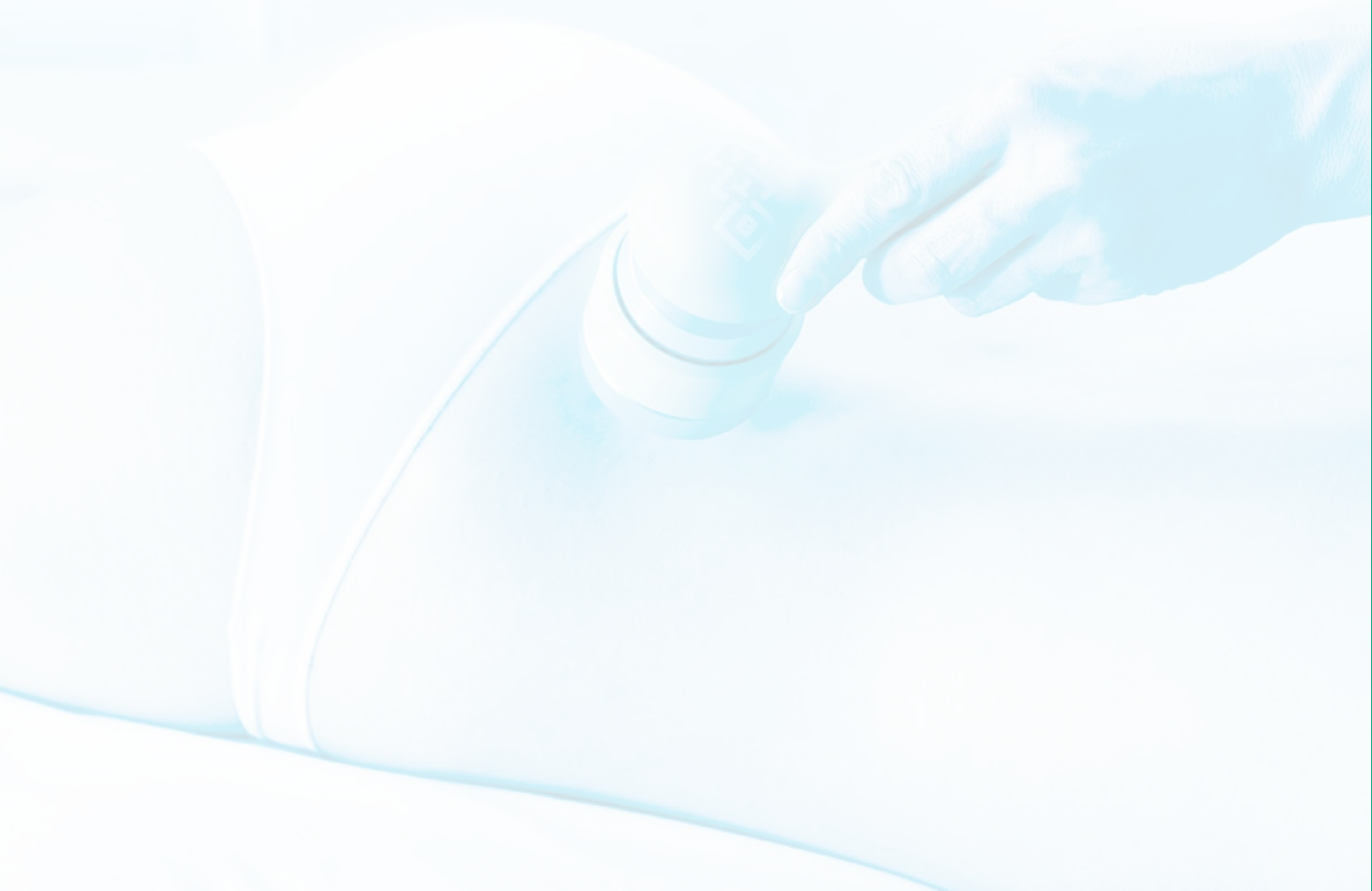




# LOW-LEVEL LASER THERAPY

## CLINICAL EVIDENCE



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## 1. LOW-LEVEL LASER THERAPY IN REHABILITATION

### TITLE: ADDITIVE EFFECTS OF LOW-LEVEL LASER THERAPY WITH EXERCISE ON SUBACROMIAL SYNDROME: A RANDOMISED, DOUBLE-BLIND, CONTROLLED TRIAL

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Source: *Clin Rheumatol.* 2011 May; 30: 1341-1346

#### ABSTRACT:

##### Introduction:

The subacromial syndrome is the most common source of shoulder pain. The mainstays of conservative treatment are non-steroidal anti-inflammatory drugs and exercise therapy. Recently, low-level laser therapy (LLLT) has been popularized in the treatment of various musculoskeletal disorders.

##### Purpose:

The aim of this study is to evaluate the additive effects of LLLT with exercise in comparison with exercise therapy alone in treatment of the subacromial syndrome.

##### Materials and Methods:

We conducted a randomized clinical study of 80 patients who presented to clinic with subacromial syndrome (rotator cuff and biceps tendinitis). Patients were randomly allocated into two groups. In group I (n=40), patients were given laser treatment (pulsed infrared laser) and exercise therapy for ten sessions during a period of 2 weeks. In group II (n=40), placebo laser and the same exercise therapy were given for the same period. Patients were evaluated for the pain with visual analogue scale (VAS) and shoulder range of motion (ROM) in an active and passive movement of flexion, abduction and external rotation before and after treatment. In both groups, significant post-treatment improvements were achieved in all parameters (P=0.00). In comparison between the two groups, a significant improvement was noted in all movements in group I (P=0.00). Also, there was a substantial difference between the groups in VAS scores (P=0.00) which showed significant pain reduction in group I.

##### Results and conclusion:

Our study indicates that LLLT combined with exercise therapy is more effective than exercise therapy alone in relieving pain and in improving the shoulder joint ROM in patients with subacromial syndrome (rotator cuff and biceps tendinitis), but further studies with larger samples, longer term findings and possible comparisons with other conservative interventions are needed to establish the effectiveness of this protocol.

### TITLE: EFFICACY OF LOW-LEVEL LASER THERAPY IN THE MANAGEMENT OF NECK PAIN: A SYSTEMATIC REVIEW AND META-ANALYSIS OF RANDOMISED PLACEBO OR ACTIVE-TREATMENT CONTROLLED TRIALS

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University of Bergen, Bergen, Norway

Source: *Lancet* 2009; 374: 1897-908

#### ABSTRACT:

##### Background:

Neck pain is a common and costly condition for which pharmacological management has limited evidence of efficacy and side-effects. Low-level laser therapy (LLLT) is a relatively uncommon, non-invasive treatment for neck pain, in which non-thermal laser irradiation is applied to sites of pain. We did a systematic review and metaanalysis of randomised controlled trials to assess the efficacy of LLLT in neck pain.

##### Methods:

We searched computerised databases comparing efficacy of LLLT using any wavelength with placebo or with active control in acute or chronic neck pain. Effect size for the primary outcome, pain intensity, was defined as a pooled estimate of mean difference in change in mm on 100 mm visual analogue scale.

##### Findings:

We identified 16 randomised controlled trials including a total of 820 patients. In acute neck pain, results of two trials showed a relative risk (RR) of 1,69 (95% CI 1,22-2,33) for pain improvement of LLLT versus placebo. Five trials of chronic neck pain reporting categorical data showed an RR for pain improvement of 4,05 (2,74-5,98) of LLLT. Patients in 11 trials reporting changes in visual analogue scale had pain intensity reduced by 19,86 mm (10,04-29,68). Seven trials provided follow-up data for 1-22 weeks after completion of treatment, with short-term pain relief persisting in the medium term with a reduction of 22,07 mm (17,42-26,72). Side-effects from LLLT were mild and not different from those of placebo.

##### Conclusion:

We show that LLLT reduces pain immediately after treatment in acute neck pain and up to 22 weeks after completion of treatment in patients with chronic neck pain.

## TITLE: EVALUATION OF LOW-LEVEL THERAPY EFFECTIVENESS ON THE PAIN AND MASTICATORY PERFORMANCE OF PATIENTS WITH MYOFASCIAL PAIN

*Authors: Mila Leite de Moraes Maia, Maria Amália Gonzaga Ribeiro, Luiz Guilherme Martins Maia, Juliana Stuginski-Barbosa, Yuri Martins Costa, André Luís Porporatti, Paulo César Rodrigues Conti, Leonardo Rigoldi Bonjardim*  
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*Source: Lasers Med Sci. 2014; 29: 29-35*

### ABSTRACT:

#### Background:

Study investigated the effect of low-level laser therapy (LLLT) on the masticatory performance (MP), pressure pain threshold (PPT), and pain intensity in patients with myofascial pain.

#### Methods:

Twenty-one subjects, with myofascial pain according to Research Diagnostic Criteria / temporomandibular dysfunction, were divided into laser group (n012) and placebo group (n09) to receive laser therapy (active or placebo) two times per week for 4 weeks. The measured variables were: (1) MP by analysis of the geometric mean diameter (GMD) of the chewed particles using Optocal test material, (2) PPT by a pressure algometer, and (3) pain intensity by the visual analog scale (VAS). Measurements of MP and PPT were obtained at three time points: baseline, at the end of treatment with low-level laser and 30 days after (follow-up). VAS was measured at the same times as above and weekly throughout the laser therapy. Irradiation parameters were as follows: wavelength 808 nm (infrared), laser optical power 100 mW, spot area 0.028 cm<sup>2</sup>, distance between the points of application 1 cm, total energy 1, 9 J, energy density 70 J/cm<sup>2</sup>, and time per point 19 s.

