

28 new abstracts added, August 2005

Effect of red and near-infrared laser light on adenosine triphosphate (ATP) in the luciferine–luciferase reaction.

Effects of low-power laser irradiation on cell locomotion in protozoa. Photochem Photobiol. 2004; 80 (3):531-534.

Low-power lasers are commonly used in human medicine for treatment of various pathological conditions, but mechanisms of their healing effects are still poorly understood. The results of this study provide information related to these effects at the cellular level. Two different protozoan species, *Euglena gracilis* and *Tetrahymena thermophila*, were used to study changes in locomotion behavior in response to low-power lasers. The cells were irradiated at 830 and 650 nm generated by a semiconductor laser (99 J/cm², 360 mW) and a laser pointer (0.75 J/cm², 5 mW), respectively, and their locomotion was recorded by a TV camera and analyzed using computer software. Exposure to laser light, regardless of the wavelength, resulted in increased cell velocity in both species. Exposure to 650 nm produced an equal increase in median cell velocity in both *E. gracilis* (19.0%) and *T. thermophila* (18.2%), and some increase persisted in the postirradiation 30 s period. Irradiation by the 830 nm laser resulted in a markedly higher response in *Tetrahymena* (29.4%) than in *Euglena* (15.2%), and the two median values remained increased after irradiation was discontinued. Different reactions found in the species studied and some mechanisms underlying the response of cells to radiation are discussed.

Pugliese LS, Medrado AP, Reis SR, Andrade Zde A. **The influence of low-level laser therapy on biomodulation of collagen and elastic fibers.** Pesqui Odontol Bras. 2003; (4): 307-313

The study of low-level laser therapy upon extra-cellular matrix elements is important to understand the wound healing process under this agent. However, little is known about the interference of laser light in relation to collagen and elastic fibers. Cutaneous wounds were performed on the back of 72 Wistar rats and a Ga-Al-As low-level laser was punctually applied with different energy densities. The animals were killed after 24, 48, 72 hours and 5, 7 and 14 days. Tissues were stained with hematoxylin-eosin, sirius red fast green and orcein and then analyzed. It was observed that the treated group exhibited larger reduction of edema and inflammatory infiltrate. The treated animals presented a larger expression of collagen and elastic fibers, although without statistical significance ($p > 0.05$). Treatment with a dosage of 4 J/cm² exhibited more expressive results than that with 8 J/cm². In this study, the authors concluded that low-level laser therapy contributed to a larger expression of collagen and elastic fibers during the early phases of the wound healing process.

Medrado A R, Pugliese L S, Reis S R, Andrade Z A. **Influence of low level laser therapy on wound healing and its biological action upon myofibroblasts.** Lasers Surg Med. 2003; 32 (3): 239-244.

Cutaneous wounds were inflicted on the back of 72 Wistar rats. Low level laser was locally applied with different energy densities. Lesions were analyzed after 24, 48, 72 hours and 5, 7, and 14 days. Tissues were studied by histology, immunohistochemistry, and electron microscopy. In treated animals, the extent of edema and the number of inflammatory cells were reduced but the amount of collagen and elastic fibers appeared slightly increased. Desmin/smooth muscle alpha-actin-phenotype myofibroblasts were statistically more prominent on the 3rd day after surgery in treated wounds than in controls. Treatment with a dosage of 4 J/cm² was superior to that with 8 J/cm².: Laser therapy reduced the inflammatory

reaction, induced increased collagen deposition and a greater proliferation of myofibroblasts in experimental cutaneous wounds.

Hopkins J T, McLoda T A, Seegmiller J G, Baxter G D. **Low-Level Laser Therapy Facilitates Superficial Wound Healing in Humans: A Triple-Blind, Sham-Controlled Study.** J Athl Train. 2004; 39 (3): 223-229.

