challenge in dermatology. Among the various non-invasive treatment modalities used for the improvement of impaired wound healing, low-intensity laser irradiations are gaining an increasing body of interest. We used low-intensity laser irradiations delivered by a 30 mW helium-neon laser at an energy density of 30 J/cm2 three times weekly for the induction of wound healing in ulcers of diverse causes. Twenty patients with the same number of ulcers, which had previously been treated by conventional wound care for a median period of 34 weeks (range: 3-120 weeks) without any significant evidence of healing, were included in the study. Concerning the underlying disorders, patients were divided into four groups: diabetes, arterial insufficiency, radio damage and autoimmune vasculitis. In all ulcers, complete epithelization could be induced by laser therapy. No amputation or any other surgical intervention was necessary and no adverse effects of any kind were noted during low-intensity laser treatment. Regarding the different diagnoses, a statistically significant difference was noted (P = 0.008): ulcers due to radio damage healed significantly faster than those caused by diabetes (6 weeks [range: 3-10 weeks] vs. 16 weeks [range: 9-45 weeks], P = 0.005). Wound healing in autoimmune vasculitis (24 weeks [range: 20-35 weeks]) required longer than in radiodermitis, although the difference was not significant. In addition to the diagnosis, wound size was found to be an important factor influencing the duration of wound closure (P = 0.028), whereas duration of previous conventional treatment (P = 0.24) and depth (P = 0.14) showed no effect. Our results indicate that low-intensity laser irradiation could be a valuable non-invasive tool for the induction of wound healing in recalcitrant ulcers, and that healing time is correlated with the ulcer cause and size.

PMID: 9990664 [PubMed - indexed for MEDLINE]

Lasers Surg Med. 2009 Aug;41(6):433-41. doi: 10.1002/lsm.20789.

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

Minatel DG[1], Frade MA, França SC, Enwemeka CS.
Author information

- [1]Department of Biotechnology, University of Ribeirão Preto, Ribeirão Preto, Brazil.

Abstract

OBJECTIVE:

We tested the hypothesis that combined 660 and 890 nm LED phototherapy will promote healing of diabetic ulcers that failed torespond 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 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 > or =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.

PMID:19588536 [PubMed - indexed for MEDLINE]

Lasers Surg Med. 2001;28(3):220-6.

830-nm irradiation increases the wound tensile strength in a diabetic murine model.

Stadler I[1], Lanzafame RJ, Evans R, Narayan V, Dailey B, Buehner N, Naim JO.

Author information

- [1]The Laser Center, Rochester General Hospital, Rochester, New York 14621, USA. Istvan.Stadler@viahealth.org

Abstract

BACKGROUND AND OBJECTIVE:

The purpose of this study was to investigate the effects of low-power laser irradiation on wound healing in genetic diabetes.

STUDY DESIGN/MATERIALS AND METHODS:

Female C57BL/Ksj/db/db mice received 2 dorsal 1 cm full-thickness incisions and laser irradiation(830 nm, 79 mW/cm(2), 5.0 J/cm(2)/wound). Daily low-level laser therapy (LLLT) occurred over 0-4 days, 3-7 days, or nonirradiated. On sacrifice at 11 or 23 days, wounds were excised, and tensile strengths were measured and standardized.

RESULTS:

Nontreated diabetic wound tensile strength was 0.77 +/- 0.22 g/mm(2) and 1.51 +/- 0.13 g/mm(2) at 11 and 23 days. After LLLT, over 0-4 days tensile strength was 1.15 +/- 0.14 g/mm(2) and 2.45 +/- 0.29 g/mm(2) (P = 0.0019). Higher tensile strength at 23 days occurred in the 3- to 7-day group (2.72 +/- 0.56 g/mm(2) LLLT vs. 1.51 +/- 0.13 g/mm(2) nontreated; P < or = 0.01).

CONCLUSION:

Low-power laser irradiation at 830 nm significantly enhances cutaneous wound tensile strength in a murine diabetic model. Further investigation of the mechanism of LLLT in primary wound healing is warranted.

PMID:11295756[PubMed - indexed for MEDLINE]

J Athl Train. 2004 Sep;39(3):223-229.

Low-
Level Laser Therapy Facilitates Superficial Wound Healing in Humans : A Triple-Blind, Sham-ControlledStudy.

Hopkins JT[1], McLoda TA, Seegmiller JG, David Baxter G.
Author information

- [1]Brigham Young University, Provo, UT.

Abstract

OBJECTIVE:

Low-level laser therapy (LLLT) has been promoted for its beneficial effects on tissue healing and pain relief. However, according to the results of in vivo studies, the effectiveness of this modality varies. Our purpose was to assess the putative effects of LLLT on healing using an experimental wound model.