#### Findings:

A reduction in the GMD of crushed particles ( $p < 0.01$ ) and an increase in PPT ( $p < 0.05$ ) were seen only in the laser group when comparing the baseline and end-of-treatment values.

#### Conclusion:

Both groups showed a decrease in pain intensity at the end of treatment. LLLT promoted an improvement in MP and PPT of the masticatory muscles.

## TITLE: A RANDOMISED, PLACEBO CONTROLLED TRIAL OF LOW-LEVEL LASER THERAPY FOR ACTIVATED ACHILLES TENDINITIS WITH MICRODIALYSIS MEASUREMENT OF PERITENDINOUS PROSTAGLANDIN E2 CONCENTRATIONS

*Authors: J. M. Bjordal, R. A. B. Lopes-Martins, V. V. Iversen*  
*Affiliations: University of Bergen, Bergen, Norway*  
*Source: Br. J. Sports Med. 2006; 40: 76-80*

### ABSTRACT:

#### Introduction:

Low-level laser therapy (LLLT) has gained increasing popularity in the management of tendinopathy and arthritis. Results from in vitro and in vivo studies have suggested that inflammatory modulation is one of several possible biological mechanisms of LLLT action.

#### Objective:

To investigate in situ if LLLT has an anti-inflammatory effect on activated tendinitis of the human Achilles tendon.

#### Subjects:

Seven patients with bilateral Achilles tendinitis (14 tendons) who had aggravated symptoms produced by pain inducing activity immediately before the study.

#### Methods:

Infrared (904 nm wavelength) LLLT (5.4 J per point, power density 20 mW/cm<sup>2</sup>) and placebo LLLT (0 J) were administered to both Achilles tendons in random blinded order. Laser probe consisted of three laser diodes placed longitudinally 9 mm apart.

#### Results:

Ultrasonography Doppler measurements at baseline showed minor inflammation through increased intratendinous blood flow in all 14 tendons and measurable resistive index in eight tendons of 0.91 (95% confidence interval 0.87 to 0.95). Prostaglandin E2 concentrations were significantly reduced 75, 90, and 105 minutes after active LLLT compared with concentrations before treatment ( $p = 0.026$ ) and after placebo LLLT ( $p = 0.009$ ). Pressure pain threshold had increased significantly ( $p = 0.012$ ) after active LLLT compared with placebo LLLT: the mean difference in the change between the groups was 0.40 kg/cm<sup>2</sup> (95% confidence interval 0.10 to 0.70).

#### Conclusion:

LLLT can suppress inflammation, as measured by a reduction in the inflammatory marker PGE2. In addition, clinical indices of small, but significant improvements in pressure pain and single hop function were observed. In conclusion, these results indicate that LLLT can be used to reduce inflammatory musculoskeletal pain.

## TITLE: EFFECT OF LOW-LEVEL LASER THERAPY ON THE EXPRESSION OF INFLAMMATORY MEDIATORS AND ON NEUTROPHILS AND MACROPHAGES IN ACUTE JOINT INFLAMMATION

Authors: Ana Carolina Araruna Alves, Rodolfo de Paula Vieira, Ernesto Cesar Pinto Leal-Junior, Solange Almeida dos Santos, Ana Paula Ligeiro, Regiane Albertini, Jose Antonio Silva Junior and Paulo de Tarso Camillo de Carvalho

Affiliations: Postgraduate Program in Rehabilitation Sciences, Universidade Nove de Julho (UNINOVE), São Paulo, Brazil

Source: *Arthritis Research & Therapy*. 2013; 15: R1 16

### ABSTRACT:

#### Introduction:

Inflammation of the synovial membrane plays an important role in the pathophysiology of osteoarthritis (OA). The synovial tissue of patients with initial OA is characterized by infiltration of mononuclear cells and production of proinflammatory cytokines and other mediators of joint injury. The objective was to evaluate the effect of low-level laser therapy (LLLT) operating at 50 mW and 100 mW on joint inflammation in rats induced by papain, through histopathological analysis, differential counts of inflammatory cells (macrophages and neutrophils), as well as gene expression of interleukin 1-beta and 6 (IL-1b and IL-6), and protein expression of tumor necrosis factor alpha (TNFa).

#### Methods:

Male Wistar rats (n = 60) were randomly divided into four groups of 15 animals, namely: a negative control group; an inflammation injury positive control group; a 50 mW LLLT group, subjected to injury and treated with 50 mW LLLT; and a 100 mW LLLT group, subjected to injury and treated with 100 mW LLLT. The animals were subject to joint inflammation (papain solution, 4%) and then treated with LLLT (808 nm, 4 J, 142.4 J/cm<sup>2</sup>, spot size 0.028 cm<sup>2</sup> for both groups).

**Results:** Laser treatment with 50 mW was more efficient than 100 mW in reducing cellular inflammation, and decreased the expression of IL-1b and IL-6. However, the 100 mW treatment led to a higher reduction of TNFa compared with the 50 mW treatment.

#### Conclusions:

Despite both power outputs tested in this study showing positive results, LLLT with 50 mW was more efficient in modulating inflammatory mediators (IL-1b, IL-6) and inflammatory cells (macrophages and neutrophils), and led to histological signs of an attenuated inflammatory process.

## TITLE: EFFECTIVENESS OF PHYSIOTHERAPY AND GaAIAs LASER IN THE MANAGEMENT OF TEMPOROMANDIBULAR JOINT DISORDERS

Authors: Tatjana Dostalova, M.D., Ph.D., DrSci, M.B.A., Petra Hlinakova M.D., Magdalena Kasparova, M.D., Adam Rehacek, D.M.D., Lenka Vavrickova, M.D., Leos Navratil, M.D., Ph.D. DrSc

Affiliations: Charles University, Prague and Hradec Kralove, Czech Republic

Source: *Photomedicine and Laser Surgery*. 2012; 30 (5): 275-280.

### ABSTRACT:

#### Objective:

The aim of this study was to monitor the function of temporomandibular joint (TMJ) and surrounding tissues and compare the objective measurements of the effect of LLLT.

#### Background data:

LLLT has been considered effective in reducing pain and muscular tension; thus improving the quality of patients' lives.

#### Materials and Methods:

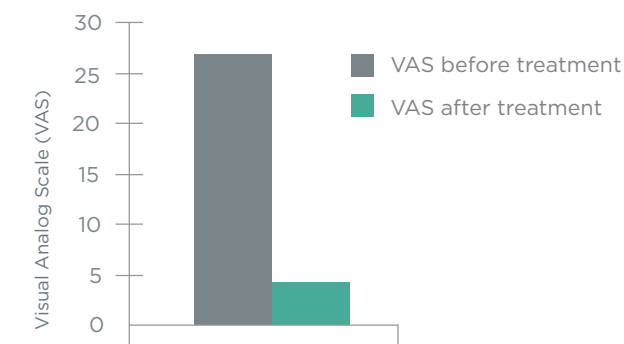
TMJ function was evaluated by cephalometric tracing analysis, orthopantomogram, TMJ tomogram, and computer face-bow record. Interveolar space between central incisors before and after therapy was measured. Patients evaluated pain on the Visual Analog Scale. LLLT was performed in five treatment sessions (energy density of 15.4 J/cm<sup>2</sup>) by semiconductive GaAIAs laser with an output of 280mW, emitting radiation wavelength of 830nm. The laser supplied a spot of 0.2 cm<sup>2</sup>.

#### Results:

Baseline comparisons between the healthy patients and patients with low-level laser application show that TMJ pain during function is based on anatomical and function changes in TMJ areas. Significant differences were seen in the posterior and anterior face height. The results comparing healthy and impaired TMJ sagittal condyle paths showed that patients with TMJ pain during function had significantly flatter nonanatomical movement during function. After therapy, the unpleasant feeling was reduced from 27.5 to 4.16 on the pain Visual Analog Scale (0 indicates "no pain", 100 indicates "the worst possible pain"). A reduction of pain enabled the ability of opening the mouth from 34 to 42 mm.

#### Conclusion:

The laser therapy was effective in the improvement of the range of temporomandibular disorders (TMD) and promoted a significant reduction of pain symptoms.





## TITLE: EVALUATION OF LOW-LEVEL LASER THERAPY IN TMD PATIENTS – A CASE REPORT

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Source: Hindawi Publishing Corporation. *Case Reports in Dentistry*. Vol. 2015: Article ID 424213, 6 pages.

### ABSTRACT:

#### Introduction:

Light amplification by stimulated emission of radiation (laser) is one of the most recent treatment modalities in dentistry. Low level laser therapy (LLLT) is suggested to have biostimulating and analgesic effects through direct irradiation without causing thermal response. There are few studies that have investigated the efficacy of laser therapy in temporomandibular disorders (TMD), especially in reduced mouth opening. The case report here evaluates performance of LLLT with a diode laser for temporomandibular clicking and postoperative findings were evaluated in two cases of TMD patients. First patient had a history of limited mouth opening and pain in temporomandibular joint (TMJ) region since nine months. Second patient's main complaint was his restricted mouth opening, which was progressed in one year.