The authors used a randomized, triple-blind, placebo-controlled design with 2 within-subjects factors (wound and time) and 1 between-subjects factor (group). Data were collected in the laboratory setting. Subjects were twenty-two healthy subjects (age = 21 ± 1 years, height = 175.6 ± 9.8 cm, mass = 76.2 ± 14.2 kg). Two standardized 1.27-cm² abrasions were induced on the anterior forearm. After wound cleaning, standardized digital photos were recorded. Each subject then received LLLT (8 J/cm²; treatment time = 2 minutes, 5 seconds; pulse rate = 700 Hz) to 1 of the 2 randomly chosen wounds from either a laser or a sham 46-diode cluster head. Subjects reported back to the laboratory on days 2 to 10 to be photographed and receive LLLT and on day 20 to be photographed. Data were analyzed for wound contraction (area), color changes (chromatic red), and luminance. A group \times wound \times time interaction was detected for area measurements. At days 6, 8, and 10, follow-up testing revealed that the laser group had smaller wounds than the sham group for both the treated and the untreated wounds. No group \times wound \times time differences were detected for chromatic red or luminance. The LLLT resulted in enhanced healing as measured by wound contraction. The untreated wounds in subjects treated with LLLT contracted more than the wounds in the sham group, so LLLT may produce an indirect healing effect on surrounding tissues. These data indicate that LLLT is an effective modality to facilitate wound contraction of partial-thickness wounds.

Lizarelli R F, Marcello O, Mazzetto M O, Bagnato V S. **Low-intensity laser therapy to treat dentin hypersensitivity: comparative clinical study using different light doses.** Proc. SPIE. 2000; Vol. 4422.

Dentin hypersensitivity is the most common patient's complaint related to pain. In fact, this is a challenge to treat especially if conventional techniques are used. The possibility to treat pain through a low intensity laser gives us an opportunity to solve this important clinical problem without promote a discomfort to patient. The main point here is not if this kind of treatment is anti-inflammatory to pulp and/or biostimulatory to production of irregular secondary dentin. The most important point here is to understand how much energy is necessary to reach conditions where tooth become insensible to external stimulus. Our double-blinded study compared a group without laser (Placebo) with five other groups where different doses at 660 nm low intensity laser were employed. The final conclusion is that for 660 nm laser therapy, the doses from 0.13 to 2.0 J/cm² were more efficiency than the others. The follow up care in this study was of 45 days.

Corona S A, Nascimento T N, Catirse A B, Lizarelli R F, Dinelli W, Palma-Dibb R G.

Clinical evaluation of low-level laser therapy and fluoride varnish for treating cervical dentinal hypersensitivity. J Oral Rehabil. 2003;30 (12): 1183-1189.

The aim of this study was to evaluate in vivo the use of low-level gallium-aluminium-arsenide (GaAlAs) laser and sodium fluoride varnish (Duraphat) in the treatment of cervical dentine hypersensitivity. Twelve patients, with at least two sensitive teeth were selected. A total of 60 teeth were included in the trial. Prior to desensitizing treatment, dentine hypersensitivity was assessed by a thermal stimulus and patients' response to the examination was considered to be a control. The GaAlAs laser (15 mW, 4 J/cm²) was irradiated on contact mode and fluoride varnish was applied at cervical region. The efficiency of the treatments was assessed at three examination periods: immediately after first application, 15 and 30 days after the first

application. The degree of sensitivity was determined following predefined criteria. Data were submitted to analysis and no statistically significant difference was observed between fluoride varnish and laser. Considering the treatments separately, there was no significant difference for the fluoride varnish at the three examination periods, and for laser therapy, significant difference was found solely between the values obtained before the treatment and 30 days after the first application. It may be concluded that both treatments may be effective in decreasing cervical dentinal hypersensitivity. Moreover, the low-level GaAlAs laser showed improved results for treating teeth with higher degree of sensitivity.

Marsilio AL, Rodrigues JR, Borges AB. **Effect of the clinical application of the GaAlAs laser in the treatment of dentine hypersensitivity.** J Clin Laser Med Surg. 2003; 21(5): 291-296.

In the study by Marsilio 25 patients, with a total number of 106 cases of dentinal hypersensitivity (DH), were treated with GaAlAs laser therapy. 65% of the teeth were premolars; 14% were incisors and molars; 6.6% were canines. The teeth were irradiated with 3 and 5 J/cm² for up to six sessions, with an interval of 72 h between each application, and they were evaluated initially, after each application, and at 15 and 60 days follow-up post-treatment. The treatment was effective in 86.53% and 88.88% of the irradiated teeth, respectively, with the minimum and maximum energy recommended by the manufacturer. There was a statistically significant difference between DH and after a follow-up of 60 days for both groups. The difference among the energy maximum and minimum was not significant.

