

Laser therapy science, January 2007

40 new studies added

Lopes-Martins RA, Marcos RL, Leonardo PS, Prianti AC Jr et al. **Effect of low-level laser (Ga-Al-As 655 nm) on skeletal muscle fatigue induced by electrical stimulation in rats.** J Appl Physiol. 2006;101(1):283-288

The authors investigated whether low-level laser therapy (LLLT) can reduce muscular fatigue during tetanic contractions in rats. Thirty-two male Wistar rats were divided into four groups receiving either one of three different LLLT doses (0.5, 1.0, and 2.5 J/cm²) or a no-treatment control group. Electrical stimulation was used to induce six tetanic muscle contractions in the tibial anterior muscle. Contractions were stopped when the muscle force fell to 50% of the initial value for each contraction (T50%). There was no significant difference between the 2.5 J/cm² laser-irradiated group and the control group in mean T50% values. Laser-irradiated groups (0.5 and 1.0 J/cm²) had significantly longer T50% values than the control group. The relative peak force for the sixth contraction in the laser-irradiated groups were significantly higher at 92.2% (SD 12.6) for 0.5 J/cm², 83.2% (SD 20.5) for 1.0 J/cm², and 82.9% (SD 18.3) for 2.5 J/cm² than for the control group [50% (SD 15)]. Laser groups receiving 0.5 and 1.0 J/cm² showed significant increases in mean performed work compared with both the control group and their first contraction values. Muscle damage was indirectly measured by creatine kinase levels in plasma. A distinct dose-response pattern was found in which 1.0 and 2.5 J/cm² LLLT groups had significantly lower creatine kinase levels than the 0.5 J/cm² LLLT group and the control group. It is concluded that LLLT doses of 0.5 and 1.0 J/cm² can prevent development of muscular fatigue in rats during repeated tetanic contractions.

Markovic AB, Todorovic L. **Postoperative analgesia after lower third molar surgery: contribution of the use of long-acting local anesthetics, low-power laser, and diclofenac.** Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006;102(5): e4-8.

The aims of the study were twofold: (1) to evaluate the postoperative analgesic efficacy, comparing long-acting and intermediate-acting local anesthetics; and 2 to compare the use of low-power laser irradiation and the nonsteroid anti-inflammatory drug diclofenac, which are claimed to be among the most successful aids in postoperative pain control. A twofold study of 102 patients of both sexes undergoing surgical extraction of LTM was conducted. In the first part of the study, 12 patients with bilaterally impacted LTMs were treated in a double-blind crossover fashion; local anesthesia was achieved with 0.5% bupivacaine plain or 2% lidocaine with 1:80,000 epinephrine. In the second part of the study, 90 patients undergoing LTM surgical extraction with local anesthesia received postoperative low-power laser irradiation (30 patients) and a preoperative single dose of 100 mg diclofenac (30 patients), or only regular postoperative recommendations (30 patients). The results of the first part of the study showed a strikingly better postoperative analgesic effect of bupivacaine than lidocaine/epinephrine (11 out of 12; 4 out of 12, respectively, patients without postoperative pain). In the second part of the study, low-power laser irradiation significantly reduced postoperative pain intensity in patients premedicated with diclofenac, compared with the controls. Provided that basic principles of surgical practice have been achieved, the use of long-acting local anesthetics and low-power

laser irradiation enables the best postoperative analgesic effect and the most comfortable postoperative course after surgical extraction of LTMs.

Turhani D, Scheriau M, Kapral D, Benesch T, Jonke E, Bantleon HP. **Pain relief by single low-level laser irradiation in orthodontic patients undergoing fixed appliance therapy.** Am J Orthod Dentofacial Orthop. 2006;130 (3): 371-377.