#### Methods and parameters:

LLLT was performed with a 685 nm red probed diode laser that has an energy density of 6.2 J/cm<sup>2</sup>, three times a week for one month, and application time was 30 seconds (685 nm, 25mW, 30 s, 0.02Hz, and 6.2 J/cm<sup>2</sup>) (BTL-2000, Portative Laser Therapy Device). The treatment protocol was decided according to the literature.

#### Results:

The patient was evaluated immediately after the application and at the follow-up appointments to investigate effectiveness and cumulative effects. After the last application of the treatment MMO was increased to 45 mm, right excursions and left excursions were also increased to 8 mm and he was painless during these limits of movement.

#### Conclusion:

This application suggested that LLLT is an appropriate treatment for TMD related pain and limited mouth opening and should be considered as an alternative to other methods.



Mouth opening ability before (left) and after (right) the treatment

## TITLE: A SYSTEMATIC REVIEW OF LOW LEVEL LASER THERAPY WITH LOCATION-SPECIFIC DOSES FOR PAIN FROM CHRONIC JOINT DISORDERS

Authors: Jan M. Bjordal, Christian Couppé, Roberta T. Chow, Jan Tunér, Elisabeth Anne Ljunggren

Affiliations: University of Bergen, Norway; Lund University, Sweden; Private Medical Practice, Sydney; Private Dental Practice, Stockholm, Sweden

Source: *Australian Journal of Physiotherapy*. 2003; 49: 107-116

### ABSTRACT:

#### Objective:

We investigated if low level laser therapy (LLLT) of the joint capsule can reduce pain in chronic joint disorders. In the following review, our hypothesis is that laser irradiation of the joint capsule can reduce pain in chronic joint disorders if the dose is adjusted to inhibit inflammatory activity in the joint capsule.

#### Materials and methods:

This included a sequential four-step reviewing procedure involving predetermination of an optimal dose range, conduct of a sensitive literature search, application of a pre-specified inclusion / exclusion procedure, and testing of differences between trials with and without optimal dose. We assumed doses of 0.4-19 J and power density of 5-21 mW/cm<sup>2</sup> would be capable of reducing inflammation at the target joint capsule without compromising fibroblast metabolism; Power density for GaAs 904 nm pulse lasers (mW/cm<sup>2</sup>).

#### Conclusion:

LLLT seemed to be effective in reducing pain from chronic joint disorders. The hypothesis that LLLT acts through a dose-specific anti-inflammatory effect in the irradiated joint capsule is a potential explanation of the positive results.

## TITLE: ROLE OF LOW-LEVEL LASER THERAPY IN NEUROREHABILITATION

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*Affiliations: Harvard Medical School, Boston, MA; Guangxi Medical University, Nanning, PR China; Aga Khan Medical College, Karachi, Pakistan; Massachusetts General Hospital, Boston; Boston University School of Medicine, Boston; Harvard-MIT Division of Health Sciences and Technology, Cambridge*

*Source: PM R. Dec 2010; 2(12): 292-305*

### ABSTRACT:

#### Objective:

This review will cover the mechanisms of LLLT that operate both on a cellular and a tissue level. Animal studies and human clinical trials of LLLT for indications with relevance to neurology, such as stroke, traumatic brain injury, degenerative brain disease, spinal cord injury, and peripheral nerve regeneration, will be covered. Many of the most compelling applications of LLLT are in the field of neurology (both central and peripheral). Many serious brain diseases and injuries can be successfully treated with non-invasive transcranial laser therapy. Furthermore, in the peripheral nervous system, LLLT can be used effectively for nerve regeneration and pain relief.

#### Study Design / Materials and Methods:

Transcranial 808 nm, 0.9 J/cm<sup>2</sup> and 7.5 mW/cm<sup>2</sup> power density LLLT has been shown to significantly improve outcome in acute human stroke patients when applied approximately 18 hours after the stroke occurs over the entire surface of the head (20 points in the 10/20 electroencephalographic system), regardless of the stroke location. Only one LLLT treatment was administered, and, 5 days later, significantly greater improvement was found in the real-treated group but not in the sham-treated group. This significantly greater improvement was still present 90 days after – the stroke occurred, at which time 70% of the patients treated with real LLLT had a successful outcome compared with only 51% of control subjects.

In humans, 2 persons with chronic mild traumatic brain injury recently have been reported to have improved cognition after a series of treatments with transcranial, red, and NIR (noninfrared) diodes, applied to the forehead and scalp areas. Each cluster head had 61 diodes (9 red 633 nm diodes and 52 NIR 870 nm diodes). Each diode was 12-15 mW, and the total power output was 500 mW. The LED cluster heads were applied to bilateral frontal, parietal, and temporal areas and to the mid-sagittal suture line. The dose of 13.3 J/cm<sup>2</sup> per placement area was estimated to deliver only 0.4 J/cm<sup>2</sup> to the brain cortex.

#### Conclusion:

LLLT is steadily moving into mainstream medical practice. As the Western populations continue to age, the incidence of the degenerative diseases of old age will only continue to increase and produce an ever more severe financial and societal burden. Moreover, despite the best efforts of “big pharma,” distrust of pharmaceuticals is growing in general because of uncertain efficacy and troublesome adverse effects. LLLT has no reported adverse effects, and no reports of adverse events can be directly attributed to laser or light therapy. We believe that the high benefit: risk ratio of LLLT should be better appreciated by medical professionals in the rehabilitation and physical medicine specialties.

## 2. LOW-LEVEL LASER THERAPY IN DERMATOLOGY

### TITLE: LOW-LEVEL LASER THERAPY IN SKIN – STIMULATING, HEALING, RESTORING

*Authors: Pinar Avci, MD; Asheesh Gupta, PhD; Magesh Sadasivam, MTech; Daniela Vecchio, PhD; Zeev Pam, MD; Nadav Pam, MD and Michael R Hamblin, PhD*

*Affiliation: Massachusetts General Hospital, Boston MA; Harvard Medical School, Boston MA; Defence Institute of Physiology & Allied Sciences, Delhi, India; Aripam Medical Center, Ashdod, Israel; Harvard-MIT Division of Health Sciences and Technology, Cambridge, MA*

*Source: Semin Cutan Med Surg. March 2013; 32(1): 41-52.*

### ABSTRACT:

#### Introduction:

Low-level laser (light) therapy (LLLT) is a fast-growing technology used to treat a multitude of conditions that require stimulation of healing, relief of pain and inflammation, and restoration of function. Although the skin is the organ that is naturally exposed to light more than any other organ, it still responds well to red and near-infrared wavelengths. In dermatology, LLLT has beneficial effects on wrinkles, acne scars, hypertrophic scars, and healing of burns. LLLT can reduce UV damage both as a treatment and as a prophylaxis. In pigmentary disorders such as vitiligo, LLLT can increase pigmentation by stimulating melanocyte proliferation and reduce depigmentation by inhibiting autoimmunity. Inflammatory diseases such as psoriasis and acne can also benefit. The non-invasive nature and almost complete absence of side-effects encourages further testing in dermatology.

#### Results:

For example for skin rejuvenation Lee et al. investigated the histologic and ultrastructural changes following a combination of 830 nm, 55 mW/cm<sup>2</sup>, 66 J/cm<sup>2</sup> and 633 nm, 105 mW/cm<sup>2</sup>, 126 J/cm<sup>2</sup> LED phototherapy and observed alteration in the status of metalloproteinases (MMPs) and their tissue inhibitors (TIMPs). Several studies reported that LLLT in the red to near infrared spectral range (630-1000 nm) and nonthermal power (less than 200 mW) alone or in combination with other treatment modalities (mainly blue light), is effective for treatment of acne vulgaris. One of these studies demonstrated significant reduction in active acne lesions after 12 sessions of treatment using 630 nm red spectrum LLLT with a fluence of 12 J/cm<sup>2</sup> twice a week for 12 sessions in conjunction with 2% topical clindamycin.

#### Conclusion:

LLLT appears to have a wide range of applications in dermatology, especially in indications where stimulation of healing and reduction of inflammation, are required. The application of LLLT to disorders of pigmentation may work both ways by producing both repigmentation of vitiligo, and depigmentation of hyperpigmented lesions depending on the dosimetric parameters. The introduction of LED array-based devices has simplified the application to large areas of skin.