Kawalec J S, Hetherington J, Pfennigwerth C et al **Effect of a diode laser on wound healing by using diabetic and nondiabetic mice.** Journal of Foot and Ankle Surgery. 2004; 43 (4): 214-220.

The purpose of this study was to evaluate therapy with a high power 980 nm GaAlAs laser for wound healing. Using genetically diabetic and non-diabetic mice, two 6 mm wounds were created on the back of each mouse by using a punch biopsy. The mice were assigned to 1 of 4 subgroups for laser treatment at different fluence and frequency of treatment: 5 W (18 J/cm²) every 2 days, 5 W (18 J/cm²) every 4 days, 10 W (36 J/cm²) every 2 days, and 10 W (36 J/cm²) every 4 days. In addition, control mice were used and the wounds were allowed to heal naturally. Wound healing was evaluated on days 5, 12, and 19 by percentage of wounds healed and percent wound closure. A maximum of 5 mice per subgroup were killed at days 7, 14, and 21, and histology was conducted on the wound sites. For diabetic mice receiving 5 W every 2 days, the percentage of wounds healed after 19 days was 100% versus 40% in the control group. Only 20% of wounds in the 10 W diabetic subgroups achieved healing during the same period. For the subgroups whose wounds did not completely heal, all but the 10 W every 2 days subgroup had average closure of >90%. The 100% closure for the 5 W every 2 days subgroup was significantly greater than the other subgroups. For non-diabetic mice, 100% of the wounds in the 5 W every 4 days and control subgroups were completely healed, whereas 90% of the wounds from the 5 W every 2 days and the 10 W every 4 days subgroups were completely healed. In the latter 2 subgroups, wound closure was 99.4% and 98.8%, respectively. These differences were not significant. The histological results confirmed these findings. In conclusion, treatment at 18 J/cm² shows a beneficial effect on wound healing in diabetic mice and does not have a detrimental effect in non-diabetic mice.

Cho H J, Lim S C, Kim S G et al. **Effect of low-level laser therapy on osteoarthropathy in rabbit.** In Vivo. 2004;18 (5):585-591.

The aim of this study was to determine whether low-level laser therapy (LLLT) aided the recovery of damaged articular cartilage in joints with artificially induced osteoarthropathy (OA). OA was induced by injecting hydrogen peroxide (H_2O_2) into the articular spaces of both knees in rabbits, twice a week for 4 weeks. The induction of OA and the effect of LLLT were evaluated by biochemical, radiological and histopathological analysis. Superoxide dismutase (SOD) activity increased about 40% in the OA group, as compared to the controls. Although SOD activity in the OA group was not significantly different from the 2-week groups, it was significantly different from the 4-week control and treatment groups. There was also a significant difference between the 4-week control and treatment groups. Simple radiographs and three-dimensional computed tomographs (3D CT) did not show detectable arthropathy in the OA group, nor any particular changes in the 2-week groups. In contrast, distinct erosions were seen in the distal articular cartilage of the femur, with irregularity of the articular surface, in the 4-week control group, while the erosions were reduced and arthropathy improved slightly in the 4-week treatment group. Grossly, erosions formed on the articular surface in the OA group. In comparison, severe erosions damaged the articular cartilage in the 4-week control group, but not in the 2-week control and treatment groups. Regeneration of articular cartilage was seen in gross observations in the 4-week treatment group. Histopathologically, there was slight irregularity of the articular surface and necrosis in the OA group, and serious cartilage damage, despite slight chondrocyte regeneration, in the 4-week control group. Conversely, the 4-week treatment group showed chondrocyte replacement, with sometimes close to normal articular cartilage on the articular surface. These results suggest that LLLT was effective in the treatment of chemically-induced OA.

Irvine J, Chong S L, Amirjani N, Chan K M. **Double-blind randomized controlled trial of low-level laser therapy in carpal tunnel syndrome.** Muscle Nerve. 2004; 30 (2):182-187.

In a double-blind randomized controlled trial of LLLT, 15 CTS patients, 34 to 67 years of age, were randomly assigned to either the control group (n = 8) or treatment group (n =7). Both groups were treated three times per week for 5 weeks. Those in the treatment group received 860 nm GaAlAs laser at a dosage of $6 J/cm^2$ over the carpal tunnel, whereas those in the control group were treated with sham laser. The primary outcome measure was the Levine Carpal Tunnel Syndrome Questionnaire, and the secondary outcome measures were electrophysiological data and the Purdue pegboard test. All patients completed the study without adverse effects. There was a significant symptomatic improvement in both the control and treatment groups. However, there was no significant difference in any of the outcome measures between the two groups.