Seventy-six patients (46 women, 30 men; mean age, 23.1 years) enrolled in this single-blind study were assigned to 2 groups. The patients in group 1 (G1; 38 patients, 13 men, 25 women; mean age, 25.1 years) received a single course of LLLT (wavelength 670 nm, power output 75 mW) for 30 seconds per banded tooth. The patients in group 2 (G2; 38 patients, 17 men, 21 women; mean age, 21.0 years) received placebo laser therapy without active laser irradiation. Pain perception was evaluated at 6, 30, and 54 hours after LLLT by self-rating with a standardized questionnaire. Major differences in pain perception were found between the 2 groups. The number of patients reporting pain at 6 hours was significantly lower in G1 (n = 14) than in G2 (n = 29) (P <.05), and the differences persisted at 30 hours (G1, n = 22; G2, n = 33) (P <.05). At 54 hours, no significant differences were seen between the number of patients reporting pain (G1, n = 20; G2, n = 25), although the women had a different prevalence between G1 (n = 11) and G2 (n = 15) (P = .079). At 6, 30, and 54 hours, more than 90% of the subjects in both groups described the pain as "tearing." LLLT immediately after multibandaging reduced the prevalence of pain perception at 6 and 30 hours. LLLT might have positive effects in orthodontic patients not only immediately after multibandaging, but also for preventing pain during treatment.

Pfander D, Jorgensen B, Rohde E, Bindig U, Muller G, Eric Scheller E. [The influence of laser irradiation of low-power density on an experimental cartilage damage in rabbit knee-joints: an in vivo investigation considering macroscopic, histological and immunohistochemical changes] Biomed Tech (Berl). 2006; 51 (3):131-138. [Article in German]

In a total of 45 rabbits, knee-joint arthrosis was induced according to the Hulth & Telhag model. Depending on the post-operative survival time, the cartilage was investigated macroscopically, histologically and immunohistochemically (within a period of 10 days to 8 months). Thereafter, the influence of laser irradiation at a wavelength of 692.6 nm and energy densities of 1 and 4 J/cm² on the cartilage morphology seven days following the exposure was examined. After joint instability surgery it was found out that the cartilage changes in the main stress area (MSA) and in regions outside the main stress area (ROMSA) progressed differently. Various qualitative and semi-quantitative changes were found for collagens I, II, IV and V, and for the glycoproteins fibronectin and tenascin. Immunohistochemically, there was a growing expression of collagen I in the apical layers, collagen II showed a stronger pericellular expression, and collagen IV showed, after an initial growth of the pericellular expression, a reduced territorial expression and a stronger apical-interterritorial expression in the osteoarthrotic cartilage. For fibronectin, the cellular expression turned out to grow in the ROMSA. In the MSA it decreased, but at the same time the interterritorial expression grew. For Tanascin, there was a decrease of the interterritorial expression in the radial zone while the pericellular and interterritorial expression of the apical layers of the osteoarthrotic cartilage grew. Lasing proved to significantly influence the osteoarthrotically changed cartilage when applied at an energy density of 1 J/cm², i.e., the morphological changes had not yet progressed to the extent the control group had. Both the chondrocyte density and the

glucosaminoglycan content turned out to be higher. When lasing was applied at higher energy densities, no significant difference among the control groups was found. Thus, it could be demonstrated in vivo that an arthrotic process decelerates through the influence of laser light of low-energy densities.

Oron A, Oron U, Chen J, Eilam A et al. **Low-level laser therapy applied transcranially to rats after induction of stroke significantly reduces long-term neurological deficits.** Stroke. 2006;37(10):2620-2624

Two sets of experiments were performed. Stroke was induced in rats by (1) permanent occlusion of the middle cerebral artery through a craniotomy or 2 insertion of a filament. After induction of stroke, a battery of neurological and functional tests (neurological score, adhesive removal) was performed. Four and 24 hours poststroke, a Ga-As diode laser was used transcranially to illuminate the hemisphere contralateral to the stroke at a power density of 7.5 mW/cm². In both models of stroke, LLLT significantly reduced neurological deficits when applied 24 hours poststroke. Application of the laser at 4 hours poststroke did not affect the neurological outcome of the stroke-induced rats as compared with controls. There was no statistically significant difference in the stroke lesion area between control and laser-irradiated rats. The number of newly formed neuronal cells, assessed by double immunoreactivity to bromodeoxyuridine and tubulin isotype III as well as migrating cells (doublecortin immunoactivity), was significantly elevated in the subventricular zone of the hemisphere ipsilateral to the induction of stroke when treated by LLLT. Our data suggest that a noninvasive intervention of LLLT issued 24 hours after acute stroke may provide a significant functional benefit with an underlying mechanism possibly being induction of neurogenesis.

