

Our latest LLLT literature review with abstracts including muscle fatigue, TMJ, myofacial pain, acne and a possible application for morphine withdrawal.

Effect of 655-nm low-level laser therapy on exercise-induced skeletal muscle fatigue in humans.

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OBJECTIVE: To investigate if development of skeletal muscle fatigue during repeated voluntary biceps contractions could be attenuated by low-level laser therapy (LLLT). **BACKGROUND DATA:** Previous animal studies have indicated that LLLT can reduce oxidative stress and delay the onset of skeletal muscle fatigue. **MATERIALS AND METHODS:** Twelve male professional volleyball players were entered into a randomized double-blind placebo-controlled trial, for two sessions (on day 1 and day 8) at a 1-wk interval, with both groups performing as many voluntary biceps contractions as possible, with a load of 75% of the maximal voluntary contraction force (MVC). At the second session on day 8, the groups were either given LLLT (655 nm) of 5 J at an energy density of 500 J/cm² administered at each of four points along the middle of the biceps muscle belly, or placebo LLLT in the same manner immediately before the exercise session. The number of muscle contractions with 75% of MVC was counted by a blinded observer and blood lactate concentration was measured. **RESULTS:** Compared to the first session (on day 1), the mean number of repetitions increased significantly by 8.5 repetitions (+/- 1.9) in the active LLLT group at the second session (on day 8), while in the placebo LLLT group the increase was only 2.7 repetitions (+/- 2.9) ($p = 0.0001$). At the second session, blood lactate levels increased from a pre-exercise mean of 2.4 mmol/L (+/- 0.5 mmol/L), to 3.6 mmol/L (+/- 0.5 mmol/L) in the placebo group, and to 3.8 mmol/L (+/- 0.4 mmol/L) in the active LLLT group after exercise, but this difference between groups was not statistically significant. **CONCLUSION:** We conclude that LLLT appears to delay the onset of muscle fatigue and exhaustion by a local mechanism in spite of increased blood lactate levels.

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Effect of low level laser therapy on bronchial hyper-responsiveness.

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The objective of this study was to investigate whether low level laser therapy (LLLTT) could reduce bronchial hyper-responsiveness (BHR) induced by tumour necrosis factor-alpha (TNF-alpha) modulating the metabolism of inositol phosphate (IP) in bronchial smooth muscle cells (BSMCs). The study was on 28 Wistar rats, randomly divided into four groups. Irradiation (1.3 J/cm²) was administered 5 min and 4 h after bronchial smooth muscle (BSM) had been suspended in TNF-alpha baths, and the contractile response-induced calcium ion (Ca²⁺) sensitization was measured. The BSMCs were isolated, and the IP accumulation was measured before and after TNF-alpha immersion in the groups that had been irradiated or not irradiated. BSM segments significantly increased contraction 24 h after TNF-alpha immersion when exposed to carbachol (CCh) as Ca²⁺, but it was significantly reduced by 64% and 30%, respectively, after laser treatment. The increase in IP accumulation induced by CCh after TNF-alpha immersion was reduced in the BSMCs by LLLTT. The dose of 2.6 J/cm² reduced BHR and IP accumulation in the rats' inflammatory BSMCs.

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Light-induced rescue of breathing after spinal cord injury.

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Paralysis is a major consequence of spinal cord injury (SCI). After cervical SCI, respiratory deficits can result through interruption of descending presynaptic inputs to respiratory motor neurons in the spinal cord. Expression of channelrhodopsin-2 (ChR2) and photostimulation in neurons affects neuronal excitability and produces action potentials without any kind of presynaptic inputs. We hypothesized that after

transducing spinal neurons in and around the phrenic motor pool to express ChR2, photostimulation would restore respiratory motor function in cervical SCI adult animals. Here we show that light activation of ChR2-expressing animals was sufficient to bring about recovery of respiratory diaphragmatic motor activity. Furthermore, robust rhythmic activity persisted long after photostimulation had ceased. This recovery was accomplished through a form of respiratory plasticity and spinal adaptation which is NMDA receptor dependent. These data suggest a novel, minimally invasive therapeutic avenue to exercise denervated circuitry and/or restore motor function after SCI.

J Neurosci 2008 Nov 12 28(46) 11862-70

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Low intensity laser therapy in temporomandibular disorder: a phase II double-blind study.