Lapchak P A, Wei J, Zivin J A. **Transcranial infrared laser therapy improves clinical rating scores after embolic strokes in rabbits.** Stroke. 2004; 35 (8):1985-1988.

In this study the rabbit small clot embolic stroke model (RSCM) was used to assess whether laser treatment (7.5 or $25 mW/cm^2$) altered clinical rating scores (behaviour) when given to rabbits beginning 1 to 24 hours post embolisation. Behavioural analysis was conducted from 24 hours to 21 days after embolisation, allowing for the determination of the effective stroke dose (P50) or clot amount (mg) that produces neurological deficits in 50% of the rabbits. Using the RSCM, a treatment is considered beneficial if it significantly increases the P50 compared with the control group. In the present study, the P50 value for controls were 0.97 ± 0.19 mg to 1.10 ± 0.17 mg; this was increased by 100% to 195% ($P50 = 2.02 \pm 0.46$ to 2.98 ± 0.65 mg) if laser treatment was initiated up to 6 hours, but not 24 hours post embolisation ($P50 = 1.23 \pm 0.15$ mg). Laser treatment also produced a durable effect that was measurable 21 days after embolisation. Laser treatment ($25 mW/cm^2$) did not affect the physiological variables that were measured. This study shows that laser treatment improved behavioural

performance if initiated within 6 hours of an embolic stroke and the effect of laser treatment is durable.

Brown S A, Rohrich R J, Kenkel J et al. **Effect of low-level laser therapy on abdominal adipocytes before lipoplasty procedures.** *Plast Reconstr Surg.* 2004; 113(6):1796-1804; discussion 1805-1806.

Recently, low-level laser therapy was reported to "liquefy" or release stored fat in adipocytes by the opening of specialized yet not identified cell membrane-associated pores after a brief treatment. To explore these data further, a series of in vitro studies on human preadipocytes and institutional animal care and use committee-approved protocols in a porcine Yucatan model and an institutional review board-approved clinical study were performed. Using a 635-nm low-level laser of 1.0 J/cm², these studies were designed to determine whether alteration in adipocyte structure or function was modulated after low-level laser therapy. Cultured human preadipocytes after 60 minutes of laser therapy did not change appearance compared with nonirradiated control cells. In the porcine model, low-level laser therapy (30 minutes) was compared with traditional lipoplasty (suction-assisted lipoplasty) and ultrasound-assisted lipoplasty. From histologic and scanning electron microscopic evaluations of the lipoaspirates, no differences were observed between low-level laser therapy-derived and suction-assisted lipoplasty-derived specimens. Using exposure times of 0, 15, 30, and 60 minutes in the presence or absence of superwet wetting solution and in the absence of lipoplasty, total energy values of 0.9 mW were delivered to tissue samples at three increasing depths from each experimental site. No histologic tissue changes or specifically in adipocyte structure were observed at any depth with the longest low-level laser therapy (60 minutes with superwet fluid). Three subjects undergoing large-volume lipoplasty were exposed to superwet wetting fluid infiltration 14 minutes before and 12 minutes after, according to vendor instructions. Tissue samples from infiltrated areas were collected before suction-assisted lipoplasty and lipoaspirates from suction-assisted lipoplasty. No consistent observations of adipocyte disruptions were observed in the histologic or scanning electron microscopy photographs. These data do not support the belief that low-level laser therapy treatment before lipoplasty procedures disrupts tissue adipocyte structure.

Gaida K, Koller R, Isler C et al. **Low Level Laser Therapy—a conservative approach to the burn scar?** *Burns.* 2004; 30 (4): 362-367. Nineteen patients with 19 burn scars were treated with a 400 mW 670 nm laser twice a week 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. 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 laser could be found. No negative effects were reported.

Zinman L H, Ngo M, Ng E T et al. **Low-intensity laser therapy for painful symptoms of diabetic sensorimotor polyneuropathy: a controlled trial.** *Diabetes Care.* 2004; 27 (4): 921-924.