Prado RP, Liebano RE, Hochman B, Pinfieldi CE, Ferreira LM. **Experimental model for low level laser therapy on ischemic random skin flap in rats.** Acta Cir Bras. 2006; 21(4): 258-262.

The sample was 24 Wistar-EPM rats. The random skin flap measured 10 x 4 cm and a plastic sheet was interposed between the flap and donor site. Group 1 (control) underwent sham irradiation with diode laser (830 nm). Group 2 was submitted to laser irradiation with diode laser (830 nm). The animals were submitted to Laser therapy with 36 J/cm² energy density (72 seconds) immediately after the surgery and on the four subsequent days. The probe was usually held in contact with the skin flap surface on a point at 2.5 cm cranial from the flap base. On the seventh postoperative day, the percentage of necrotic area was measured and calculated. Group 1 reached an average necrotic area of 48.86%, Group 2 - 23.14%. After the statistic analysis, compared with the control group, Group 2 showed a statistically significant increase in survival area (p<0.001). The experimental model proved to be reliable to be used in the study of effects of low level laser therapy in random skin flap in rats.

Chow RT, Heller GZ, Barnsley L. **The effect of 300 mW, 830 nm laser on chronic neck pain: a double-blind, randomized, placebo-controlled study.** Pain. 2006; 124 (1-2): 201-210.

A randomized, double-blind, placebo-controlled study of low-level laser therapy (LLLT) in 90 subjects with chronic neck pain was conducted with the aim of determining the efficacy of 300 mW, 830 nm laser in the management of chronic neck pain. Subjects were randomized to receive a course of 14 treatments over 7 weeks with either active or sham laser to tender areas in the neck. The primary outcome measure was change in a 10 cm Visual Analogue Scale (VAS) for pain. Secondary

outcome measures included Short-Form 36 Quality-of-Life questionnaire (SF-36), Northwick Park Neck Pain Questionnaire (NPNQ), Neck Pain and Disability Scale (NPAD), the McGill Pain Questionnaire (MPQ) and Self-Assessed Improvement (SAI) in pain measured by VAS. Measurements were taken at baseline, at the end of 7 weeks' treatment and 12 weeks from baseline. The mean VAS pain scores improved by 2.7 in the treated group and worsened by 0.3 in the control group (difference 3.0, 95% CI 3.8-2.1). Significant improvements were seen in the active group compared to placebo for SF-36-Physical Score (SF36 PCS), NPNQ, NPAD, MPQVAS and SAI. The results of the SF-36 - Mental Score (SF36 MCS) and other MPQ component scores (afferent and sensory) did not differ significantly between the two groups. Low-level laser therapy (LLLT), at the parameters used in this study, was efficacious in providing pain relief for patients with chronic neck pain over a period of 3 months.

Mdinaradze N. **Laser therapy in treatment of generalized parodontitis.** Georgian Med News. 2006; (134): 94-96.

Laser therapy has a significant place among the treatment methods in stomatology. An experiment was carried out on 48 male white rats with the masses of 150,0-200,0 gr. Parodontitis was simulated by application of ligature around the dental cervix. Morphometric indicators such as diameter of arterioles and capillars Dk (mkm), density of blood vessels distribution VvK, diameter of the zone of peri-capillar diffusion Di (mkm) and intensity of the local blood circulation were taken as the criteria for the effectiveness of treatment. We also conducted microbiological studies of the mucous tunic of the oral cavity. The results gained on the seventh day of treatment equaled to the reference ones. As a result of a combined treatment with medications (3% indometacin ointment, heparin ointment, vitamins, ferments, antibiotics) and laser-beam therapy, the diameter of arterioles and capillaries was increased, or it is to say, the diameter indicator equaled to the reference one, the capillary distribution density $V(v)(K)$ was increased and the diameter of peri-capillar diffusion was also increased. The indicator of the local blood circulation was increased and reached the norm. The analysis of the data gained through research indicates the efficiency of inclusion of laser therapy into the thorough treatment of parodontitis.

Qadri T, Miranda L, Tunér J, Gustafsson A. **The short-term effects of low-level lasers as adjunct therapy in the treatment of periodontal inflammation.** J Clin Periodontol. 2005; 32 (7): 714-719.