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The purpose of this study was to evaluate the analgesic effect of Low Intensity Laser Therapy (LILT) and its influence on masticatory efficiency in patients with temporomandibular dysfunction (TMD). This study was performed using a random, placebo-controlled, and double-blind research design. Fourteen patients were selected and divided into two groups (active and placebo). Infrared laser (780 nm, 70 mw, 60s, 105J/cm²) was applied precisely and continuously into five points of the temporomandibular joint (TMJ) area: lateral point (LP), superior point (SP), anterior point (AP), posterior point (PP), and posterior-inferior point (PIP) of the condylar position. This was performed twice per week, for a total of eight sessions. To ensure a double-blind study, two identical probes supplied by the manufacturer were used: one for the active laser and one for the inactive placebo laser. They were marked with different letters (A and B) by a clinician who did not perform the applications. A Visual Analogue Scale (VAS) and a colorimetric capsule method were employed. Data were obtained three times: before treatment (Ev1), shortly after the eighth session (Ev2), and 30 days after the first application (Ev3). Statistical tests revealed significant differences at one percent (1%) likelihood, which implies that superiority of the active group offered considerable TMJ pain improvement. Both groups presented similar masticatory behavior, and no statistical differences were found. With regard to the evaluation session, Ev2 presented the lowest symptoms and highest masticatory

efficiency throughout therapy. Therefore, low intensity laser application is effective in reducing TMD symptoms, and has influence over masticatory efficiency [Ev2 (0.2423) and Ev3 (0.2043), observed in the interaction Evaluations x Probes for effective dosage].

Cranio 2008 Oct 26(4) 274-81

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Low-level laser therapy and myofacial pain dysfunction syndrome: a randomized controlled clinical trial.

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Myofacial pain dysfunction syndrome (MPDS) is the most common reason for pain and limited function of the masticatory system. The effects of low-level lasers (LLTs) for controlling the discomfort of patients are investigated frequently. However, the aim of this study was to evaluate the efficacy of a particular source producing 660 nm and 890 nm wavelengths that was recommended to reduce of the pain in the masticatory muscles. This was a double-blind and placebo-controlled trial. Sixteen MPDS patients were randomly divided into two groups. For the laser group, two diode laser probes (660 nm (nanometers), 6.2 J/cm², 6 min, continuous wave, and 890 nm, 1 J/cm² (joules per square centimetre), 10 min, 1,500 Hz (Hertz)) were used on the painful muscles. For the control group, the treatment was similar, but the patients were not irradiated. Treatment was given twice a week for 3 weeks. The amount of patient pain was recorded at four time periods (before and immediately after treatment, 1 week after, and on the day of complete pain relief). A visual analog scale (VAS) was selected as the method of pain measurement. Repeated-measures analysis of variance (ANOVA), the t-test and the paired t-test were used to analyze the data. In each group the reduction of pain before and after the treatment was meaningful, but, between the two groups, low-level laser therapy (LLLT) was more effective (P = 0.031) According to this study, this type of LLLT was the effective treatment for pain reduction in MPDS patients.

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Non-invasive diagnostic evaluation of phototherapeutic effects of red light phototherapy of acne vulgaris.

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BACKGROUND: During the past few years, various phototherapeutic protocols with full-spectrum visible light or selected wavebands have been investigated in the treatment of acne vulgaris with variable results. **METHODS:** Fifteen women suffering from moderate acne vulgaris of the face were exposed to 20 J/cm² of broad-band red (lambda: 600-750 nm) light twice weekly for 4 weeks. In addition, with the aim to improve the present knowledge of the mechanisms of action of phototherapy, we measured skin sebum, pH, hydration and trans-epidermal water loss (TEWL). Lesions of the trunk were not irradiated and served as controls. **RESULTS:** A significant improvement of acne lesions and a significant decrease of skin sebum excretion and TEWL of the face were registered at the end of the therapy and at the 3-month follow-up visit. The results could be related to a reduced follicular colonization of Propionibacterium acnes, in that it was lethally damaged by photoactivated endogenous porphyrins. **CONCLUSION:** The present findings seem to indicate that red light phototherapy may represent an effective, well-tolerated, safe, simple and inexpensive treatment option for moderate acne vulgaris.

Photodermatol Photoimmunol Photomed 2008 Oct 24(5) 244-8

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High fluence low-power laser irradiation induces mitochondrial permeability transition mediated by reactive oxygen species.