## TITLE: LOW LEVEL LASER THERAPY - A CONSERVATIVE APPROACH TO THE BURN SCAR

Authors: Karin Gaida, Rupert Koller, Can Isler, Oygur Aytekin, Mahdi Al-Awami, Günther Meissl, Manfred Frey

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Source: Elsevier. Burns 2004; 30: 362-367

### ABSTRACT:

#### Introduction:

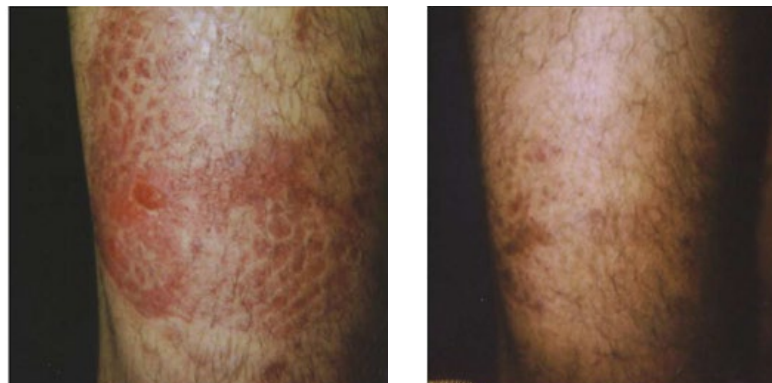
Burn scars are known to be difficult to treat because of their tendency to worsen with hypertrophy and contracture. Various experimental and clinical efforts have been made to alleviate their effects but the problem has not been solved. Since patients keep asking for Low Level Laser Therapy (LLLT) and believe in its effectiveness on burn scars, and since former studies show contradictory results of the influence of LLLT on wound healing, this prospective study was designed to objectify the effects of LLLT on burn scars.

#### Methods and materials:

Nineteen patients with 19 burn scars were treated with a power of 400 mW and wavelength 670 nm softlaser twice a week over 8 weeks. The applied energy density (dose) was 4 J/cm<sup>2</sup> and the laser beam was adjusted to correspond to the size of the lesion. Radiation time and distance between diode and wound varied with the size of the lesion as a result of the defocused laser beam. The treatment was performed twice a week, with a minimum interval of 3 days, over 8 weeks. In each patient a control area was defined, that was not irradiated. Parameters assessed were the Vancouver Scar Scale (VSS) for macroscopic evaluation and the Visual Analogue Scale (VAS) for pruritus and pain. Photographical and clinical assessments were recorded in all the patients.

#### Results and conclusion:

Seventeen out of 19 scars exhibited an improvement after treatment. The average rating on the VSS decreased from 7.10 ± 2.13 to 4.68 ± 2.05 points in the treated areas, whereas the VSS in the control areas decreased from 6.10 ± 2.86 to 5.88 ± 2.72. A correlation between scar duration and improvement through LLLT could be found. No negative effects of LLLT were reported. The present study shows that the 400 mW, 670 nm softlaser has a positive, yet sometimes limited effect on burn scars concerning macroscopic appearance, pruritus, and pain.



Disappearance of the pattern of mesh grafts during treatment with LLLT before (left) and after (right)

## TITLE: PROPHYLACTIC LOW-LEVEL LIGHT THERAPY FOR THE TREATMENT OF HYPERTROPHIC SCARS AND KELOIDS - A CASE SERIES

Authors: Daniel Barolet, MD.; Annie Boucher, PhD.

Affiliations: RoseLab Skin Optics Research Laboratory, Montreal, Quebec, Canada; Dermatology Division, Department of Medicine, McGill University, Montreal, Quebec, Canada

Source: Lasers in Surgery and Medicine. 2010; 42: 597-601

### ABSTRACT:

#### Background and Objectives:

Hypertrophic and keloid scars result from alterations in the wound healing process. Treating abnormal scars remains an important challenge. The aim of this case series was to investigate the effectiveness of near infrared (NIR) light emitting diode (LED) treatment as a prophylactic method to alter the wound healing process in order to avoid or attenuate the formation of hypertrophic scars or keloids.

#### Study Design/Patients and Methods:

Three patients (age 27–57) of phototypes I–III with hypertrophic scars or keloids due to acne or surgery participated in this case series. Following scar revision by surgery or CO<sub>2</sub> laser ablation on bilateral areas, one scar was treated daily by the patient at home with non-thermal, non-ablative NIR LED (805 nm at 30 mW/cm<sup>2</sup>) for 30 days. Efficacy assessments, conducted up to a year post-treatment, included the Vancouver Scar scale (VSS), clinical global assessment of digital photographs, and quantitative profilometry analysis using PRIMOS. Safety was documented by adverse effects monitoring.

#### Results:

Significant improvements on the NIR-treated versus the control scar were seen in all efficacy measures. No significant treatment-related adverse effects were reported.

#### Conclusion:

Possible mechanisms involved are inhibition of TGF-β1 expression. Further studies in larger group of patients are needed to evaluate this promising technique.



Case 1 after pre-auricular scar revision (up) and 1-year follow-up (down).

Left picture: IR - treated side; Right picture: control side



## TITLE: EFFECTS OF LOW - LEVEL LASER THERAPY ON THE PROGRESS OF WOUND HEALING IN HUMANS: THE CONTRIBUTION OF IN VITRO AND IN VIVO EXPERIMENTAL STUDIES

*Authors: Adeir Moreira Rocha Júnior, Beatriz Julião Vieira, Luís Carlos Ferreira de Andrade, Fernando Monteiro Aarestrup*

*Affiliations: Universidade Federal de Juiz de Fora, Universidade Federal de São Paulo*

*Source: J Vasc Bras. 2007; 6 (3): 258-266.*

### ABSTRACT:

#### Introduction:

Low-level laser therapy is an important method for the treatment of healing processes, and several experimental studies have been carried out in search of a greater understanding of its therapeutic possibilities. The objective of this study was to review pathogenetic aspects of soft tissue repair to better understand skin lesion healing and the role of low-intensity laser in the progression of tissue healing. This study consists of a concise review of scientific literature data on the use of low-level laser and its influence on wound healing. Many studies have extensively covered the effects of using laser radiation in tissues, describing its beneficial aspects in tissue healing.

#### Conclusion:

Several research studies have used superficial wounds to assess the effects of low-intensity laser on healing. Some have used clinical wounds such as ulcers of different sizes and depths and others have developed models of superficial wounds in animals. These diverse methods have produced a variety of results and conclusions on the effects of LLLT. Recent results of a study demonstrated that LLLT is an effective method to modulate tissue repair, thus significantly contributing to a faster and more organized healing process.

## TITLE: EFFECT OF LASER PHOTOTHERAPY ON RECCURING HERPES LABIALIS PREVENTION - AN IN VIVO STUDY

*Authors: Renata Rodrigues de Carvalho, Fernanda de Paula Eduardo, Karen Müller Ramalho, José Leopoldo Ferreira Antunes, Leticia Mello Bezinelli, Marina Helena Cury Gallottini de Magalhães, Tatiana Pegoretti, Patrícia Moreira de Freitas, Carlos de Paula*

*Affiliations: School of Dentistry, University of São Paulo, São Paulo, SP, Brazil*

*Source: Lasers Med. Sci. 2010; 25: 397-402*

### ABSTRACT:

#### Purpose:

Alternative treatment for recurrent labial infection by herpes simplex virus (HSV) has been considered. The aim of this study was to evaluate the effectiveness of laser phototherapy in prevention and reduction of severity of labial manifestations of herpes labialis virus.

#### Materials and methods:

Seventy one patients, divided into experimental (n=41) and control (n=30) groups were followed up for 16 months. Patients in the control group were treated topically with acyclovir and patients in the experimental group were subjected to laser phototherapy (one session per week, 10 weeks): 780 nm, 60 mW, 3.0 J/cm<sup>2</sup> or 4.5 J/cm<sup>2</sup> on healthy (no HSV-1 infection) and affected (with HSV-1 infection) tissues. Patients in the experimental group presented a significant decrease in dimension of herpes labialis lesions (P=0.013) and inflammatory oedema (P=0.031).

#### Conclusion:

It was concluded that the laser phototherapy treatment tested in this study contributed to the decrease in size of the lesions, and to the reduction in inflammatory edema, of recurrent herpes labialis. These results represent an initial indication that this treatment modality should be further considered as an effective alternative to therapeutic regimens already established for this health condition.

# TITLE: BLUE AND RED LIGHT COMBINATION LIGHT EMITTING DIODE PHOTOTHERAPY FOR ACNE VULGARIS IN PATIENTS WITH SKIN PHOTOTYPE IV

Authors: Seung Yoon Lee, MD, Chung Eui You, MD, and Mi Youn Park, MD, PhD

Affiliations: Department of Dermatology, National Medical Center, Seoul, Republic of Korea

Source: Lasers in Surgery and Medicine. 2006 Aug; 39:180-188

**ABSTRACT:**

**Background and Objectives:**

This study was designed to investigate the efficacy of combined blue and red light-emitting diode (LED) phototherapy for acne vulgaris.