DESIGN AND SETTING:

We used a randomized, triple-blind, placebo-controlled design with 2 within-subjects factors (wound and time) and 1 between-subjects factor (group). Data were collected in the laboratory setting.

SUBJECTS:

Twenty-two healthy subjects (age = 21 +/- 1 years, height = 175.6 +/- 9.8 cm, mass = 76.2 +/- 14.2 kg).

MEASUREMENTS:

Two standardized 1.27-cm(2) abrasions were induced on the anterior forearm. After wound cleaning, standardized digital photos were recorded. Each subject then received LLLT (8 J/cm(2); treatment time = 2 minutes, 5 seconds; pulse rate = 700 Hz) to 1 of the 2 randomly chosen wounds from either a laser or a sham 46-diode cluster head. Subjects reported back to the laboratory on days 2 to 10 to be photographed and receive LLLT and on day 20 to be photographed. Data were analyzed for wound contraction (area), color changes (chromatic red), and luminance.

RESULTS:

A group x wound x time interaction was detected for area measurements. At days 6, 8, and 10, follow-up testing revealed that the lasergroup had smaller wounds than the sham group for both the treated and the untreated wounds ($P < .05$). No group x wound x time differences were detected for chromatic red or luminance.

CONCLUSIONS:

The LLLT resulted in enhanced healing as measured by wound contraction. The untreated wounds in subjects treated with LLLT contracted more than the wounds in the sham group, so LLLT may produce an indirect healing effect on surrounding tissues. These data indicate that LLLT is an effective modality to facilitate wound contraction of partial-thickness wounds.

PMID:15496990[PubMed - as supplied by publisher] PMCID: PMC522143

Photomed Laser Surg. 2004 Aug;22(4):323-9.

The efficacy of low-power lasers in tissue repair and pain control: a meta-analysis study.

Enwemeka CS[1], Parker JC, Dowdy DS, Harkness EE, Sanford LE, Woodruff LD.
Author information

- [1]School of Health Professions, Behavioral and Life Sciences, New York Institute of Technology, Old Westbury, NY 11568-8000, USA. Enwemeka@nyit.edu

Abstract

OBJECTIVE:

We used statistical meta-analysis to determine the overall treatment effects of laser phototherapy on tissue repair and pain relief.

BACKGROUND DATA:

Low-power laser devices were first used as a form of therapy more than 30 years ago. However, their efficacy in reducingpain or promoting tissue repair remains questionable.

METHODS:

Following a literature search, studies meeting our inclusion criteria were identified and coded. Then, the effect size of laser treatment, that is, Cohen's d, was calculated from each study using standard meta-analysis procedures.

RESULTS:

Thirty-four peer-reviewed papers on tissue repair met our inclusion criteria and were used to calculate 46 treatment effect sizes. Nine peer-reviewed papers on pain control met the inclusion criteria and were used to calculate nine effect sizes. Meta-analysis revealed a positive effect of laser phototherapy on tissue repair (d = +1.81; n = 46) and pain control (d = +1.11; n = 9). The positive effect of treatment on specific indices of tissuerepair was evident in the treatment effect sizes determined as follows: collagen formation (d = +2.78), rate of healing (d = +1.57), tensile strength (d = +2.13), time needed for wound closure (d = +0.76), tensile stress (d = +2.65), number and rate of degranulation of mast cells (d = +1.87), and flap survival (d = +1.95). Further, analysis revealed the positive effects of various wavelengths of laser light on tissue repair, with 632.8 nm having the highest treatment effect (d = +2.44) and 780 nm the least (d = 0.60). The overall treatment effect for pain control was positive as well (d = +1.11). The fail-safe number-that is, the number of studies in which laser phototherapy has negative or no effect-needed to nullify the overall outcome of this analysis was 370 for tissue repair and 41 for pain control.

CONCLUSIONS:

These findings mandate the conclusion that laser phototherapy is a highly effective therapeutic armamentarium for tissue repair andpain relief.

PMID:15345176[PubMed - indexed for MEDLINE]

Photomed Laser Surg. 2010 Jun;28(3):417-22. doi: 10.1089/pho.2009.2548.

Effects of low-level laser therapy on pain and scar formation after inguinal herniation surgery: a randomizedcontrolled single-blind study.

Carvalho RL[1], Alcântara PS, Kamamoto F, Cressoni MD, Casarotto RA.

Author information

- [1]Postgraduate Program in Rehabilitation Sciences, University of São Paulo, São Paulo, Brazil.

Abstract

OBJECTIVE:

The aim of this study was to investigate the efficacy of an infrared GaAlAs laser operating with a wavelength of 830 nm in the postsurgical scarring process after inguinal-hernia surgery.