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High fluence low-power laser irradiation (HF-LPLI) can induce cell apoptosis via the mitochondria/caspase-3 pathway. Here, we further investigated the mechanism involved in the apoptotic process in human lung adenocarcinoma cells (ASTC-a-1) at a laser irradiation fluence of 120 J/cm² (633 nm). Cytochrome c release was ascribed to mitochondrial permeability transition (MPT) because the release was prevented by cyclosporine (CsA), a specific inhibitor of MPT. Furthermore, mitochondrial permeability for calcein (approximately 620 Da) was another evidence for the MPT induction under HF-LPLI treatment. A high-level intracellular reactive oxygen species (ROS) generation was observed after irradiation. The photodynamically produced ROS caused onset of MPT, as the ROS scavenger docosahexaenoic acid (DHA) prevented the MPT. However, CsA failed to prevent cell death induced by HF-LPLI, indicating the existence of other signaling pathways. Following laser irradiation, Bax activation occurred after mitochondrial depolarization and cytochrome c release, indicating Bax activation was a downstream event. In the presence of CsA, Bax was still activated at the end-stage of apoptotic process caused by HF-LPLI, suggesting that Bax was involved in an alternative-signaling pathway, which was independent of MPT. Under HF-LPLI treatment, cell viabilities due to pre-treatment with DHA, CsA, or Bax small interfering RNA (siRNA) demonstrated that the MPT signaling pathway was dominant, while Bax signaling pathway was secondary, and more importantly ROS mediated both pathways. Taken together, these results showed that HF-LPLI induced cell apoptosis via the CsA-sensitive MPT, which was ROS-dependent. Furthermore, there existed a secondary signaling pathway through Bax activation. The observed link between MPT and triggering ROS could be a fundamental phenomenon in HF-LPLI-induced cell apoptosis. *J. Cell. Physiol.* (c) 2008 Wiley-Liss, Inc.

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Low-level laser irradiation promotes cell proliferation and mRNA expression of type I collagen and decorin in porcine achilles tendon fibroblasts In Vitro.

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Achilles tendon problems are commonly encountered in sports medicine and low-level laser therapy (LLLT) is widely used in rehabilitative applications to decrease pain, reduce inflammatory processes, and promote tissue healing. This study examined the effects on the proliferation of porcine Achilles tendon fibroblasts and gene expression, using different doses of low-level laser irradiation (LLLI). Four groups of identically cultured fibroblasts were exposed to LLLI and harvested after 24 h. The control group (Group 1) was subjected to no LLLI. Other groups received 1 J/cm² (Group 2), 2 J/cm² (Group 3), and 3 J/cm² (Group 4), respectively. Cell proliferation and mRNA expressions of type I collagen and decorin were then measured. When compared to the control group, the cell proliferation of irradiated Achilles tendon fibroblasts in the other three groups increased significantly by 13% +/- 0.8% (Group 2), 30% +/- 0.4% (Group 3), and 12% +/- 0.6% (Group 4) respectively. But progressively higher laser intensity did not achieve a correspondingly higher cell proliferation effect in Achilles tendon fibroblasts. The mRNA expressions of decorin and type I collagen in fibroblasts with LLLI were significantly higher (p < 0.05). Therefore, suitable dosages of LLLI may result in more effective tissue healing by promoting type I collagen and decorin synthesis. However, these positive effects of LLLI on the repair of the Achilles tendon in humans should be further investigated in clinic. Published by Wiley Periodicals, Inc. J Orthop Res.

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Low-intensity red laser on the prevention and treatment of induced-oral mucositis in hamsters.

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OBJECTIVE: The purpose of this study was to investigate the effects of laser phototherapy as preventive and therapeutic regime on induced-oral mucositis in hamsters. **DESIGN:** The animals were divided into four groups: preventive cryotherapy, preventive laser, therapeutic laser and therapeutic control group. Mucositis was induced in hamsters by intraperitoneal injection of 5-fluorouracil (5-FU) and superficial scratching. All preventive treatment was performed on the right cheek pouch mucosa. The left pouch

mucosa was used for a spontaneous development of mucositis and did not receive any preventive therapy. Laser parameters were: $\lambda=660\text{nm}$, $P=30\text{mW}$, $D=1.2\text{J/cm}^2$, $\Delta t=40\text{s}$, spot size 3mm^2 , $I=1\text{W/cm}^2$. Cryotherapy was done positioning ice packs in the hamster mucosa 5min before 5-FU infusion and 10min afterward. To study the healing of mucositis, the left pouch mucosa of each of the hamsters in the TLG received laser irradiation on the injured area. Irradiation parameters were kept the same as abovementioned. The control hamsters in the TCG did not receive any treatment. The mucositis degree and the animal's body mass were evaluated. An assessment of blood vessels was made based on immunohistochemical staining. RESULTS: The CG animals lost 15.16% of their initial body mass while the LG animals lost 8.97% during the first 5 days. The laser treated animals had a better clinical outcome with a faster healing, and more granulation tissue. The quantity of blood vessels at both LG and CG were higher than in healthy mucosa. Regarding the therapeutic analysis, the severity of the mucositis in the TLG was always lower than TCG. TLG presented higher organization of the granulation tissue, parallel collagen fibrils, and increased angiogenesis. CONCLUSION: The results suggest that laser phototherapy had a positive effect in reducing mucositis severity, and a more pronounced effect in treating established mucositis.