Zinman conducted a randomized, double-masked, sham therapy-controlled clinical trial in 50 patients with painful diabetic sensorimotor polyneuropathy (DSP). All patients received sham therapy over a 2-week baseline period and were then randomised to receive biweekly sessions of either sham or LLLT for 4 weeks. The primary efficacy parameter was the difference in the weekly mean pain scores on a visual analog scale (VAS). The patients had similar baseline

characteristics for pain intensity, and duration of DSP. Both groups noted a decrease in weekly mean pain scores during sham treatment. After the 4-week intervention, the LLLT group had an additional reduction. LLLT had no effect on the Toronto Clinical Neuropathy Score, nerve conduction studies, sympathetic skin response, or quantitative sensory testing. Although an encouraging trend was observed with LLLT, the study results do not provide sufficient evidence to recommend this treatment for painful symptoms of DSP.

Ozkan N, Altan L, Bingol U et al. **Investigation of the supplementary effect of GaAs laser therapy on the rehabilitation of human digital flexor tendons.** J Clin Laser Med Surg. 2004; 22 (2):105-110.

The study by Ozkan was performed in a total of 25 patients with 41 digital flexor tendon injuries in five anatomical zones. In Group I (21 digits in 13 patients), whirlpool and infrared GaAs diode laser with a frequency of 100 Hz. was applied between the 8th and 21st days postoperatively and all patients were given the Washington rehabilitation program until the end of the 12th week. In Group II (20 digits in 12 patients), the same treatment protocol was given but the laser instrument was switched off during applications. The results of the study showed a significant improvement in the laser-treated group only for the parameter of edema reduction but the difference between the two groups was non-significant for pain reduction, hand grip strength, and functional evaluation performed according to Strickland and Buck-Gramcko systems using total active motion and fingertip-to distal palmar crease distance parameters. Significant improvement obtained in edema reduction both immediately and 12 weeks after supplementary GaAs laser application in our study has been interpreted as an important contribution to the rehabilitation of human flexor tendon injuries because edema is known to have a detrimental effect on functional recovery during both early and late stages of tendon healing. However, this study failed to show a significant positive effect of supplementary GaAs laser application on the other functional parameters. recovery parameters of human flexor tendon injury rehabilitation.

Cruz D R, Kohara E K, Ribeiro M S, Wetter N U. **Effects of low-intensity laser therapy on the orthodontic movement velocity of human teeth: a preliminary study.** Lasers Surg Med. 2004; 35 (2):117-120.

Eleven patients were recruited for this 2-month study. One half of the upper arcade was considered control group (CG) and received mechanical activation of the canine teeth every 30 days. The opposite half received the same mechanical activation and was also irradiated with a diode laser emitting light at 780 nm, during 10 seconds at 20 mW, 5 J/cm², on 4 days of each month. Data of the biometrical progress of both groups were statistically compared. All patients showed significant higher acceleration of the retraction of canines on the side treated with LLLT when compared to the control. These findings suggest that LLLT does accelerate human teeth movement and could therefore considerably shorten the whole treatment duration.

Wenzel G I, Pikkula B, Choi C H, Anvari B, Oghalai J S. **Laser irradiation of the guinea pig basilar membrane.** Lasers Surg Med. 2004; 35 (3): 174-180.

The authors sought to assess the effect of laser irradiation on collagen within the basilar membrane using histological analysis Two samples were treated with a 600 nm pulsed dye laser and two were controls. Collagen organization was visualized using polarization microscope. Laser reduced the birefringence within the basilar membrane as well as within other stained collagen-containing structures. Larger reduction in birefringence were measured when more laser pulses were given. The effects were similar across all turns of each cochlea. Laser irradiation causes immediate alterations in collagen organization within the cochlea that

can be visualized with polarization microscopy. These alterations may effect cochlear tuning. Ongoing research is aimed at analyzing the effect of laser irradiation on cochlear function. It is conceivable that this technique may have therapeutic benefits for patients with high frequency sensorial hearing loss.

Gur A, Sarac A J, Cevik R, Altindag O, Sarac S. **Efficacy of 904 nm gallium arsenide low level laser therapy in the management of chronic myofascial pain in the neck: a double-blind and randomize-controlled trial.** Lasers Surg Med. 2004; 35 (3):229-235.