BACKGROUND:

Low-level laser therapy (LLLT) has been shown to be beneficial in the tissue-repair process, as previously demonstrated in tissue culture and animal experiments. However, there is lack of studies on the effects of LLLT on postsurgical scarring of incisions in humans using an infrared 830-nm GaAlAs laser.

METHOD:

Twenty-eight patients who underwent surgery for inguinal hernias were randomly divided into an experimental group (G1) and a control group (G2). G1 received LLLT, with the first application performed 24 h after surgery and then on days 3, 5, and 7. The incisions were irradiated with an 830-nm diode laser operating with a continuous power output of 40 mW, a spot-size aperture of 0.08 cm(2) for 26 s, energy per point of 1.04 J, and an energy density of 13 J/cm(2). Ten points per scar were irradiated. Six months after surgery, both groups were reevaluated using the VancouverScar Scale (VSS), the Visual Analog Scale, and measurement of the scar thickness.

RESULTS:

G1 showed significantly better results in the VSS totals (2.14 +/- 1.51) compared with G2 (4.85 +/- 1.87); in the thickness measurements (0.11 cm) compared with G2 (0.19 cm); and in the malleability (0.14) compared with G2 (1.07). The pain score was also around 50% higher in G2.

CONCLUSION:

Infra-red LLLT (830 nm) applied after inguinal-hernia surgery was effective in preventing the formation of keloids. In addition, LLLT resulted in better scar appearance and quality 6 mo postsurgery.

PMID:19821701PubMed - indexed for MEDLINE]

ScientificWorldJournal. 2014; 2014: 398412.

Published online 2014 Jan 6. doi: 10.1155/2014/398412

Shedding Light on a New Treatment for Diabetic Wound Healing: A Review on Phototherapy

Nicolette N. Houreld*

*Nicolette N. Houreld: Email: az.ca.ju@dleruohn

Academic Editors: A. Schreiber and S. Ulisse

Author information ▼ Article notes ▼ Copyright and License information ▼

Received 2013 Aug 28; Accepted 2013 Oct 9.

Abstract

Impaired wound healing is a common complication associated with diabetes with complex pathophysiological underlying mechanisms and often necessitates amputation. With the advancement in laser technology, irradiation of these wounds with low-intensity laser irradiation (LILI) or phototherapy, has shown a vast improvement in wound healing. At the correct laser parameters, LILI has shown to increase migration, viability, and proliferation of diabetic cells *in vitro*; there is a stimulatory effect on the mitochondria with a resulting increase in adenosine triphosphate (ATP). In addition, LILI also has an anti-inflammatory and protective effect on these cells. In light of the ever present threat of diabetic foot ulcers, infection, and amputation, new improved therapies and the fortification of wound healing research deserves better prioritization. In this review we look at the complications associated with diabetic wound healing and the effect of laser irradiation both *in vitro* and *in vivo* in diabetic wound healing.

Int J Exp Pathol. 2014 Apr; 95(2): 138–146.

Published online 2013 Dec 20. doi: 10.1111/iep.12063

PMCID: PMC3960041

The energy density of laser light differentially modulates the skin morphological reorganization in a murine model of healing by secondary intention

Rômulo D Novaes,[*†] Reggiani V Gonçalves,[‡] Marli C Cupertino,[*] Bruna M Araújo,[§] Rafael M Rezende,[*] Eliziária C Santos,[*] João Paulo V Leite,[§] and Sérgio Luis P Matta[*]

Correspondence Reggiani Vilela Gonçalves, Universidade Federal de Viçosa, Av Ph Rolfs S/N, centro, Viçosa, Minas Gerais 36570-000,, Brazil, Tel.: +55 31 3899-4867, Fax: +55 31 3899-2530, E-mail: rb.moc.oohay@alelivsygger

Author information ▼ Article notes ▼ Copyright and License information ▼

Received 2013 May 12; Accepted 2013 Oct 1.

