

Shibata Y , Ogura N, Yamashiro K et al. **Anti-inflammatory effect of linear polarized infrared irradiation on interleukin-1-induced chemokine production in MH7A rheumatoid synovial cells.** Lasers in Medical Science. 2005. July 27.

Shibata examined the anti-inflammatory effect of infrared linear polarized light irradiation on the MH7A rheumatoid fibroblast-like synoviocytes stimulated with the proinflammatory cytokine interleukin (IL)-1. Expression of messenger ribonucleic acids (mRNAs) encoding IL-8, RANTES (regulated upon activation, normal T cell expressed and secreted), growth-related gene alpha (GRO), and macrophage inflammatory protein-1 (MIP1) was measured using real-time reverse transcription polymerase chain reaction, and the secreted proteins were measured in the conditioned media using enzyme-linked immunosorbent assays. It was found that irradiation with linear polarized infrared light suppressed IL-1-induced expression of IL-8 mRNA and, correspondingly, the synthesis and release of IL-8 protein in MH7A cells. This anti-inflammatory effect was equivalent to that obtained with the glucocorticoid dexamethasone. Likewise, irradiation suppressed the IL-1-induced expression of RANTES and GRO mRNA. These results suggest that the irradiation of the areas around the articular surfaces of joints affected by rheumatoid arthritis (RA) using linear polarized light may represent a useful new approach to treatment.

Aimbire F , Albertine R , de Magalhães R G, Lopes-Martins R A et al. **Effect of LLLT Ga–Al–As (685 nm) on LPS-induced inflammation of the airway and lung in the rat.** Lasers in Medical Science. 2005;

The purpose of the study by Aimbire was to investigate the effect of low level laser therapy on male Wistar rat trachea hyperreactivity (RTHR), bronchoalveolar lavage (BAL) and lung neutrophils influx after Gram-negative bacterial lipopolysaccharide (LPS) intravenous injection. The RTHR, BAL and lung neutrophils influx were measured over different intervals of time (90 min, 6 h, 24 h and 48 h). The energy density (ED) that produced an anti-inflammatory effect was 2.5 J/cm², reducing the maximal contractile response and the sensibility of trachea rings to methacholine after LPS. The same ED produced an anti-inflammatory effect on BAL and lung neutrophils influx. The Celecoxib COX-2 inhibitor reduced RTHR and the number of cells in BAL and lung neutrophils influx of rats treated with LPS. Celecoxib and laser reduced the PGE₂ and TXA₂ levels in the BAL of LPS-treated rats. These results demonstrate that 685 nm laser therapy produced anti-inflammatory effects on RTHR, BAL and lung neutrophils influx in association with inhibition of COX-2-derived metabolites.

Vinck E , Coorevits P, Cagnie B, De Muynck M et al. **Evidence of changes in sural nerve conduction mediated by light emitting diode irradiation.** Lasers in Medical Science. 2005; 20 (1):

A randomised controlled study was conducted by Vinck through measuring antidromic nerve conduction on the peripheral sural nerve of healthy subjects (n=64). One baseline measurement and five post-irradiation recordings (2-min interval each) were performed of the nerve conduction velocity (NCV) and negative peak latency (NPL). Interventional set-up was identical for all subjects, but the experimental group (=32) received an irradiation (2 min at a continuous power output of 160 mW, resulting in a radiant exposure of 1.07 J/cm²) with an infrared LED device, while the placebo group was treated by sham irradiation. Statistical analysis of NCV and NPL difference scores, revealed a significant interactive effect for both NCV (P=0.003) and NPL (P=0.006). Further post hoc LSD analysis showed a time-related statistical significant decreased NCV and an increased NPL in the experimental group and a statistical significant difference between placebo and experimental group at various points of time. Based on these results, it can be concluded that LED irradiation, applied to intact skin at

the described irradiation parameters, produces an immediate and localized effect upon conduction characteristics in underlying nerves.