A prospective, double-blind, randomized, and controlled trial was conducted by Gur in patients with chronic myofascial pain syndrome (MPS) in the neck to evaluate the effects of infrared low level 904 nm Gallium-Arsenide laser therapy on clinical and quality of life (QoL).: The study group consisted of 60 MPS patients. Patients were randomly assigned to two treatment groups: Group I (actual laser; 30 patients) and Group II (placebo laser; 30 patients). LLLT continued daily for 2 weeks except weekends. Follow-up measures were evaluated at baseline, 2, 3, and 12 weeks. All patients were evaluated with respect to pain at rest, pain at movement, number of trigger points (TP), the Neck Pain and Disability Visual Analog Scale (NPAD), Beck depression Inventory (BDI), and the Nottingham Health Profile (NHP). In the active laser group, statistically significant improvements were detected in all outcome measures compared with baseline while in the placebo laser group; significant improvements were detected in only pain score at rest at 1 week after the end of treatment. The score for self-assessed improvement of pain was significantly different between the active and placebo laser groups (63 vs. 19%). This study revealed that short-period application of LLLT is effective in pain relief and in the improvement of functional ability and QoL in patients with MPS.

Ozkan N, Altan L, Bingol U, Akin S U, Yurtkuran M. **Investigation of the supplementary effect of GaAs laser therapy on the rehabilitation of human digital flexor tendons.** Journal of Clinical Laser Medicine & Surgery. 2004; 22 (2): 105-110.

This study was performed in a total of 25 patients with 41 digital flexor tendon injuries in five anatomical zones. In Group I (21 digits in 13 patients), whirlpool and infrared GaAs diode laser with a frequency of 100 Hz. was applied between the 8(th) and 21(st) days postoperatively and all patients were given the Washington rehabilitation program until the end of the 12(th) week. In Group II (20 digits in 12 patients), the same treatment protocol was given but the laser instrument was switched off during applications. The results of the study showed a significant improvement in the laser-treated group only for the parameter of edema reduction ($p < 0.01$) but the difference between the two groups was non-significant for pain reduction, hand grip strength, and functional evaluation performed according to Strickland and Buck-Gramcko systems using total active motion and fingertip-to distal palmar crease distance parameters. Significant improvement obtained in edema reduction both immediately and 12 weeks after supplementary GaAs laser application in this study has been interpreted as an important contribution to the rehabilitation of human flexor tendon injuries because edema is known to have a detrimental effect on functional recovery during both early and late stages of tendon healing. However, this study has failed to show a significant positive effect of supplementary GaAs laser application on the other functional recovery parameters of human flexor tendon injury rehabilitation.

Zati A, Fortuna D, Valent A, Pulvirenti F, Bilotta T W. **Treatment of low back pain caused by intervertebral disk displacement: comparison between high power laser, TENS and NSAIDs.** Medicina Dello Sport. 2004; 57 (1): 77-82.

In physiotherapy, high power laser therapy is in increasing use to treat pain due to several orthopedic diseases. In this clinical study, we have tried to assess the efficacy of high power laser therapy in low back pain caused by intervertebral disk herniation, by comparing a new laser (pulsed Nd:YAG) with the TENS and a well-known NSAIDs (Ketoprofen). This trial highlights a better result of the high power laser therapy with respect to those obtained from TENS and NSAIDs. The most striking results are represented by the longer duration of the laser effects. It is therefore to be hoped that further research will be carried out in this field.

Stergioulas A. Low-level laser treatment can reduce edema in second degree ankle sprains. Journal of Clinical Laser Medicine & Surgery. 2004; 22 (2): 125-128.

Low-level laser therapy (LLLT) has been used for the last few years to treat sports injuries. The purpose of this study was to compare three therapeutic protocols in treating edema in second degree ankle sprains that did not require immobilization with a splint, under placebo-controlled conditions. Materials and Methods: Forty-seven soccer players with second degree ankle sprains, selected at random, were divided into the following groups: The first group (n = 16) was treated with the conventional initial treatment (RICE, rest, ice, compression, elevation), the second group (n = 16) was treated with the RICE method plus placebo laser, and the third group (n = 15) was treated with the RICE method plus an 820-nm GaAlAs diode laser with a radiant power output of 40 mW at 16 Hz. Before the treatment, and 24, 48, and 72 hrs later, the volume of the edema was measured. Results: A three by three repeated measures ANOVA with a follow up post hoc test revealed that the group treated with the RICE and an 820 nm GaAlAs diode laser presented a statistically significant reduction in the volume of the edema after 24 h (40).