Abstract

This study investigates the influence of gallium–arsenide (GaAs) laser photobiostimulation applied with different energy densities on skin wound healing by secondary intention in rats. Three circular wounds, 10 mm in diameter, were made on the dorsolateral region of 21 Wistar rats weighting 282.12 ± 36.08 g. The animals were equally randomized into three groups: Group SAL, saline solution 0.9%; Group L3, laser GaAs 3 J/cm^2; Group L30, laser GaAs 30 J/cm^2. Analyses of cells, blood vessels, collagen and elastic fibres, glycosaminoglycans and wound contraction were performed on the scar tissue from different wounds every 7 days for 21 days. On day 7, 14 and 21, L3 and L30 showed higher collagen and glycosaminoglycan levels compared to SAL ($P < 0.05$). At day 21, elastic fibres were predominant in L3 and L30 compared to SAL ($P < 0.05$). Type-III collagen fibres were predominant at day 7 in both groups. There was gradual reduction in these fibres and accumulation of type-I collagen over time, especially in L3 and L30 compared with SAL. Elevated density of blood vessels was seen in L30 on days 7 and 14 compared to the other groups ($P < 0.05$). On these same days, there was higher tissue cellularity in L3 compared with SAL ($P < 0.05$). The progression of wound closure during all time points investigated was higher in the L30 group ($P < 0.05$). Both energy densities investigated increased the tissue cellularity, vascular density, collagen and elastic fibres, and glycosaminoglycan synthesis, with the greater benefits for wound closure being found at the density of 30 J/cm^2.

Research performed using a K-LASER®

Diabetes Care. 2015 Oct;38(10):e152-3. doi: 10.2337/dc15-0774.

A pilot study to evaluate the efficacy of class IV lasers on nonhealing neuroischemic diabetic foot ulcers in patients with type 2 diabetes.

Maltese G[1], Karalliedde J[2], Rapley H[3], Amor T[3], Lakhani A[3], Gnudi L[2].

Author information

- [1]Cardiovascular Division, Faculty of Life Sciences & Medicine, King's College London, London, U.K. giuseppe.maltese@kcl.ac.uk.
- [2]Cardiovascular Division, Faculty of Life Sciences & Medicine, King's College London, London, U.K.
- [3]Diabetes and Endocrinology Service, Guy's and St Thomas' Hospital NHS Foundation Trust, London, U.K

Diabetic foot ulcers (DFUs) represent a disabling complication of diabetes that has a devastating impact on the quality of life and predict lower-limb amputa- tion and premature mortality (1). De- spite best practice, 30–40% of DFUs do not heal within 12–20 weeks (2). Novel therapeutic agents have been tested in clinical trials, and it has been estimated that ;30–50% of patients with neuro- pathic DFUs receiving these new treat- ments have healed by 12–20 weeks (3). Laser therapy, delivered with devices emitting one or two wavelengths, has been reported as an adjunctive proce- dure that promotes the healing of chronic diabetic wounds by increasing the blood flow and the release of growth factors and by reducing the inflammation (4).

In this pilot study, we have been the first to investigate the efficacy of an ad- vanced class IV laser (emitting four wave- lengths) on Wagner stage 1 and 2 neuroischemic DFUs of five patients with type 2 diabetes who were nonresponsive to conventional treatment for at least 12 weeks. Laser treatment was delivered once a week prior to standard care and dressing. As a control we selected patients with similar DFUs and clinical character- istics treated within our department with standard care. In the laser-treated group, age was 58.2 6 3.6 years (mean 6 SEM; range 47–66) and mean dura- tion of diabetes was 20.4 6 2.1 years.

At the time of enrollment, glycosylated hemoglobin (HbA_{1c}) was 9.0 6 0.8% (74.6 6 8.4 mmol/mol). All laser-treated patients had preserved renal function (es- timated glomerular filtration rate [eGFR] 72 6 8.3 mL/min/1.73 m^2) and moderate to severe peripheral artery disease, de- fined as 20–49% and 50–99% diameter reduction in at least one of the arterial segments from aorto-iliac to popliteal seg- ments on an arterial duplex scan. The mean size of the ulcers was 2.4 6 1.0 cm^2. The control group of six patients with type 2 diabetes received standard care and had similar ulcer duration and size; comparable glycemic control, age, dia- betes duration, and eGFR; and similar degree of peripheral artery disease (Table 1). Standard care for DFUs, in- cluding antibiotic treatment, dressing, and off-loading, was similar in both groups. Within the 12-week follow-up, four of five laser-treated patients (80%) had a com- plete ulcer resolution (most ulcers healed after 4.6 weeks). In the control group, no ulcer healing occurred by week 12.

A limited number of small clinical trials and case studies evaluating the effects of laser devices with lower power and one or two wavelengths on DFUs have previously reported positive outcomes (4). However, because of the heterogeneity in the meth- odology, findings from these studies have not been consistent. The laser used in this pilot study is the first example of a high- powered device with four wavelengths concomitantly acting on multiple meta- bolic processes that accelerate the wound healing: stimulation of cytochrome-C oxi-

dase, an increase in angiogenesis, and im- provement in blood perfusion (5).

Taking into consideration the limitations of this proof-of-concept study, our findings indicate that laser therapy delivered by a class IV laser can significantly impact the healing process of neuroischemic DFUs re- fractory to standard treatment. Random- ized controlled clinical trials with this new laser device in larger populations are re- quired to confirm our results.