Vinck E M, Cagnie B J, Cornelissen M J et al. **Increased fibroblast proliferation induced by light emitting diode and low power laser irradiation.** *Lasers in Medical Science.* 2003; 18 (2): 95-99.

In a study by Vinck cultured fibroblasts were treated in a controlled, randomised manner during three consecutive days, either with an infrared laser or with a LED light source emitting several wavelengths (950 nm, 660 nm and 570 nm) and respective power outputs. Treatment duration varied in relation to varying surface energy densities (radiant exposures). Statistical analysis revealed a higher rate of proliferation in all irradiated cultures in comparison with the controls. Green light yielded a significantly higher number of cells than red and infrared LED light and than the cultures irradiated with the laser; the red probe provided a higher increase than the infrared LED probe and than the laser source.

Siedentopf C M, Koppelstaetter F, Haala I A et al. **Laser acupuncture induced specific cerebral cortical and subcortical activations in humans.** *Lasers in Medical Science.* 2005.

As recent studies demonstrated, acupuncture can elicit activity in specific brain areas. The study by Siedentopf aimed to explore further the central effect using laser acupuncture. The researchers investigated the cerebral effects of laser acupuncture at both acupoints GB43 with functional magnetic resonance imaging (fMRI). As a control condition the laser was mounted at the same acupoints but without application of laser stimulation. The group results showed significant brain activations within the thalamus, nucleus subthalamicus, nucleus ruber, the brainstem, and the Brodmann areas 40 and 22 for the acupuncture condition. No significant brain activations were observed within the placebo condition. The activations we observed were laser acupuncture-specific and predominantly ipsilateral. This supports the assumption that acupuncture is mediated by meridians, since meridians do not cross to the other side.

Zalewska-Kaszubska J, Obzejta D. **Use of low-energy laser as adjunct treatment of alcohol addiction.** *Lasers in Medical Science.* 2004; 19 (2): 100-104.

The aim of the study by Zalewska-Kaszubska was to treat patients with alcohol dependence syndrome with laser acupuncture. Fifty-three alcoholics were treated with two types of laser stimulation in four sessions. Each session consisted of 20 consecutive daily helium-neon laser neck irradiation and 10 auricular acupuncture treatments with argon laser (every 2nd day). The Beck Depression Inventory–Fast Screen (BDI-FS) was used to assess their frame of mind before the session and after 2 months of treatment. Moreover, β -endorphin plasma concentration was estimated five times using the radioimmunoassay (RIA) method. Improvement in BDI-FS and increase in β -endorphin level were observed.

Dube A, Jayasankar K, Prabakaran L et al. **Nitrogen laser irradiation (337 nm) causes temporary inactivation of clinical isolates of Mycobacterium tuberculosis.** *Lasers in Medical Science.* 2004; 19 (1): 52-56.

Dube investigated the effect of nitrogen laser irradiation (337 nm) on viability of clinical isolates of Mycobacterium tuberculosis. Bacteria were exposed to a nitrogen laser (average power 2.0 mW) in vitro at power density of 70 ± 0.7 W/m² for 0–30 min, and the cell viability was determined by luciferase reporter phage (LRP) assay. Immediately after laser exposure, all the clinical isolates investigated showed a dose-dependent decrease in cell viability. However, when the laser-exposed isolates were incubated in broth medium for 3 days, most of these showed significant recovery from laser-induced damage. Addition of 5.0 g/ml acriflavine (a DNA repair inhibitor) in the incubation medium had no significant effect

on recovery. This suggests that DNA damage may not be involved in the cell inactivation. Electron paramagnetic resonance (EPR) studies using 5-doxyl stearic acid (5-DS) as a probe suggest alterations in lipid regions of the cell wall.

Gigo-Benato D, Geuna S, de Castro Rodrigues A, Tos P et al. **Low-power laser biostimulation enhances nerve repair after end-to-side neurorrhaphy: a double-blind randomized study in the rat median nerve model.** *Lasers in Medical Science*, 2004; 19 (1): 57-65.