Seventeen patients with moderate periodontitis were included. After clinical examination, all teeth were scaled and root planed (SRP). One week after SRP, we took samples of gingival crevicular fluid (GCF) and subgingival plaque. The laser therapy was started 1 week later and continued once a week for 6 weeks. One side of the upper jaw was treated with active laser and the other with a placebo. The test side was treated with two low-level lasers having wavelengths of 635 and 830 nm. The patients then underwent another clinical examination with sampling of GCF and plaque. The GCF samples were analysed for elastase activity, interleukin-1beta (IL-1beta) and metalloproteinase-8 (MMP-8). We examined the subgingival plaque for 12 bacteria using DNA probes. The clinical variables i.e. probing pocket depth, plaque and gingival indices were reduced more on the laser side than on the placebo one ($p < 0.01$). The decrease in GCF volume was also greater on the laser side, 0, 12 microl, than on the placebo side, 0.05 microl ($p = 0.01$). The total amount of MMP-8 increased on the placebo side but was slightly lower on the laser side ($p = 0.052$).

Elastase activity, IL-1beta concentration and the microbiological analyses showed no significant differences between the laser and placebo sides. It is concluded that additional treatment with low-level lasers reduced periodontal gingival inflammation.

Aigner N, Fialka C, Radda C, Vecsei V. **Adjuvant laser acupuncture in the treatment of whiplash injuries: a prospective, randomized placebo-controlled trial.** Wien Klin Wochenschr. 2006; 118 (3-4): 95-99.

Following introduction of the compulsory use of seat belts in cars, whiplash injuries of the cervical spine have become common in everyday practice. Current treatment approaches lead to resolution of the symptoms within a short time in most cases but cannot prevent a small proportion of patients developing persistent health problems. The effects of adjuvant treatment with laser acupuncture on the acute symptoms and the results one year after the injury were studied in this prospective, randomized, placebo-controlled single-blind study. One group of patients (n = 23) were treated with laser acupuncture (5 mW HeNe laser on 22 acupuncture points for 15 s each) plus cervical collar and a combination of paracetamol and chlormezanone; a second group (n = 22) received the same treatments but with the use of a placebo laser. The treatment was given three times per week until the patient was asymptomatic. No statistically significant advantage of the laser acupuncture treatment was found in the acute phase (mobility in all three planes, duration of pain and duration of use of a cervical collar) or the chronic phase (drug use and the incidences of chronic recurrent problems such as myofascial pain, headaches, vertigo and tinnitus).

da Silva Dde F, Vidal Bde C, Zezell DM, Zorn TM, Nunez SC, Ribeiro MS. **Collagen birefringence in skin repair in response to red polarized-laser therapy.** J Biomed Opt. 2006; 112:024002.

The authors the optical path difference (OPD) technique to quantify the organization of collagen fibers during skin repair of full-thickness burns following low-intensity polarized laser therapy with two different polarization incidence vectors. Three burns are cryogenerated on the back of rats. Lesion L (parallel) is irradiated using the electric field vector of the polarized laser radiation aligned in parallel with the rat's occipital-caudal direction. Lesion L (perpendicular) is irradiated using the electric field vector of the polarized laser radiation aligned perpendicularly to the aforementioned orientation. Lesion C is untreated. A healthy area labeled H is also evaluated. The tissue samples are collected and processed for polarized light microscopy. The overall finding is that the OPD for collagen fibers depends on the electric field vector of the incident polarized laser radiation. No significant differences in OPDs are observed between L (parallel) and H in the center, sides, and edges of the lesion. Lesions irradiated using the electric field vector of the polarized laser radiation aligned in parallel with the rat's occipital-caudal direction show higher birefringence, indicating that collagen bundles in these lesions are more organized.

Ozen T, Orhan K, Gorur I, Ozturk A **Efficacy of low level laser therapy on neurosensory recovery after injury to the inferior alveolar nerve.** Head Face Med. 2006 Feb 15;2:3.

This paper reports the effects of low level laser therapy in 4 patients with longstanding sensory nerve impairment following mandibular third molar surgery. Four female patients had complaints of paresthesia and dysesthesia of the lip, chin and gingiva, and buccal regions. Each patient had undergone mandibular third molar surgery at least 1 year before. All patients were treated with low level laser therapy.