**Materials and Methods:**

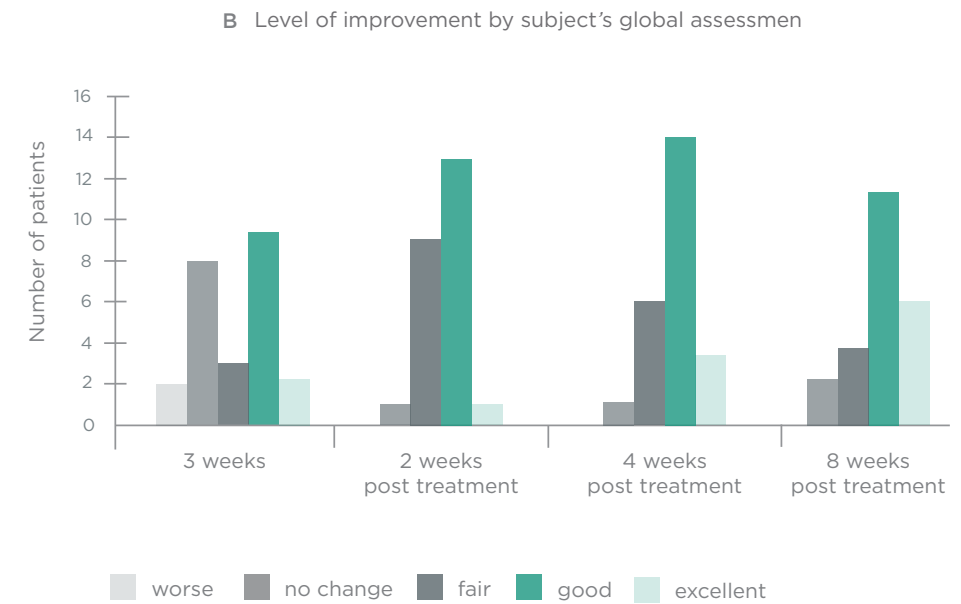
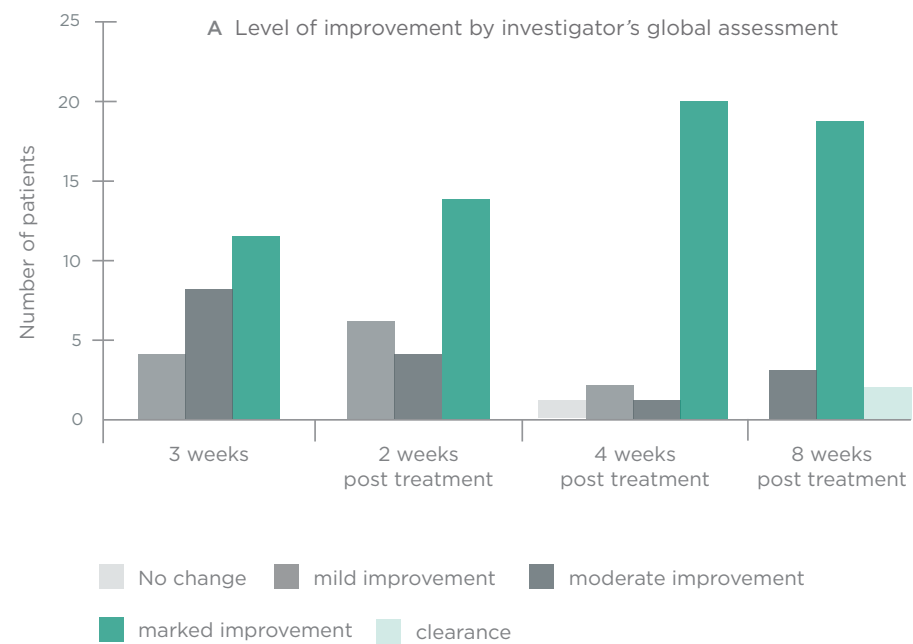
Twenty-four patients with mild to moderately severe facial acne were treated with quasi monochromatic LED devices, alternating blue (415 nm) and red (633 nm) light. The treatment was performed twice a week for 4 weeks. Objective assays of the skin condition were carried out before and after treatment at each treatment session. Clinical assessments were conducted before treatment, after the 2nd, 4th, and 6th treatment sessions and at 2, 4, and 8 weeks after the final treatment by grading and lesion counting.

**Results:**

The final mean percentage improvements in non-inflammatory and inflammatory lesions were 34.28% and 77.93%, respectively. Instrumental measurements indicated that the melanin levels significantly decreased after treatment. Brightened skin tone and improved skin texture were spontaneously reported by 14 patients.

**Conclusion:**

Blue and red light combination LED phototherapy is an effective, safe and non-painful treatment for mild to moderately severe acne vulgaris, particularly for papulopustular acne lesions.



## TITLE: HELIUM-NEON LASER IRRADIATION STIMULATES MIGRATION AND PROLIFERATION IN MELANOCYTES AND INDUCES REPIGMENTATION IN SEGMENTAL - TYPE VITILIGO

Authors: Hsin-Su Yu, C hieh-Shan Wu, C hia-Li Yu, n Ying-Hsien Kao, Min-Hsi Chiou  
 Affiliations: Kaohsiung Medical University, Kaohsiung, Taiwan; National Taiwan University, Taipei, Taiwan  
 Source: *The journal of investigative dermatology*. Jan 2003; 120 (1): 56-64

### ABSTRACT:

#### Introduction:

Low-energy helium-neon lasers (632.8 nm) have been employed in a variety of clinical treatments including vitiligo management. Light-mediated reaction to low energy laser irradiation is referred to as biostimulation rather than a thermal effect. This study sought to determine the theoretical basis and clinical evidence for the effectiveness of helium-neon lasers in treating vitiligo. Cultured keratinocytes and fibroblasts were irradiated with 0.5-1.5 J/cm<sup>2</sup> helium-neon laser radiation. The effects of the helium-neon laser on melanocyte growth and proliferation were investigated.

#### Methods:

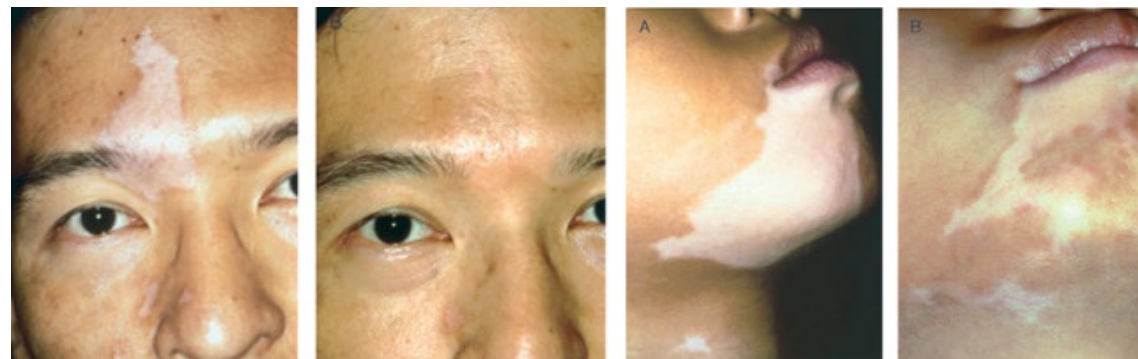
Helium-neon laser light was administered locally at 3.0 J/cm<sup>2</sup> with point stimulation once or twice weekly. The percentage of repigmented area was used for clinical evaluation of effectiveness.

#### Results:

After an average of 16 treatment sessions, initial repigmentation was noticed. Marked repigmentation (450%) was observed in 60% of patients with successive treatments.

#### Conclusion:

The results of this in vitro study revealed a significant increase in basic fibroblast growth factor release from both keratinocytes and fibroblasts and a significant increase in nerve growth factor release from keratinocytes. Medium from helium-neon laser irradiated keratinocytes stimulated [3H] thymidine uptake and proliferation of cultured melanocytes. Furthermore, melanocyte migration was enhanced either directly by helium-neon laser irradiation or indirectly by the medium derived from helium-neon laser treated keratinocytes.



He-Ne laser treatment induced repigmentation in two typical patients with segmental-type vitiligo.

## TITLE: THE USE OF LASER ACUPUNCTURE FOR THE TREATMENT OF NEUROGENIC PRURITUS IN A CHILD - A CASE HISTORY

Authors: Anthony Stellon  
 Source: *Acupuncture in medicine*. 2005; 23 (1): 31-33

### ABSTRACT:

#### Introduction:

This report describes the successful treatment using laser acupuncture of a six year old girl with neurogenic pruritus of the abdomen. It is the first case report of neurogenic pruritus treated by laser acupuncture. The main advantage of using low energy laser, as opposed to acupuncture needles, to stimulate points, is that low energy laser causes little or no sensation, which is particularly useful when treating children.

#### Methods and materials:

Treatment consisted of laser therapy to the paravertebral points at 1cm intervals alongside T9 to T12, bilaterally. A 300mW laser emitting 820nm wavelength was used. Each point was irradiated for 15 seconds, giving an energy density at the surface of 40 J/cm<sup>2</sup>. This was repeated on two further occasions, one week and three weeks after the initial treatment.

#### Results:

As the patient's symptoms resolved, the palpable tightness of the paravertebral muscles disappeared. The patient has remained symptom-free 16 weeks post-treatment. She has slept through the night and has not complained of itching during the day.

#### Conclusion:

Laser acupuncture appears to have been an effective treatment of neurogenic pruritus in this case. It may be especially useful for children with this condition as it avoids the use of needles. Laser therapy warrants further evaluation in adults with this condition.

### 3. LOW-LEVEL LASER THERAPY IN OTORHINOLARYNGOLOGY

#### TITLE: EFFECTS OF LOW LEVEL LASER THERAPY ON OVALBUMIN-INDUCED MOUSE MODEL OF ALLERGIC RHINITIS

*Authors: Binhye Choi, Mun Seog Chang, Ha Young Kim, Jae-Woo Park, Bongha Ryu, Jinsung Kim*  
*Affiliations: Department of Internal Medicine, College of Korean Medicine, Kyung Hee University, Republic of Korea; Department of Prescriptionology, College of Korean Medicine, Kyung Hee University, Republic of Korea*  
*Source: Evidence - based Complementary and Alternative Medicine 2013; Article ID 753829, 8 pages*

#### ABSTRACT:

##### Introduction:

This study was designed to investigate the effects of low level laser therapy (LLLT) on experimental allergic rhinitis (AR) models induced by ovalbumin.