Tascioglu F, Armagan O, Tabak U, Corapci I, Oner C. Low power laser treatment in patients with knee osteoarthritis. Swiss Medical Weekly. 2004; 134 (17-18): 254-258.

The aim of this study was to investigate the analgesic efficacy of low power laser therapy in patients with knee osteoarthritis (OA). The study design was randomised, placebo-controlled and single blinded. Sixty patients with knee OA according to the American College of Rheumatology criteria were included and randomly assigned to three treatment groups: active laser with dosage of 3J/per painful point, active laser with a dosage of 1.5/J per painful point and placebo laser treatment groups. A GaAlAs laser was used as a source of low power laser with a power output of 50 mW and a wavelength of 830 nm. The patients were treated 5 times weekly with 10 treatments in all. The clinical assessments included Western Ontario and McMaster Universities osteoarthritis index (WOMAC) pain, stiffness and physical function subscales. In addition, the intensity of pain at rest and on activation was evaluated on a visual analogue scale. Compared to baseline, at week 3 and at month 6, no significant improvement was observed within the groups. Similarly, no significant differences were found among the treatment groups at any time. With the chosen laser type and dose regimen the results that we obtained in this study, suggest that low-level laser therapy has no effect on pain in patients with knee OA.

Giuliani A, Fernandez M, Farinelli M, Baratto L et al. Very low level laser therapy attenuates edema and pain in experimental models. Int J Tissue React. 2004; 26 (1-2): 29-37.

In this study, the authors tested a new square wave microprocessor-controlled red laser with a low peak power output (<3 mW) in experimental pain in the rat. Acute inflammation was induced by intraplantar injection of carrageenan, chronic inflammation was induced by complete Freund's adjuvant (CFA) and neuropathic pain was produced by sciatic nerve

chronic constriction injury (CCI). In this study LLLT was effective in reducing edema and hyperalgesia in acute and chronic inflammation, if administered at the points usually selected for acupuncture. Moreover, spontaneous pain and thermal hyperalgesia were reduced in CCI rats treated with vLLLT. In conclusion, LLLT reduced edema and induced analgesia in experimental plantar pain in rats. The authors interpret this to mean that enkephalin mRNA level was strongly upregulated in the external layers of the dorsal horn of the spinal cord in CFA and CCI animals, and that LLLT further increased the mRNA level in single neurons.

Burduli N M, Aksenova I Z. **[Platelet aggregatory impairments in chronic obstructive bronchitis and a role of laser therapy in their correction]**. *Klin Med (Mosk)*. 2004;82(8):34-7. [Article in Russian]

A comparative follow-up was made to study platelet aggregatory function in patients with chronic obstructive bronchitis (COB) prior to and following treatment. The patients were divided into study and control groups. In addition to conventional treatment, the patients of the study group received laser therapy as intravenous blood irradiation. According to the type of baseline platelet aggregatory changes, all the patients were divided into 3 subgroups: 1) patients with hyperaggregation; 2) those with normal aggregation; and 3) those with hypoaggregation. In the patients from the study group, the performed treatment corrected platelet aggregatory disorders--the degree of aggregation decreased from 78 +/- 8.6% to 56.8 +/- 6.9% in Subgroup 1, increased from 23 +/- 4.8% to 54.6 +/- 6.21% in Subgroup 3. The similar positive changes in aggregation rates and the cumulative aggregation index was observed in the study group. In the control group, conventional drug therapy caused no substantial changes in platelet aggregatory function. Thus, intravenous blood laser irradiation is an effective technique in correcting thrombocytic dysfunction in COB.

Nussbaum E L, Lilje L, Mazzulli T. **Effects of low-level laser therapy (LLLT) of 810 nm upon in vitro growth of bacteria: relevance of irradiance and radiant exposure**. *J Clin Laser Med Surg*. 2003; 21 (5):283-290.