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Ten Years Evidence-based High-Tech Acupuncture Part 3: A Short Review of Animal Experiments.

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High-tech acupuncture research has been performed for 10 years at the Research Unit of Biomedical Engineering in Anesthesia and Intensive Care Medicine at the Medical University of Graz. This article as a part of a series comprises animal experiments in the field of needle and laser acupuncture. The investigations presented in this article were performed in pigs, dogs and sheep. In all studies sedative

stimulation effects of the acupoint Yintang are described using different measurement parameters (EEG-bispectral index, EEG spectral edge frequency and metabolic parameters).

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Blinding Techniques in Randomized Controlled Trials of Laser Therapy: An Overview and Possible Solution.

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Low-level laser therapy has evidence accumulating about its effectiveness in a variety of medical conditions. We reviewed 51 double blind randomized controlled trials (RCTs) of laser treatment. Analysis revealed 58% of trials showed benefit of laser over placebo. However, less than 5% of the trials had addressed beam disguise or allocation concealment in the laser machines used. Many of the trials used blinding methods that rely on staff cooperation and are therefore open to interference or bias. This indicates significant deficiencies in laser trial methodology. We report the development and preliminary testing of a novel laser machine that can blind both patient and operator to treatment allocation without staff participation. The new laser machine combines sealed preset and non-bypassable randomization codes, decoy lights and sound, and a conical perspex tip to overcome laser diode glow detection.

Evid Based Complement Alternat Med 2007 Sep 13

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[Photon radiation-induced structural and functional changes in the myocardium of hypertensive SHR rats]

Male rats were irradiated by a Korobkov photon light-emitting diode matrix with a maximum irradiation at 612 nm every day 1 h per day for 13 days. After a course of irradiation, the rhythmoinotropic characteristics of the cardiac muscle significantly improved. Exposure to photon radiation initiated an active rearrangement in myocytes as shown by a morphological analysis. Considerable changes were found

in the structure of sarcoplasmic reticulum (SR); the area of SR profiles increased more than twofold compared to control. This suggests a proportional increase in the ability of SR to absorb calcium, due to both an increase in its buffer capacity and possibly, an improved functioning of Ca²⁺ ATPase of the reticulum. Probably, the photon therapy leads to the normalization of calcium homeostasis in myocytes and improvement of the characteristics of the cardiac muscle contraction-relaxation cycle. Furthermore, changes in the proportions of the myocardium capillaries (increased by 75% compared to control; $p < 0.001$) and the area of mitochondrial profiles of myocytes (increased by 13%; $p < 0.05$) were observed, which lead to more active metabolic processes and a rise in energy potential in myocardial cells after photon radiation treatment.

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Near infrared light protects cardiomyocytes from hypoxia and reoxygenation injury by a nitric oxide dependent mechanism.

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Photobiomodulation with near infrared light (NIR) provides cellular protection in various disease models. Previously, infrared light emitted by a low-energy laser has been shown to significantly improve recovery from ischemic injury of the canine heart. The goal of this investigation was to test the hypothesis that NIR (670 nm) from light emitting diodes produces cellular protection against hypoxia and reoxygenation-induced cardiomyocyte injury. Additionally, nitric oxide (NO) was investigated as a potential cellular mediator of NIR. Our results demonstrate that exposure to NIR at the time of reoxygenation protects neonatal rat cardiomyocytes and HL-1 cells from injury, as assessed by lactate dehydrogenase release and MTT assay. Similarly, indices of apoptosis, including caspase 3 activity, annexin binding and the release of cytochrome c from mitochondria into the cytosol, were decreased after NIR treatment. NIR increased NO in cardiomyocytes, and the protective effect of NIR was completely reversed by the NO scavengers carboxy-PTIO and oxyhemoglobin, but only partially blocked by the NO synthase (NOS) inhibitor L-

NMMA. Mitochondrial metabolism, measured by ATP synthase activity, was increased by NIR, and NO-induced inhibition of oxygen consumption with substrates for complex I or complex IV was reversed by exposure to NIR. Taken together these data provide evidence for protection against hypoxia and reoxygenation injury in cardiomyocytes by NIR in a manner that is dependent upon NO derived from NOS and non-NOS sources.

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Attenuation of morphine withdrawal signs by low level laser therapy in rats.