Clinical neurosensory tests (the brush stroke directional discrimination test, 2-point discrimination test, and a subjective assessment of neurosensory function using a visual analog scale) were used before and after treatment, and the responses were plotted over time. When the neurosensory assessment scores after treatment with LLL therapy were compared with the baseline values prior to treatment, there was a significant acceleration in the time course, as well as in the magnitude, of neurosensory return. The VAS analysis revealed progressive improvement over time. Low level laser therapy seemed to be conducive to the reduction of long-standing sensory nerve impairment following third molar surgery. Further studies are worthwhile regarding the clinical application of this treatment modality.

Silveira PC, Streck EL, Pinho RA. **Evaluation of mitochondrial respiratory chain activity in wound healing by low-level laser therapy.** J Photochem Photobiol B. 2006 Nov 17;

In this work, we evaluated mitochondrial respiratory chain complexes II and IV and succinate dehydrogenase activities in wounds after irradiation with low-level laser. The animals were divided into two groups: group 1, the animals had no local nor systemic treatment and were considered as control wounds; group 2, the wounds were treated immediately after they were made and every day after with a low-level laser (GaAs, wavelength of 904nm) for 10 days. The results showed that low-level laser therapy improved wound healing. Besides, our results showed that low-level laser therapy significantly increased the activities of complexes II and IV but did not affect succinate dehydrogenase activity. These findings are in accordance to other works, where cytochrome c oxidase (complex IV) seems to be activated by low-level laser therapy. Besides, we showed, for the first time, that complex II activity was also activated. More studies are being carried out in order to evaluate other mitochondrial enzymes activities after different doses and irradiation time of low-level laser.

McNeely ML, Armijo Olivo S, Magee DJ. **A systematic review of the effectiveness of physical therapy interventions for temporomandibular disorders.** Phys Ther. 2006;86(7):910-901.

A literature search of published and unpublished articles resulted in the retrieval of 36 potential articles. Twelve studies met all selection criteria for inclusion in the review: 4 studies addressed the use of therapeutic exercise interventions, 2 studies examined the use of acupuncture, and 6 studies examined electrophysical modalities. Two studies provided evidence in support of postural exercises to reduce pain and to improve function and oral opening. One study provided evidence for the use of manual therapy in combination with active exercises to reduce pain and to improve oral opening. One study provided evidence in support of acupuncture to reduce pain when compared with no treatment; however, in another study no significant differences in pain outcomes were found between acupuncture and sham acupuncture. Significant improvements in oral opening were found with muscular awareness relaxation therapy, biofeedback training, and low-level laser therapy treatment. Most of the studies included in this review were of very poor methodological quality; therefore, the findings should be interpreted with caution.

da Silva RV, Camilli JA. **Repair of bone defects treated with autogenous bone graft and low-power laser.** J Craniofac Surg. 2006;172: 297-301.

Because bone healing at the graft site is similar to a fracture repair, the purpose of the present study was to evaluate the effects of low-power laser irradiation on the repair of rat skull defects treated with autogenous bone graft. A defect measuring 3 mm in diameter was produced in the left parietal bone and filled with an autogenous bone graft obtained from the right parietal bone. The animals were divided into 3 groups of 20 rats each: nonirradiated control, irradiated with 5.1 J/cm, and irradiated with 10.2 J/cm. The laser (2.4 mW, 735 nm, 3.4×10^{-3} W/cm, 3-mm spot size) was applied three times per week for 4 weeks. Greater volume of newly formed bone was observed in the irradiated group with 10.2 J/cm. In both irradiated groups, a greater volume of newly formed bone occurred only in the first 2 weeks. The results demonstrated that laser irradiation at the grafted site stimulated osteogenesis during the initial stages of the healing process in a skull defect of the rat and that this effect was dose dependent.

Renno AC, de Moura FM, dos Santos NS, Tirico RP, Bossini PS, Parizotto NA. **Effects of 830-nm laser light on preventing bone loss after ovariectomy.** Photomed Laser Surg. 2006;24 (5): 642-645.