The aim of this study was to investigate the irradiance-dependency of low-level laser therapy (LLLT) effects on bacterial growth. LLLT is applied to open wounds to improve healing; however, its effect on wound bacteria is not well understood. *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus* were irradiated using a wavelength of 810 nm at irradiances of 0.015 W/cm² (0-50 J/cm²) and 0.03 W/cm² (0-80 J/cm²). Bacteria were counted after 20 h of incubation. LLLT effects varied significantly with species. *P.aeruginosa* growth decreased overall dependent on an interaction of irradiance and radiant exposure; greatest inhibition was produced using high irradiance delivering radiant exposures in the range of 1-20 J/cm² (p = 0.001-0.04). In contrast, *E. coli* growth increased overall (p = 0.01), regardless of irradiance; greatest effects were produced using low radiant exposures (1-20 J/cm²). There was a main effect for irradiance on *S. aureus* growth; however, growth was not different compared with controls. Additional analysis showed that there were differences in growth of *P.aeruginosa* when comparing samples that were matched by exposure times (66, 329, 658, 1316, 1974, and 2632 sec) rather than radiant exposure; this suggests that irradiance rather than exposure time was the significant factor in *P. aeruginosa* inhibition. These findings have immediate relevancy in the use of LLLT for infected wounds. Exposure to 810-nm irradiation (0.03 W/cm²) could potentially benefit wounds infected with *P. aeruginosa*. However, increased *E. coli* growth could further delay recovery.

Lin Y S, Huang M H, Chai C Y, Yang R C. **Effects of helium-neon laser on levels of stress protein and arthritic histopathology in experimental osteoarthritis**. *Am J Phys Med Rehabil*. 2004; 83 (10): 758-765.

A total of 42 rats with similar degrees of induced arthritis evaluated by means of bone scan were divided randomly into two groups. In the treated group, 21 rats received helium-neon laser treatment; in the control group, 21 rats received sham laser treatment. The changes in chondrocytes of SPs were measured by electrophoresis of proteins extracted from chondrocytes of arthritic cartilage at various time periods. The histopathologic changes and the presence of SP of arthritic cartilage were identified by hematoxylin and eosin stain and by immunostains of SP72 antibody individually from frozen sections of arthritic cartilage. SP density increased markedly in rats after laser treatment and was closely related to the repair of arthritic cartilage. Furthermore, the pathohistology of arthritic cartilage improved significantly with the decline of SP levels in the follow-up period. Thus, helium-neon (632 nm) laser can enhance SP production in arthritic chondrocytes. The extragenic production of SP is well correlated with the therapeutic effect of low-power laser in preserving chondrocytes and the repair of arthritic cartilage in rats.

Taly A B, Sivaraman Nair K P, Murali T, John A. **Efficacy of multiwavelength light therapy in the treatment of pressure ulcers in subjects with disorders of the spinal cord: A randomized double-blind controlled trial.** Archives of Physical Medicine and Rehabilitation. 2004; 85 (10): 1657-1661.

Thirty-five subjects with spinal cord injury, with 64 pressure ulcers (stage 2, n=55; stage 3, n=8; stage 4, n=1), were randomized into treatment and control groups. One subject refused consent. Mean duration of ulcers in the treatment group was 34.2 ± 45.5 days and in the control group, 57.1 ± 43.5 days. Treatment group received 14 sessions of multi wavelength light therapy, with 46 probes of different wavelengths from a gallium-aluminum-arsenide laser source, 3 times a week. Energy used was 4.5 J/cm^2 . Ulcers in the control group received sham treatment. Healing of the ulcer, defined as the complete closure of the wound with healthy scar tissue, time taken for the ulcer to heal, and stage of the ulcer and Pressure Sore Status Tool score 14 days after last treatment. There was no significant difference in healing between the treatment and control groups. Eighteen ulcers in treatment group and 14 in control group healed completely. Mean time taken by the ulcers to heal was 2.45 ± 2.06 weeks in the treatment group and 1.78 ± 2.13 weeks in the control group ($P=.330$). Time taken for stage 3 and 4 ulcers to reach stage 2 was 2.25 ± 0.5 weeks in treatment group and 4.33 ± 1.53 weeks in control group. Multi wavelength light therapy from a gallium-aluminum-arsenide laser source did not influence overall healing pressure ulcers. Limited evidence suggested that it improved healing of stage 3 and 4 pressure ulcers.

Editorial comment: Is this laser or rather LED?