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In the present study, the effects of low-intensity laser therapy (LILT) on naloxone-induced withdrawal signs of morphine-dependent rats were examined. Low-intensity lasers with a power density of 12.5J/cm² have been used by a Ga-Al-As laser. One-way ANOVA showed that the LILT which applied immediately or 15min prior to naloxone injection significantly decreased total withdrawal score (TWS). These results suggest that LILT prior to naloxone injection attenuates the expression of withdrawal signs in morphine-dependent rats. Further studies may elucidate the likely role of LILT in clinical management of opioid withdrawal syndrome.

Behav Brain Res 2008 Sep 24

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Intracellular ATP level increases in lymphocytes irradiated with infrared laser light of wavelength 904 nm.

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OBJECTIVE: Red and near-infrared laser irradiation is reported to have a range of biological effects on cultured cells and different tissues, leading to the hypothesis that laser light can affect energy metabolism. Increased adenosine triphosphate (ATP) synthesis has been reported in cultured cells and rat brain tissue after irradiation at 632.8 nm and 830 nm, respectively. This study investigated whether diode pulsed laser irradiation enhances ATP production in lymphocytes. **MATERIALS AND METHODS:** Aliquots (500 microL) of an extract of cultured lymphocytes of the Molt-4 cell line were irradiated with diode laser light ($\lambda = 904$ nm, pulsed mode, 6 kHz frequency) with an average emission power of 10 mW for 60 min. A Spectra Physics M404 power meter was used to measure light intensity. Controls were treated similarly but not irradiated. The amount of ATP was measured by the luciferin-luciferase bioluminescent assay.

RESULTS: The amount of ATP in irradiated cell cultures was 10.79 ± 0.15 microg/L (SD; n = 10), and in non-irradiated cell cultures it was 8.81 ± 0.13 microg/L (SD; n = 10). The average percentage increase of irradiated versus control cell cultures was about $22.4\% \pm 0.56\%$ SD ($p < 0.001$). **CONCLUSION:** This significant increase is probably due to laser irradiation; it cannot be attributed to any thermal effect, as the temperature during irradiation was maintained at 37.0 ± 0.5 degrees C. Thus the therapeutic effects of the biostimulating power of this type of laser are identified and its indications may be expanded.

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Role of nitric oxide in the visible light-induced rapid increase of human skin microcirculation at the local and systemic levels: II. healthy volunteers.

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OBJECTIVE: The aim of this study is to evaluate the skin microcirculation increase seen in healthy volunteers after a single exposure to polychromatic visible (pVIS) light, and to prove the role of nitric oxide (NO) in the development of this effect. **BACKGROUND DATA:** Improvement of microcirculation is

one of the most important effects of laser and pVIS light therapy; however, its mechanism of action remains unknown. A main role in the regulation of vascular tone is known to be played by NO. It is produced by NO-synthase (NOS) located in membranes of many cells, including endothelial and blood cells. NOS, a biopteroflavohemoprotein, absorbs pVIS light, resulting in its activation. MATERIALS AND METHODS: The central area of the dorsal side of the right hand (24 cm²) of 42 volunteers was irradiated for 5 min with pVIS light from a Q-light (385-750 nm, 95% polarization, 40 mW/cm², 12 J/cm²). Then for 90 min, the blood flow rate (Qas) was measured eight times, both in the area of the irradiation (local effect) and in the non-irradiated left hand (systemic effect) by using a high-frequency ultrasound Doppler device, recording Qas in human skin to a depth up to 5 mm. In the central area of the right hand of 14 volunteers an NOS inhibitor, N-monomethyl-L-arginine (L-NMMA, 0.1% solution), was iontophoretically administered prior to exposure, whereas in 10 other subjects it was administered to the left hand with subsequent exposure of the right hand. RESULTS: As soon as 2 min after exposure, Qas in the irradiated area rose on average by 32%, and in 20 min by 45%; it then decreased and in 90 min returned to the initial level. A statistically significant Qas increase in the non-irradiated hand was recorded in 5 min (+9%), and in 20 min it reached a maximum level (+39%), and 90 min later it decreased to the initial values. The presence of L-NMMA in the light-exposed area completely blocked the photoinduced rise of microcirculation, both in the irradiated and in non-irradiated hand; however, its administration to the non-irradiated hand did not prevent these effects. CONCLUSION: The increase in skin microcirculation produced by pVIS light at the local and systemic levels is due to activation of NO synthesis in the irradiated area.

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Role of nitric oxide in the visible light-induced rapid increase of human skin microcirculation at the local and systemic level: I. diabetic patients.