Osteoporosis affects 30% of postmenopausal women, and it has been recognized as a major public health problem. Based on the stimulatory effects of LLLT on proliferation of bone cells, we hypothesized that LLLT would be efficient in preventing bone mass loss in OVX rats. Methods: Forty female rats were divided into four groups: sham-operated control (SC), OVX control (OC), sham-operated irradiated at a dose of 120 J/cm² (I120), and OVX irradiated at a dose of 120 J/cm² (O120). Animals were operated at the age of 90 days. Laser irradiation was initiated 1 day after the operation and was performed three times a week, for 2 months. Femora were submitted to a biomechanical test and a physical properties evaluation. RESULTS: Maximal load of O120 was higher than in control groups. Wet weight, dry weight, and bone volume of O120 did not show any difference when compared with SC. The results of the present study indicate that LLLT was able to prevent bone loss after OVX in rats. However, further studies are needed to investigate the effects of different parameters, wavelengths, and sessions of applications on OVX rats.

do Nascimento RX, Callera F. **Low-level laser therapy at different energy densities (0.1-2.0 J/cm²) and its effects on the capacity of human long-term cryopreserved peripheral blood progenitor cells for the growth of colony-forming units.** Photomed Laser Surg. 2006; 24 (5): 601-604.

There are no data concerning the effects of LLLT on human cryopreserved PBPC. Methods: Cryopreserved PBPC samples were thawed after 3 years in order to demonstrate the positive effect of LLLT and after 5 years in order to confirm the LLLT's proliferative effect. Cultures were plated in quadruplicate 35-mm-diameter Petri dishes in methylcellulose medium (2×10^5 /mL final concentration) and incubated for 14 days at 37 degrees C with 5% CO₂. A 685-nm diode laser with 25-mW optical power was used as the source of irradiation. Cultures were exposed to energy densities of 0.1, 0.5, 1.0, 1.5, and 2.0 J/cm² before incubation (10 irradiated and 10 controls at each energy density group). A higher number of CFU was observed at the dose of 1.0 J/cm² (control $21.3 \pm 8.5 \times 10^5$ cells, irradiated $40.1 \pm 10.5 \times$

10(5) cells, $p < 0.001$). No differences were observed in cultures exposed to doses of 0.1, 0.5, and 1.5 J/cm². A decreased number of CFU was demonstrated in samples exposed to the dose of 2.0 J/cm² (control 21.4 +/- 11.9 x 10(5) cells, $p = 0.013$). PBPC samples cryopreserved for 5 years were thawed for CFU assays and exposed to a single dose of 1.0 J/cm²; once again the exposed group showed a higher number of CFU (control 8.8 +/- 7.8 x 10(5) cells, irradiated 18.1 +/- 13.1 x 10(5) cells, $p = 0.026$). Dependent upon the energy density, LLLT elevates (1.0 J/cm²) or decreases (2.0 J/cm²) the potential of long-term cryopreserved PBPC for growth of CFU in vitro.

Gal P, Vidinsky B, Toporcer T, Mokry M et al. **Histological assessment of the effect of laser irradiation on skin wound healing in rats.** Photomed Laser Surg. 2006; 24 (4): 480-488.

Two parallel full-thickness skin incisions were performed on the back of each rat (n = 49) and immediately sutured. After surgery, one wound of each rat was exposed to laser irradiation (continuous mode, 670 nm, daily dose 30 J/cm²), whereas the parallel wound was not irradiated and served as control. Both wounds were removed 24, 48, 72, 96, 120, 144, and 168 h after surgery and routinely fixed and embedded in paraffin sections, stained with hematoxylin and eosin, van Gieson, periodic acid Schiff + periodic acid Schiff diastase, Mallory's phosphotungstic hematoxylin, and azur and eosin, and histopathologically evaluated. As compared to nonirradiated control wounds, laser stimulation shortened the inflammatory phase as well as accelerated the proliferative and maturation phase, and positively stimulated the regeneration of injured epidermis and the reparation of injured striated muscle. LLLT at 670 nm positively influences all phases of rat skin wound healing.

Cetiner S, Kahraman SA, Yucetas S. **Evaluation of low-level laser therapy in the treatment of temporomandibular disorders.** Photomed Laser Surg. 2006; 24 (5): 637-641.

Thirty-nine patients with myogenic TMD-associated orofacial pain, limited mandibular movements, chewing difficulties, and tender points were included in this study. Twenty-four of them were treated with LLLT for 10 sessions per day excluding weekends as test group, and 15 patients with the same protocol received placebo laser treatment as a control group. These parameters were assessed just before, just after, and 1 month after the treatment. Maximal mouth-opening improvement, and reductions in pain and chewing difficulty were statistically significant in the test group when compared with the control group. Statistically significant improvements were also detected between two groups regarding reduction in the number of tender points. Based on the results of this placebo-controlled report, LLLT is an appropriate treatment for TMD and should be considered as an alternative to other methods.