##### Methods and materials:

AR was induced by 1% ovalbumin in mice. Twenty-four mice were divided into 4 groups: normal, control, low and high dose irradiation. Low and high dose LLLT were irradiated once a day for 7 days. Total IgE, cytokines concentrations (IL-4 and IFN- $\gamma$ ), and thymus and activation regulated chemokine (TARC) were measured. Histological changes in the nasal mucosal tissue by laser irradiation were examined.

##### Results:

LLLT significantly inhibited total IgE, IL-4, and TARC expression in ovalbumin-induced mice at low dose irradiation. The protein expression level of IL-4 in spleen was inhibited in low dose irradiation significantly. IL-4 expression in EL-4 cells was inhibited in a dose dependent manner. Histological damages of the epithelium in the nasal septum were improved by laser irradiation with marked improvement at low dose irradiation.

##### Conclusion:

These results suggest that LLLT might serve as a new therapeutic tool in the treatment of AR with more effectiveness at low dose irradiation. To determine the optimal dose of laser irradiation and action mechanisms of laser therapy, further studies will be needed.

### TITLE: LOW - LEVEL LASER THERAPY OF SINUSITIS

*Authors: M. Hacarova; J. Hubacek*  
*Affiliations: ENT and Allergology, Olomouc, Czech Republic; Faculty Hospital, ENT Clinic, Olomouc, Czech Republic*

#### ABSTRACT:

The authors have been monitoring influence of a therapeutic laser (LLLT), wavelength 830 nm, output 40 - 120 mW, on treatment of acute sinusitis in 194 patients in group I (consisting of 20 patients with diagnosis of sinusitis maxillaris unilat., bilateralis: 145, frontalis unilat.: 2, pansinusitis: 24 patients). Control group II consisted of 241 patients with the same diagnosis, treated without the use of a laser. Energy density applied on children was 1.6 J/cm<sup>2</sup>, 3 times every other day, on adults 2.5 J/cm<sup>2</sup>, 5 times every other day on every affected sinus. Laser probe was applied externally on the skin of frontal wall of the sinus. 30 patients were treated with laser only, 91 patients were treated with laser and antihistaminics, 73 patients were treated with laser, antihistaminics and antibiotics.

#### Conclusion:

A significant analgetic effect of laser irradiation was noticed in all groups, the number of punctures decreased substantially in comparison with group II, presumably thanks to release of outlets of the sinus and improved drainage, the time of treatment decreased significantly. No complications were noticed.

## TITLE: POTENTIAL ANTI-INFLAMMATORY EFFECT OF LOW-LEVEL LASER THERAPY ON THE EXPERIMENTAL REFLUX LARYNGITIS: A PRELIMINARY STUDY

*Authors: Renata R. Marinho & Renata M. Matos & Jandson S. Santos & Maria A. G. Ribeiro & Ronaldo A. Ribeiro & Roberto C. P. Lima Jr & Ricardo L. C. Albuquerque Jr & Sara M. Thomazzi*

*Affiliations: Universidade Federal de Sergipe, Brazil; Universidade Federal de Ceará, Brazil;*

*Universidade Tiradentes, Brazil*

*Source: Lasers Med Sci. 2014; 29: 239 - 243*

### ABSTRACT:

The most common cause of laryngitis is the laryngopharyngeal reflux disease. The symptoms of laryngitis can be hoarseness, globus, chronic cough, voice fatigue, throat pain and dysphagia. Low-level laser therapy (LLLT) is beneficial to reduce the pain and inflammatory response without side effects. Therefore, LLLT may be a useful tool for the treatment of laryngitis. This study proposes to analyze the effect of laser therapy in a model of reflux-induced laryngitis. The animals were randomly put into three groups: control-non-intubated; nasogastric intubation-intubated; and nasogastric intubation with laser therapy-intubated treated with 105 J/cm<sup>2</sup> laser irradiation.

### Conclusion:

We demonstrated that 105 J/cm<sup>2</sup> infrared laser irradiation is potentially useful to control reflux laryngitis secondary to nasogastric intubation by reducing the influx of neutrophils to the injured area and improving the reparative collagenisation of the laryngeal tissues. Therefore, we suggest that low-level laser is a promising therapy to be used in treatment of reflux-induced laryngitis.

## TITLE: LOW-LEVEL LASER THERAPY IN PATIENTS WITH COMPLAINTS OF TINNITUS - A CLINICAL STUDY

*Authors: Ahmed H. Salahaldin, Khalid Abdulhadi, Nihal Najjar, Abdulbari Bener*

*Affiliations: ENT and Head and Neck Surgery Department, Rumaillah Hospital and Hamad General Hospital, Qatar; Department of Medical Statistics, Epidemiology, Hamad General Hospital, Qatar;*

*Department of Public Health, Medical Education, Weill Cornell Medical College, New York, USA;*

*Evidence for Population Health Unit, School of Epidemiology and Health Sciences, The University*

*of Manchester, UK*

*Source: ISRN Otolaryngology; Volume 2012, Article ID 132060*

### ABSTRACT:

#### Objective:

The objective of the study was to investigate the effectiveness of Low-level laser therapy (LLLT) in patients who were suffering from long-term complaints of tinnitus with well-understood etiology and who were not responding to conventional therapy.

#### Subjects and Methods:

The study included 65 patients aged 15-76 years with chronic unilateral or bilateral tinnitus with a minimum duration of illness of one year. The investigation included 101 ears of 65 patients. A 5 mW laser with a wavelength of 650 nm was applied transmeatally for 20 minutes once daily for 3 months. The study was based on a face-to-face interview with a designed questionnaire that recorded the diagnosis of patients, clinical evaluation and audiometric test results, and side effects of Low-level laser therapy (LLLT) and scored their symptoms loudness on five-point scale every two weeks. A decrease of one scale point regarding the loudness duration and degree of annoyance of tinnitus was accepted to represent an improvement; at the same time, a pure tone audiometric test was carried out and the results recorded. In addition, a record of the side effect was taken.

#### Results:

Over half of the patients (56.9%) had some form of improvement in their tinnitus symptoms. Mild improvement was reported in 33.8% of patients, moderate improvement was reported in 16.9%, and full improvement was reported in 6.15%. Of the patients who reported dizzy spells as a symptom of their tinnitus condition, 27.7% reported mild improvement and 16.9% reported full improvement. Common side effects of LLLT were noted among 20% of patients; however, all of them were mild and disappeared within a few days.

#### Conclusion:

LLLT was effective in producing a reasonable improvement in patients' complaints of long-standing tinnitus despite previous treatment of the condition. In addition, it was useful in reducing dizziness that patients may have as a result of their illness. Considering that the side effects are very mild and that over half of the patients had some improvement in their symptoms, it is clear that LLLT is a useful treatment for chronic tinnitus patients.



## TITLE: LOW-LEVEL LASER FOR TREATMENT OF TINNITUS: A SELF-CONTROLLED CLINICAL TRIAL

Authors: Ahmadreza Okhovat, Nezamoddin Berjjs, Hoda Okhovat, Afsaneh Malekpour, Hamidreza Abtahi

Affiliations: Department of Otorhinolaryngology, Department of Community Medicine, School of Medicine, Isfahan University of Medical Science, Isfahan, Iran

Source: JRMS 2011; 16(1): 33-38

### ABSTRACT:

#### Background:

Despite the high prevalence and morbidity, tinnitus still remains an obscure symptom. We assessed the efficacy of low-level laser for treatment of tinnitus.

#### Methods:

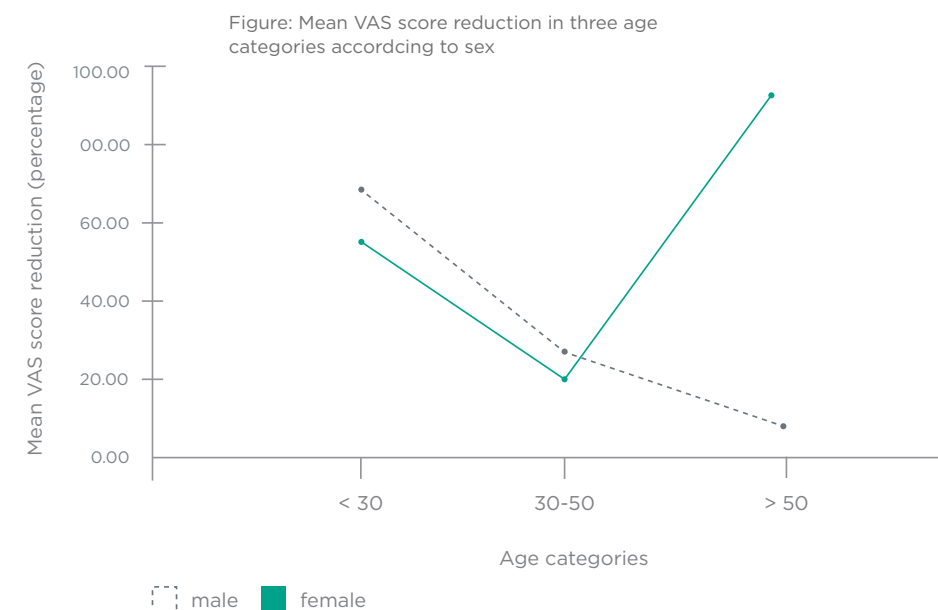
It was a self-controlled clinical trial study on 61 outpatients with subjective tinnitus. The patients were irradiated with a 650 nm, 5 mW soft laser for twenty days and twenty minutes per day. The sensation of tinnitus was measured on a Visual Analog Scale (VAS) before and two weeks after treatment and they were compared by means of Wilcoxon signed rank-test.