The objective of the study by Gigo-Benato was to investigate the effects of postoperative lasertherapy on nerve regeneration after end-to-side neurorrhaphy, an innovative technique for peripheral nerve repair. After complete transection, the left median nerve was repaired by end-to-side neurorrhaphy on the ulnar donor nerve. The animals were then divided into four groups: one placebo group, and three laser-treated groups that received laser therapy three times a week for 3 weeks starting from postoperative day 1. Three different types of laser emission were used: continuous (808 nm), pulsed (905 nm), and a combination of the two. Functional testing was carried out every 2 weeks after surgery by means of the grasping test. At the time of withdrawal 16 weeks postoperatively, muscle mass recovery was assessed by weighing the muscles innervated by the median nerve. Finally, the repaired nerves were withdrawn, embedded in resin and analyzed by light and electron microscopy. Results showed that laser biostimulation induces: (1) a statistically significant faster recovery of the lesioned function; (2) a statistically significant faster recovery of muscle mass; (3) a statistically significant faster myelination of the regenerated nerve fibres. From comparison of the three different types of laser emissions, it turned out that the best functional outcome was obtained by means of pulsed-continuous-combined laser biostimulation.

Hamajima S, Hiratsuka K, Kiyama-Kishikawa M, Tagawa T et al. **Effect of low-level laser irradiation on osteoglycin gene expression in osteoblasts.** *Lasers in Medical Science*. 2003; 18 (2): 78-82.

Hamajima investigated the stimulatory effect of LLLI on bone formation during the early proliferation stage of cultured osteoblastic cells. A mouse calvaria-derived osteoblastic cell line, MC3T3-E1, was utilised to perform a cDNA microarray hybridisation to identify genes that induced expression by laser at the early stage. Among those genes that showed at least a twofold increased expression, the osteoglycin/mimecan gene was upregulated 2.3-fold at 2 h after laser irradiation. Osteoglycin is a small leucine-rich proteoglycan (SLRP) of the extracellular matrix which was previously called the osteoinductive factor. SLRP are abundantly contained in the bone matrix, cartilage cells and connective tissues, and are thought to regulate cell proliferation, differentiation and adhesion in close association with collagen and many other growth factors. The researchers investigated the time-related expression of this gene by laser, using a reverse transcription polymerase chain reaction (RT-PCR) method, and more precisely with a real-time PCR method, and found increases of 1.5–2-fold at 2–4 h after laser, compared with the non-irradiated controls. These results suggest that the increased expression of the osteoglycin gene by laser irradiation in the early proliferation stage of cultured osteoblastic cells may play an important role in the stimulation of bone formation in concert with matrix proteins and growth factors.

Bagis S, Comelekoglu U, Coskun B, Milcan A et al. **No effect of GaAs (904 nm) laser irradiation on the intact skin of the injured rat sciatic nerve.** *Lasers in Medical Science*. 2003; 18 (2): 83-88.

Bagis evaluated the electrophysiological and histopathological effects of gallium arsenide (904 nm) laser irradiation on the intact skin injured rat sciatic nerve. Twenty-four male Wistar

rats were divided into three groups (n=8 each). At the level of proximal third of the femur the sciatic nerve was crushed bilaterally with an aneurysm clip for half a second. A gallium arsenide laser (wavelength 904 nm, pulse duration 220 ns, peak power per pulse 27 W, spot size 0.28 cm², pulse repetition rate 16, 128 and 1000 Hz; total applied energy density 0.31, 2.48 and 19 J/cm²) was applied to the right sciatic nerve for 15 min daily at the same time on 7 consecutive days. The same procedure was performed on the left sciatic nerve of same animal, but without radiation emission, and this was accepted as control. Compound muscle action potentials were recorded from right and left sides in all three groups before surgery, just at the end of injury, at the 24th hour and on the 14th and 21st days of injury in all rats. Twenty-one days after injury, the rats were sacrificed. The sciatic nerves of the operated parts were harvested from the right and left sides. Histopathological evaluation was performed by light microscopy. Statistical evaluation was done using analysis of variance for two factors (right and left sides) repeated-measures (CMAP variables within groups) and the Tukey–Kramer Honestly Significant Difference test (CMAP variables between laser groups). No statistically significant difference was found regarding the amplitude, area, duration and conduction velocity of CMAP for each applied dose (0.31, 2.48 and 19 J/cm²) on the irradiated (right) side and the control (left) side, or between irradiated groups. Twenty-one days after injury there were no qualitative differences in the morphological pattern of the regenerated nerve fibres in either irradiated (0.31, 2.48 and 19 J/cm²) or control nerves when evaluated by light microscopy.