Aihara N, Yamaguchi M, Kasai K. **Low-energy irradiation stimulates formation of osteoclast-like cells via RANK expression in vitro.** Lasers Med Sci. 2006; 21 (1): 24-33

Low-power laser irradiation (GaAlAs semiconductor laser, output 50 mW) was applied to rat osteoclast precursor cells for 1, 3, 6, or 10 min at 24-h intervals during the culture period. The number of tartrate-resistant acid phosphatase positive multinucleate cells was increased by approximately 1.3-fold in the 3- and 6-min irradiation groups. Further, osteoclasts appeared on day 2 in the laser irradiation groups but not until day 3 in the control groups. In immunohistochemical staining for

receptor activator of NF-kappaB (RANK), the laser irradiation groups showed significantly greater amounts of staining in comparison with the control group on days 2 and 3. Reverse transcription-polymerase chain reaction results also showed that the expressions of RANK were upregulated. In the pit formation assay, resorption pits were significantly more abundant in the laser irradiation groups than in the controls.

Nunez SC, Garcez AS, Suzuki SS, Ribeiro MS. **Management of mouth opening in patients with temporomandibular disorders through low-level laser therapy and transcutaneous electrical neural stimulation.** Photomed Laser Surg. 2006; 24 (1): 45-49.

This clinical trial was performed in 10 patients, 18-56 years old, diagnosed with TMD of multiple causes. All patients received both methods of treatment in two consecutive weeks. LLLT was delivered via a 670-nm diode laser, output power 50 mW, fluence 3 J per site/4 sites (masseter muscle, temporal muscle, mandibular condyle, and intraauricular). TENS therapy was applied with a two-electrode machine at 20 W, maximum frequency of 60 Hz, adjusted by the patient according to their sensitivity. The amplitude of mouth opening was recorded before treatment and immediately after using a millimeter rule; the measurements were performed from the incisal of the upper incisors to the incisal of the lower incisors. A paired t-test was applied to verify the significance of the results. A significant improvement in the range of motion for both therapies was observed immediately after treatment. Comparing the two methods, the values obtained after LLLT were significantly higher than those obtained after TENS. Both methods are effective to improve mouth opening. Comparing the two methods, LLLT was more effective than TENS applications.

Mi XQ, Chen JY, Zhou LW. **Effect of low power laser irradiation on disconnecting the membrane-attached hemoglobin from erythrocyte membrane.** J Photochem Photobiol B. 2006; 1:832:146-50.

In our previous study the authors found that low power laser irradiation improved the erythrocyte deformability, but the mechanism is unclear. The membrane-attached hemoglobin (Hbm) may be one of the determining factors for the erythrocyte deformability. It is reported here for the first time, that laser irradiation can reduce the Hbm contents in pig's erythrocytes, providing the explanation for the improvement of erythrocyte deformability. The decrease of the Hbm was proportional to the irradiation dose, but the relative change of Hbm was saturated around 35%. The 532 nm laser was more efficient at lowering Hbm than the 632.8 nm laser, consistent with the absorption spectrum of Hbm.

Bayat M, Vasheghani MM, Razavi N. **Effect of low-level helium-neon laser therapy on the healing of third-degree burns in rats.** J Photochem Photobiol B. 2006;832:87-93.

This paper presents the results of a study on the effects of low-level helium-neon laser therapy on the healing of burns. Seventy-eight adult male rats, having been subjected to third-degree burns, were randomly divided into four groups: two laser treated groups (n=20, each), one control group (n=19) and one nitrofurazone treated group (n=19). In the two laser treated groups, the burns were treated on a daily basis with LL He-Ne LT with an energy density of 1.2 and 2.4 J/cm², respectively. The response