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OBJECTIVE: This study aimed to reveal the effects of polychromatic visible (pVIS) or pVIS + near IR (nIR) light similar to some components of solar light on skin microcirculation and microvascular response to the vasodilators acetylcholine (ACh) and nitroglycerine (NG), in the extremities of patients with

diabetic microangiopathy. BACKGROUND DATA: The mechanisms behind light-induced increases in microcirculation as well as extracellular effects of terrestrial pVIS and pVIS + nIR light remain unknown. MATERIALS AND METHODS: In 24 subjects with type 2 diabetes mellitus local microcirculation was measured in the skin of the foot before and after exposure to both types of light. In another 26 patients systemic microcirculation was studied in the back of the hand before and after exposure of the lumbar-sacral area to light energy. Two different types of light therapy were performed by using two devices: Q-light, which delivers pVIP (385-750 nm) and pVIS nIR light (385-1700 nm) with a power density of 40 mW/cm², which is similar to summer sunlight at noon in Central Europe. RESULTS: At 2 min after irradiation (12 J/cm²) of the forefoot with pVIS or pVIS + nIR light, a rise in local blood flow volume (Q_{as}) was observed, on average by 39% and 31%, respectively. The maximal effect (+41-47%) had developed in all patients at 30 min, and it then decreased and disappeared completely 24 h post-irradiation. We obtained similar results after irradiation of the sacral area in Q_{as} of the skin of the hand. Both types of microcirculation also increased following a second exposure to the light sources. Enhancement of microcirculation was accompanied by a decrease in the microvascular response to ACh and NG solutions administered intracutaneously by iontophoresis. CONCLUSION: Both types of irradiation stimulated microcirculation at the local and systemic levels through a mechanism of enhancement of endothelium-dependent and endothelium-independent vasodilation, in which nitric oxide plays a major role.

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Combining therapeutic laser and herbal remedy for treating ligament injury: an ultrastructural morphological study.

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OBJECTIVE: We examined the ultrastructural morphology (number of collagen fibrils, mean and mass-averaged diameter) of isolated and combined treatments of a therapeutic laser and herbs for medial collateral ligament (MCL) injury in rats. MATERIALS AND METHODS: Twenty-eight rats, divided into seven groups: laser (L), herb (H), laser + herb (LH), laser control (LC), herb control (HC), laser sham (LS)

and herb sham (HS), were studied. Right MCL of groups L, H, LH, LC and HC were transected, while that of LS and HS remained intact. Group L received 9 treatment sessions of GaAlAs laser with a dosage of 3.5 Jcm(-2); group H received herbal plaster treatment; groups LH had combined treatments of laser and herb; group LC had placebo laser; group LS had no treatment; groups HC and HS received only bandage without herb. All MCLs were analyzed using transmission electron microscopy at 3 weeks. RESULTS: Differences ($p < 0.05$) existed in mean fibril diameters among groups. Core mass-averaged diameters of groups L and H were larger than the control groups (LC and HC). Fibril diameter of group LH (combined treatment) was even larger and approaching that of the intact MCL. CONCLUSION: Combined therapeutic laser and herbal treatment hastened collagen fibril maturation in MCL repair.

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http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=18922085

Analgesic action of laser therapy (LLLT) in an animal model.

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OBJECTIVES: To evaluate the analgesic effect of laser therapy on healthy tissue of mice. STUDY DESIGN: Forty-five animals were divided in three groups of 15: A–infrared laser irradiation (830 nm, Kondortech, Sao Carlos, SP, Brazil); B–red laser irradiation (660 nm, Kondortech, Sao Carlos, SP, Brazil); C– ham irradiation with laser unit off. After laser application, the mice remained immobilized for the injection of 30 microl of 2% formalin in the plantar pad of the irradiated hind paw. The time that the mouse kept the hind paw lifted was measured at 5 min intervals for 30 minutes. RESULTS: Results showed statistically significant differences comparing the control group with the infrared laser group at 5, 20, 25 and 30 accumulated minutes, and with the red laser group at all time points. The analysis of partial times, at each 5 minutes, showed statistically significant differences between the control and the laser groups up to 20 minutes. CONCLUSIONS: Laser therapy had an analgesic effect and red laser had the best results.

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[Effect of low-intensity laser radiation on neutrophils from cervical discharge of women with mycoplasma infection]

Dolgushin II, Gizinger OA

Effect of low-intensity laser radiation on the main effector functions of neutrophils from the cervical discharge was studied in women with mycoplasma infection and dysfunction of neutrophil granulocytes manifest in the first place as a reduced number of phagocytic cells and decreased intensity of phagocytosis. The fraction of intracellular active forms of oxygen in cervical neutrophils from infected women was smaller than in healthy ones. Irradiation by low-intensity laser light increased both activity of phagocytosis and intracellular generation of active oxygen forms. It is concluded that low-intensity laser radiation normalizes disturbed neutrophil function.