#### Results:

Thirty-eight (62.3%) patients were men and twenty-three (37.7%) were women. Fourteen patients (31.8%) worked in noisy environment. The VAS mean difference before and after the treatment was statistically significant ( $p < 0.0001$ ). The best treatment effect was in the youngest group and there were significant differences between this group and the middle age and older groups ( $p = 0.018$  and  $0.001$ , respectively). The mean VAS score reduction was not statistically significant between male and female patients ( $p = 0.23$ ). Also, the treatment outcome according to the noise level in patient's workplaces was not significantly different in women ( $p = 0.693$ ), but it was significant in men ( $p = 0.029$ ).

#### Conclusion:

Low-level laser therapy can offer significant benefit in treatment of tinnitus. In addition, we assessed the treatment effect in different gender, job, and age categories. These variables can affect the treatment outcome.



## 4. LOW LEVEL LASER THERAPY IN DENTISTRY

### TITLE: A CLINICAL INVESTIGATION OF LOW LEVEL LASER IRRADIATION ON HYPERSENSITIVE DENTINE

Authors: Ahmet Eralp AKCA DDS, PhD, Suat GÖKÇE DDS, PhD, Mehmet KÜRKÇÜ DDS, PhD, Atilla ÖZDEMİR DDS, PhD

Affiliations: Gülhane Military Medical Academy, Center of Dental Sciences, Department of Periodontology, Çukurova University, Faculty of Dentistry, Department of Oral Surgery, Gülhane Military Medical Academy, Center of Dental Sciences, Department of Prosthodontics

Source: Hacettepe Dişhekimliği Fakültesi Dergisi. 2006; 30 (2): 94-99

### ABSTRACT:

#### Purpose:

The study was conducted to evaluate the efficacy of low power diode laser for the treatment of dentin hypersensitivity, to assess the reliability of two pain measurement methods.

#### Materials and Methods:

Twenty seven patients with a history of dentin hypersensitivity were selected and 54 exposed sensitive teeth were divided into test and control groups. After the baseline pain assessment, a low level laser irradiation (685 nm, 25 mW, 2 J/cm<sup>2</sup>) with continuous wave mode was used for 1 min and 40 s with a GaAlAs laser (BTL 2000, UK).

#### Results:

After desensitizing procedures, most of the patients reported distinct reductions in dentin sensitivity at the baseline. Statistical analysis between the examination periods of control group showed no difference. However, we observed statically significant results between the baseline measurement and the examination periods of test group. The statistical analysis of data revealed that laser irradiation on hypersensitive teeth is a very effective method.

#### Conclusion:

The goal in hypersensitivity studies is to relieve patient's discomfort and to provide long lasting effect. Although the action mechanisms of low output lasers are unclear, the results of our study indicated that they were very effective in dentine hypersensitivity and resistant to mechanical forces and chemical irritation. In addition, we could not determine any side effect that could be evaluated as a special feature.

## TITLE: THE EFFECT OF LOW-LEVEL LASER THERAPY DURING ORTHODONTIC MOVEMENT – A PRELIMINARY STUDY

*Authors: Mohamed Youssef; Sharif Ashkar; Eyad Hamade; Norbert Gutknecht; Friedrich Lampert; Maziar Mir*

*Affiliations: Damascus University, Damascus, Syria; RWTH Hospital, Aachen, Germany*

*Source: Lasers Med Sci. 2008; 23: 27-33*

### ABSTRACT:

#### Background and Objectives:

The aim of this study is to evaluate the effect of the low-level (GaAlAs) diode laser (809 nm, 100 mW) on the canine retraction during an orthodontic movement and to assess pain level during this treatment. A group of 15 adult patients with age ranging from 14 to 23 years attended the orthodontic department at Dental School, Damascus University. The treatment plan for these patients included extraction of the upper and lower first premolars because there was not enough space for a complete alignment or presence of biprotrusion. For each patient, this diagnosis was based on a standard orthodontic documentation with photographs, model casts, cephalometric, panorama, and superior premolar periapical radiographies. The orthodontic treatment was initiated 14 days after the premolar extraction, the canine retraction was accomplished in both upper and lower jaws.

#### Methods and materials:

The right side of the upper and lower jaw was chosen to be irradiated with the laser, whereas the left side was considered the control without laser irradiation. The laser was applied with 0-, 3-, 7-, and 14-day intervals. The retraction spring was reactivated on day 21 for all sides.

#### Results:

The pain level was prompted by a patient questionnaire. The velocity of canine movement was significantly greater in the lased group than in the control group. The pain intensity was also at lower level in the lased group than in the control group throughout the retraction period.

#### Conclusion:

Our findings suggest that low-level laser therapy can highly accelerate tooth movement during orthodontic treatment and can also effectively reduce pain level.

## TITLE: COMPARISON OF THE LOW-LEVEL LASER THERAPY EFFECTS ON CULTURED HUMAN GINGIVAL FIBROBLASTS PROLIFERATION USING DIFFERENT IRRADIANCE AND SAME FLUENCE

*Authors: Luciana Almeida-Lopes, DDS, MSD; Josepa Rigau, MD, PhD; Renato Amaro ZaÑangaro, PhD;*

*JoaÑo Guidugli-Neto, MD, PhD; MaÁrcia Martins Marques Jaeger, DDS, PhD*

*Affiliations: Universidade Vale do ParaiÁba-SJC, Brazil; University Camilo Castelo Branco-SP, Brazil; University Rovira i Virgili, Reus, Spain; University of SaÑo Paulo-SP, Brazil*

*Source: Lasers in Surgery and Medicine. 2001; 29: 179-184*

### ABSTRACT:

#### Background and Objectives:

The Low level laser therapy (LLLT) has been used in Dentistry to improve wound healing. In order to analyse the effect of LLLT on the in vitro proliferation of gingival fibroblasts we developed a primary culture of human gingival fibroblasts.

#### Study Design/Materials and Methods:

The cell line named LMF was grown in Dulbecco's Modified Eagle's medium (DME) with either 5% (nutritional deficit) or 10% fetal bovine serum (fbs). Laser irradiation was carried out with diode lasers with the following wavelengths: 670 nm (L1), 780 nm (L2), 692 nm (L3), and 786 nm (L4). The fluence was fixed in 2 J/cm<sup>2</sup>. For growth analysis, control (not irradiated) and treated cultures (irradiated) were plated in 60 mm diameter culture dishes for 12 h before the irradiation.

#### Results:

We found that cells cultured in nutritional deficit condition grown in medium supplemented by only 5% fbs presented a cell proliferation rate significantly smaller than cell grown in ideal culture conditions (10% fbs). However, when irradiated, cells in nutritional deficit presented cell growth similar or higher than that of control cells grown in ideal culture conditions. Using the same fluence, the infrared laser induced a higher cell proliferation than visible laser when the power outputs were different. However, lasers of equal power output presented similar effect on cell growth independently of their wavelengths.

#### Conclusion:

The LLLT acts by improving the in vitro fibroblast proliferation and a smaller laser exposure time results in higher proliferation.

## 5. LOW-LEVEL LASER THERAPY - OTHER CLINICAL INDICATIONS

### TITLE: EFFICIENCY OF THERAPEUTIC ULTRASOUND, LOW-LEVEL LASER AND COMPRESSION THERAPY FOR HEALING OF VENOUS LEG ULCERS

Authors: Nillie Ezzeldin, Dina Said, Sahar Said, Mahmoud Mustafa Ashour, Medhat EL-leboudy

Affiliations: Zagazig University, Sharkia Governorate, Sharkia, Egypt

Source: *Egyptian Rheumatology & Rehabilitation*. 2015; 42: 27-33

#### ABSTRACT:

##### Aim:

To evaluate the efficiency of therapeutic ultrasound, low level laser and compression therapy for healing of venous leg ulcers and compare the effect of modalities on the ulcers.

##### Subjects and methods:

Three groups were included in the study. Group I: 20 patients with leg ulcers treated with low level laser therapy. Group II: 20 patients with leg ulcers treated with ultrasound therapy. Group III: 20 patients with leg ulcers treated by compression therapy (four layer bandage) were used in this study. All patients were subjected to detailed history, clinical evaluation in addition to X-ray of legs and feet, and Doppler ultrasound of both legs. The main variables for follow up were the measurement of the area of the lesions under aseptic conditions at 0, 1, 2, 3 months and qualitative clinical evaluation of the ulcers by physician and by the patient. The results from group I, group II and group III were obtained and then compared with each other.