Nicola R A, Jorgetti V, Rigau J, Marcos T T. **Effect of low-power GaAlAs laser (660 nm) on bone structure and cell activity: an experimental animal study.** *Lasers in Medical Science.* 2003; 18 (2): 89-94.

Nicola studied the activity in bone cells after 660 nm laser irradiation, close to the site of the bone injury. The femurs of 48 rats were perforated (24 in the irradiated group and 24 in the control group) and the irradiated group was treated with a GaAlInP laser of 660 nm, 10J/cm² of radiant exposure on the 2nd, 4th, 6th and 8th days after surgery (DAS). The researchers carried out histomorphometry analysis of the bone. It was found that activity was higher in the irradiated group than in the control group: (a) bone volume at 5 DAS (p=0.035); (b) osteoblast surface at 15 DAS (p=0.0002); (c) mineral apposition rate at 15 and 25 DAS (p=0.0008 and 0.006); (d) osteoclast surface at 5 DAS and 25 DAS (p=0.049 and p=0.0028); and (e) eroded surface (p=0.0032). It is concluded that this type of irradiation increases the activity in bone cells (resorption and formation) around the site of the repair without changing the bone structure.

Kreisler M, Christoffers A B, Willershausen B, d'Hoedt B et al. **Low-level 809 nm GaAlAs laser irradiation increases the proliferation rate of human laryngeal carcinoma cells in vitro.** *Lasers in Medical Science.* 2003; 18 (2): 100-103.

The aim of the study by Kreisler was to investigate the effect of 809 nm laser irradiation on the proliferation rate of human larynx carcinoma cells in vitro. Epithelial tumor cells were obtained from a laryngeal carcinoma and cultured under standard conditions. For laser treatment the cells were spread on 96-well tissue culture plates. Sixty-six cell cultures were irradiated with an 809 nm GaAlAs laser. Another 66 served as controls. Power output was 10 mW (cw) and the time of exposure 75–300 s per well, corresponding to an energy fluence of 1.96–7.84 J/cm². Subsequent to laser treatment, the cultures were incubated for 72 h. The irradiated cells revealed a considerably higher proliferation activity. The differences were highly significant up to 72 h after irradiation.

Fekrazad R, Jafari Sh, Kalhori K. **The effects of Pulsed Nd:YAG Laser Therapy on Recurrent Aphthous Ulcers.** Internat Congress of. ESOLA, Vienna, Austria, May 2001, p. 40-41.

The study by Fekrazad was performed as a clinical trial on 138 patients with aphthous ulcers. The patients were randomly assigned into three groups, as follows: (1) treatment with a focalised beam; (2) treatment with a non-focalised beam and (3) placebo treatment. The specifications of the laser treatment were as follows: Nd:YAG laser, power 3 W, energy 100 mJ, frequency 30Hz, time 60 sec. A HeNe laser was used for marking the beam of the Nd:YAG area (power 5 mW). In group (1) the laser beam was administered from a distance of 6 mm from the centre of the ulcer and up to 1 mm of its outer border without using a clear and defined point of irradiation. In group (2) a well defined point beam of the laser was irradiated from a distance of 2 mm from the centre of the ulcer, in a helical fashion and covering up to 1 mm of the ulcer's outer border. In group (3) the HeNe laser was used as placebo at a long distance and not covering the aphtho itself, while the Nd:YAG laser beam was off. In group (1) and (2) a significant reduction in pain was observed compared to group (3). The duration of pain and the duration of the recovery period were shortest in group (2).