Vopr Kurortol Fizioter Lech Fiz Kult 2008 Jul-Aug -4 29-31

http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=18822484

[Low-intensity laser irradiation in the combined treatment of depressive disorders in patients with chronic salpingo-oophoritis]

Mamedov FM

This study was designed to evaluate the possibility to use low-intensity laser radiation in combined therapy of somatogenic depressions in patients having gynecological problems, such as inflammatory disease of uterine appendages. It was shown that the combined treatment including administration of antidepressants significantly accelerated the development of beneficial changes and stabilized depressive manifestations. Inclusion of low-intensity laser irradiation in the combined therapy further improved its positive effect. Nevertheless, the complete recovery could not be achieved in the absence of specific antidepressant treatment despite the alleviation of depressive symptoms.

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The Effects of a 785-nm AlGaInP Laser on the Regeneration of Rat Anterior Tibialis Muscle After Surgically-Induced Injury.

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Abstract Objective: This study aims to investigate the effects of low-level laser therapy (LLLT) on muscle regeneration. For this purpose, the anterior tibialis muscle of 48 male Wistar rats received AlGaInP laser treatment (785 nm) after surgically-induced injury. **Background Data:** Few studies have been conducted on the effects of LLLT on muscle regeneration at different irradiation doses. **Materials and Methods:** The animals were randomized into four groups: uninjured rats (UN); uninjured and laser-irradiated rats (ULI); injured rats (IN); and injured and laser-irradiated rats (ILI). The direct contact laser treatment was started 24 h after surgery. An AlGaInP diode laser emitting 75 mW of continuous power at 785 nm was used for irradiation. The laser probe was placed at three treatment points to deliver 0.9 J per point, for a total dose of 2.7 J per treatment session. The animals were euthanized after treatment sessions 1, 2, and 4. Mounted sections were stained with hematoxylin and eosin and used for quantitative morphological analysis, in which the number of leukocytes and fibroblasts were counted over an area of 4480 μm^2 . The data were statistically analyzed by analysis of variance (ANOVA) and the Bonferroni t-test. **Results:** Quantitative data showed that the number of both polymorphonuclear and mononuclear leukocytes in the inflammatory infiltrate at the injury site was smaller in the ILI(1), ILI(2), and ILI(4) subgroups compared with their respective control subgroups (IN(1), IN(2), and IN(4)) for sessions 1, 2, and 4, respectively ($p < 0.05$). On the other hand, the number of fibroblasts increased after the fourth treatment session ($p < 0.05$). With regard to the regeneration of muscle fibers following injury, only after the fourth treatment session was it possible to find muscle precursor cells such as myoblasts and some myotubes in the ILI(4) subgroup. **Conclusion:** During the acute inflammatory phase, the AlGaInP laser treatment was found to have anti-inflammatory effects, reducing the number of leukocytes at the injury site and accelerating the regeneration of connective tissue.

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Improvement in Quality of Life of An Oncological Patient by Laser Phototherapy: A Case Report.

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Abstract Objective and Background Data: Common side effects of radiotherapy (RT) to the head and neck include oral mucositis, xerostomia, and severe pain. The aim of this study is to report improvement in the quality of life of an oncological patient by laser phototherapy (LPT). **Clinical Case and Laser Phototherapy Protocol:** The patient, a 15-year-old girl diagnosed with mucoepidermoid carcinoma, underwent surgical excision of a tumor of the left palatamaxilla. After that, she was subjected to 35 sessions of RT (2 Gy/d). Clinical examination revealed the spread of severe ulcerations to the jugal mucosa, gums, lips, hard palate, and tongue (WHO mucositis score 3). She had difficulty in moving her tongue and she was unable to eat any solid food. Oral hygiene orientation and LPT were performed throughout all RT sessions. A continuous diode laser, 660 nm, 40 mW, 6 J/cm², 0.24 J per point in contact mode, with spot size of 0.04 cm² was used in the entire oral cavity. A high-power diode laser at 1 W, 10 sec per cm of mucositis, approximately 10 J/cm², was used in defocused mode only on ulcerative lesions. After the first laser irradiation session, decreases in pain and xerostomia were reported; however, a more significant improvement was seen after five sessions. At that point although the mucositis score was still 2, the patient reported that she was free of pain, and consequently a palatine plate could be made to rehabilitate the entire surgical area. Seventeen laser irradiation sessions were necessary to eliminate all oral mucositis lesions. **Conclusion:** Normal oral function and consequent improvements in the quality of life of this oncologic patient were observed with LPT.