##### Results:

According to the size of the ulcer, some ulcers heal within 1 month which is (15.6%) in group I, (10%) in group II, and (28.5%) in group III. Some ulcers heal within 2 months which is (28%) in group I, (23.3%) in group II and (37%) in group III. The remaining ulcers heal within 3 months or more which are (56%) in group I, (66.6%) in group II and (34.2%) in group III. Thus the percentage of healing denoting that compression bandage technique used in group III is the most efficient in healing of chronic venous leg ulcer followed by laser therapy and lastly US therapy ( $P = 0.04$  at the end of the first month and  $P = 0.03$  at the end of the third month).

##### Conclusion:

Compression therapy is the most efficient treatment of venous leg ulcers. Low-level laser therapy and Ultrasound therapy are useful methods as a conservative treatment of venous leg ulcers and can be used in ulcers of small size.

### TITLE: LOW-LEVEL LASER THERAPY OF LEG ULCER IN SICKLE CELL ANEMIA

Authors: Claudia Regina Bonini - Domingos, Flavia Mariana Valente

Affiliations: Laboratory of Hemoglobin and Genetics of Hematological Diseases, Biology department, Universidade Estadual Paulista, SP, Brazil

Source: *Rev. Bras. Hematol. Hemoter*. 2012; 34 (1): 64 - 67

#### ABSTRACT:

##### Introduction:

Cutaneous lesions represent a dilemma and instigate clinical interest because of the high morbidity associated with changes in the normal healing process. An adequate choice of therapy and effort of the medical team can make the healing process quicker and reduce possible complications. Among currently available methods, low-level laser therapy (LLLT) is an important, safe and practical tool. In vitro and in vivo studies have demonstrated that LLLT is an effective method to modulate tissue repair, thus significantly contributing to a faster and better organized healing process. Here we describe the results of a therapeutic intervention in a 35-year-old female sickle cell anemia patient with recurring leg ulcers who was prevented from maintaining employment and appropriate social activities due to the disease.

##### Materials and Methods:

The patient participated in the "ulcer healing group" and the leg ulcers were treated. At an initial evaluation the patient had an active leg ulcer of the lower third of left leg above the medial malleolus. Treatment using LLLT was proposed to accelerate the healing of the ulcer. The device used was a He-Ne Laser with a wavelength of 632.8 nm and red (visible), 5 mW peak emission, 10 - 60 mJ energy with an application area of 0.02 - 100 cm<sup>2</sup> and automatic dosimeter.

##### Results:

An outline of the lesion was drawn on transparent plastic to evaluate the results; an estimation of the area of the ulcer was achieved by measuring the largest cephalocaudal and mediolateral lengths. The initial area of 1.5 cm<sup>2</sup> was reduced by 80% to 0.3 cm<sup>2</sup> with treatment: 60% in length and 50% in width.



Figure 1 - Outline of the leg ulcer on clear plastic treatment (left) and after laser therapy (right)

## TITLE: LASER ACUPUNCTURE THERAPY FOR PRIMARY MONOSYMPTOMATIC NOCTURNAL ENURESIS

Authors: M. Ihsan Karaman, Orhan Koca, Eyüp V. Küçük, Metin Öztürk, Mustafa Günes, Cevdet Kaya

Affiliations: Department of Urology, Haydarpaşa Numune Training and Research Hospital, Istanbul, Turkey

Source: *The Journal of Urology*. May 2011; 185: 1852-1856

### ABSTRACT:

#### Purpose:

Monosymptomatic nocturnal enuresis is the nighttime bed-wetting that occurs among children without lower urinary tract symptoms or bladder dysfunction, and affects a considerable part of the population. In our study the effect of laser acupuncture therapy on patients with primary monosymptomatic nocturnal enuresis was evaluated in a prospective, randomized, placebo controlled, single-blind study.

#### Materials and Methods:

A total of 91 children with a mean age of 8.6 years who presented to our outpatient clinic with primary monosymptomatic nocturnal enuresis and had not received any medical therapy were included in the study. The children were randomized into 2 groups. In group 1 laser acupuncture was performed 3 times a week for 4 weeks, whereas the same program via a nonlaser light to the same points was performed on the children in group 2 (placebo group). The number of weekly bed-wetting episodes before therapy was recorded, and the children were reevaluated 15, 30, 90 and 180 days after treatment.

#### Results:

The mean number of bed-wetting episodes was 1.7 per week 6 months after laser therapy. In the placebo group the mean number of weekly bed-wetting episodes was 3.1. Laser acupuncture therapy was significantly more beneficial compared to placebo in terms of complete dryness, partial improvement and a decrease in the mean number of weekly bed-wetting episodes.

#### Conclusions:

Laser acupuncture therapy, a noninvasive, painless, short-term therapy with a low cost, can be considered as an alternative therapy for patients with primary monosymptomatic nocturnal enuresis.

## TITLE: LOW REACTIVE LEVEL LASER THERAPY FOR MESENCHYMAL STROMAL CELLS THERAPIES – REVIEW ARTICLE

Authors: Toshihiro Kushibiki, Takeshi Hirasawa, Shinpei Okawa, and Miya Ishihara

Affiliations: Department of Medical Engineering, National Defense Medical College, Japan

Source: *Stem Cells International* 2015. Article ID 974864, 12 pages

### ABSTRACT:

#### Introduction:

In recent years, the term LLLT has become widely recognized in the field of regenerative medicine. In this review, we will describe the mechanisms of action of LLLT at a cellular level and introduce the application to mesenchymal stem cells and mesenchymal stromal cells (MSCs) therapies. A large number of literatures and review articles have shown that LLLT accelerates wound healing, and we present some typical results here. Irradiation of cultured human keratinocytes with 632 nm helium - neon laser elevated the interleukin-1 $\alpha$  and interleukin-8 mRNA levels, promoted keratinocyte migration and proliferation, and accelerated wound repair. In addition in vitro studies of laser-irradiated cells revealed elevated levels of vascular endothelial growth factor (VEGF) and transforming growth factor  $\beta$  (TGF  $\beta$ ) expression. These findings illustrate the laser-enhanced expression of many cytokines and growth factors in keratinocytes and fibroblasts, the key cellular mediators of the wound-healing process.

#### Conclusion:

Since LLLT has been scientifically proven as a beneficial therapeutic modality for numerous diseases and diseased conditions, it was applied to enhance MSCs proliferation and differentiation. Abrahamse's group published some literatures for LLLT application to stem cells. It is the cellular effect of increasing proliferation and viability that may significantly contribute to the addition of LLLT to many biomedical disciplines that further augment the successes of regenerative medicine. Abramovitch-Gottlieb et al. reported that the consequent phenotype modulation and development of MSCs towards ossified tissue were studied in the combined 3D biomatrix/LLLT system. Their results obtained from the irradiated samples showed enhanced tissue formation, appearance of phosphorous peaks, and calcium and phosphate incorporation to newly formed tissue. Those findings of cell and tissue parameters up to 28 days of culture revealed higher ossification levels in irradiated samples compared with the control group. They suggested that both the surface properties of the 3D crystalline biomatrices and the LLLT have biostimulatory effect on the conversion of MSCs into bone-forming cells and on the induction of ex vivo ossification.

## TITLE: EFFECT OF LOW-LEVEL LASER THERAPY ON PATIENT REPORTED MEASURES OF ORAL MUCOSITIS AND QUALITY OF LIFE IN HEAD AND NECK CANCER PATIENTS RECEIVING CHEMORADIOTHERAPY - A RANDOMIZED CONTROLLED TRIAL

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### ABSTRACT:

#### Purpose:

Chemoradiotherapy (CRT)-induced oral mucositis (OM) adversely affects a patient's oral functions and quality of life (QOL). Low-level laser therapy (LLLT) showed some preventive and curative effects against clinically reported objective measures of OM in few trials including our recently published study. There is dearth of evidence regarding the effects of LLLT on patient's subjective experience of OM and QOL. Hence, we did this study to evaluate the effects of LLLT on a patient's reported measures of OM and QOL in head and neck cancer (HNC) patients receiving CRT.

#### Methods:

This triple blinded study randomized 220 HNC patients scheduled for CRT (three weekly Cisplatin + RTO 66 Gray (2 Gy/session), five fractions/week for 6.5 weeks, total 33 fractions) into laser (110) and placebo (110) groups. The laser group received LLLT (Technomed Electronics Advanced Laser Therapy 1000, He-Ne, 632.8 nm, power density 24 mW/cm<sup>2</sup>, dosage 3.0 J at each point, total dose/session 36-40 J, spot size 1 cm<sup>2</sup>, irradiation time/point 125 s) before each radiation session, while the placebo group did not receive laser therapy.

#### Results:

Results analysis revealed that OMWQ-HN (F 12.199, df 6,1314, p < 0.001) and FACT-HN (p < 0.05) scores were significantly lower in LLLT than placebo group patients. Also, a significant reduction (p < 0.001) in incidence of severe OM, need for opioid analgesics, and total parenteral nutrition was observed.

#### Conclusions:

LLLT was effective in improving the patient's subjective experience of OM and QOL in HNC patients receiving CRT.