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Effects of 808 nm low-power laser irradiation on the muscle contraction of frog gastrocnemius.

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BACKGROUND AND OBJECTIVES: The efficacy of low-power laser irradiation (LLI) on muscle fibers remains unclear; therefore, we examined the effect of LLI (808 nm: 60 or 100 mW) on muscle contraction and conducted waveform analyses of the twitch curve, including alterations in the peak amplitudes of tension (AMP), latency (LAT), contraction period (CP), and relaxation period (RP). **STUDY DESIGN/MATERIALS AND METHODS:** The sciatic nerve-gastrocnemius muscles of 35 frogs (*Xenopus laevis*) were prepared. In Experiment 1, continuous stimulation for gastrocnemius contraction was delivered to the sciatic nerve (10 minutes); the experimental group simultaneously received LLI. In Experiment 2, two sets of stimulation and cessation (2 minutes each) were repeated after the initial stimulation period (2 minutes); the experimental group received LLI during the resting period. **RESULTS AND CONCLUSIONS:** In Experiment 1, 60 mW LLI significantly facilitated an attenuation of AMP and maintained a smaller prolongation of CP ($P < 0.05$), whereas 100 mW LLI significantly influenced a retardation of AMP attenuation and LAT prolongation ($P < 0.05$). In Experiment 2, 100 mW LLI significantly influenced AMP attenuation and LAT prolongation by retardation ($P < 0.05$); almost no effects were obtained in the case of 60 mW LLI. These results suggest that 808 nm LLI influences both synaptic signal transmission at the neuromuscular junction and excitation-contraction coupling in the muscle fibers, but not the relaxation process. We conclude that LLI at relatively high doses can influence muscle by retarding AMP attenuation and LAT prolongation.

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Evaluation of laser beam profile in soft tissue due to compression, glycerol, and micro-needling.

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BACKGROUND AND OBJECTIVES: Various methods have been suggested to enhance photon density in biological tissues in an attempt to maximize the efficacy of laser therapy. In this study, the effects of tissue compression, glycerol, and micro-needling methods on the laser beam profile (LBP) were investigated by quantitatively evaluating the spatial distribution of subsurface tissue photon density. **STUDY DESIGN/MATERIALS AND METHODS:** The LBP in tissue was obtained by imaging the laser beam transmitted through ex vivo porcine skin samples. The independent and combinational effects of tissue compression, glycerol, and micro-needling methods on the LBP were evaluated by quantitatively analyzing the full width at half-maximum (FWHM), maximum intensity, and total intensity at FWHM. **RESULTS:** Experimental results indicate the enhancement of the quality of Gaussian beam profile in ex vivo porcine skin. Glycerol and tissue compression resulted in an increase of maximum and total intensity and a decrease of FWHM. Tissue compression in conjunction with glycerol was determined to be the most effective method for enhancing the LBP. The topical application of glycerol in conjunction with micro-needling reduced the time period to optically clear tissue, which resulted in a further increase of subsurface tissue photon density. **CONCLUSION:** Tissue compression, glycerol, and micro-needling methods might be used independently or in combination to effectively enhance the photon density delivered to target chromophores in subsurface tissue, thus improving the LBP quality.

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Effect of Phototherapy on neonatal Heart Rate Variability and Complexity.

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Background: Phototherapy is a common mode of treatment for neonatal hyperzemia. However, phototherapy has been reported to alter cardiovascular function by causing increased peripheral blood flow, diminished cardiac output and increased sympathetic activity that may be of concern particularly in sick or premature newborns. The effects of phototherapy on the autonomic nervous system modulation of heart

rate in term neonates have not yet been investigated. Objectives: The aim of the present study was to investigate the effects of phototherapy on the autonomic nervous system modulation of heart rate in healthy full-term jaundiced neonates. Methods: 30 full-term jaundiced infants were prospectively studied before and during phototherapy. Heart rate variability was analyzed with conventional time-domain, spectral, and time-dynamic techniques by using Poincare plots. Results: Phototherapy was found to cause significant diminution in the short- and long-term variability of heart rate in newborns as documented by time-domain analysis of heart rate variability, and visually demonstrated by using Poincare plots. Spectral indices and heart rate were unchanged during phototherapy. Conclusions: A significant diminution in heart rate variability was documented during phototherapy, a phenomenon assumed to be centrally mediated. The reasons for this decrease are yet unknown. The use of time-dynamic analysis methods may offer important details on the newborn's physiology that cannot be revealed by traditional methods.

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http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=18787336