to treatment was assessed histologically at 7, 16 and 30 days after burning, and microbiologically at day 15. Analysis of variance showed that the mean of blood vessel sections in the 1.2J/cm² laser group was significantly higher than those in the other groups and the mean of the depth of new epidermis in the 2.4 J/cm² laser group on day 16 was significantly lower than in the nitrofurazone treated group (P=0.025, P=0.047, respectively). When *Staphylococcus aureus* and *Pseudomonas aeruginosa* grew in more than 50% of samples obtained from control group, there were no *S. aureus* and *P. aeruginosa* in the samples of 2.4 J/cm² laser group. It is concluded that LL He-Ne LT induced the destruction of *S. aureus* and *P. aeruginosa* in third-degree burns of rats, yet at the same time our histological findings showed that HeNe caused a significant increase in the mean of blood vessel sections on day 7 after third degree burns and a decrease in the mean of the depth of new epidermis on day 16 after the same burns in rats.

Hawkins DH, Abrahamse H. **The role of laser fluence in cell viability, proliferation, and membrane integrity of wounded human skin fibroblasts following helium-neon laser irradiation.** *Lasers Surg Med.* 2006; 38 (1):74-83.

Changes in normal and wounded fibroblast cell morphology were evaluated by light microscopy. Changes following laser irradiation were evaluated by assessing the mitochondrial activity using adenosine triphosphate (ATP) luminescence, cell proliferation using neutral red and an alkaline phosphatase (ALP) activity assay, membrane integrity using lactate dehydrogenase (LDH), and percentage cytotoxicity and DNA damage using the Comet assay. Morphologically, wounded cells exposed to 5 J/cm² migrate rapidly across the wound margin indicating a stimulatory or positive influence of phototherapy. A dose of 5 J/cm² has a stimulatory influence on wounded fibroblasts with an increase in cell proliferation and cell viability without adversely increasing the amount of cellular and molecular damage. Higher doses (10 and 16 J/cm²) were characterized by a decrease in cell viability and cell proliferation with a significant amount of damage to the cell membrane and DNA. Results show that 5 J/cm² stimulates mitochondrial activity, which leads to normalization of cell function and ultimately stimulates cell proliferation and migration of wounded fibroblasts to accelerate wound closure. Laser irradiation can modify cellular processes in a dose or fluence (J/cm²) dependent manner.

Novoselova EG, Glushkova OV, Cherenkov DA, Chudnovsky VM, Fesenko EE. **Effects of low-power laser radiation on mice immunity.** *Photodermatol Photoimmunol Photomed.* 2006; 22 (1):33-38.

To study of the possible side effects of laser immunotherapy we monitored the productions of cytokines, nitric oxide (NO), and heat shock protein 70 (Hsp70) in mice subjected to a periodic laser exposure for 1 month. Helium-neon laser radiation with the power of 0.2 mW/cm² and wavelength of 632.8 nm was applied on two different mouse skin surfaces, i.e. a thymus projection area or a hind limb. Healthy NMRI male mice were irradiated repeatedly with laser light for 1 min with 48-h intervals for 30 days. The animals were divided into three groups of 25 mice. The first and the second groups were exposed to laser light, on the thymus and hind limb area, respectively. The third, sham-irradiated group served as a control. Early and prolonged effects of laser radiation on the levels of NO (by Griess assay), Hsp70 (by Western blot assay), tumor necrosis factors (TNF-alpha and TNF-beta) (by cytotoxic assay using L929 cells as targets), and interleukin-2 (IL-2) (by ELISA assay) were determined. The dynamics of immune responses to low-power laser light intensity was shown to be dependent on two factors, i.e. the cumulative dose and the

localization of the irradiated surface. Besides, various populations of cells demonstrated different sensitivity to laser radiation, with T cells being more responsive among examined populations of the cells. Low intensity laser light induced an immune cell activity when the exposure duration did not exceed 10 days, while a more prolonged period of treatment generated more severe changes in the immune system, up to immunosuppression. The treatment of the thymus zone resulted in more pronounced changes in the cytokine production as well as in NO and Hsp70 synthesis. Low-power laser irradiation showed more effective immunomodulatory effects when applied on the thymus projection area. The rise in IL-2 and Hsp70 production related to a short-term effect of laser application may be reversed after repeating laser treatment. We suggest that for the support of immune system stability, the prolonged laser therapy should be accompanied by supplementary methods.

Bjordal JM, Lopes-Martins RA, Iversen VV **A randomised, placebo controlled trial of low level laser therapy for activated Achilles tendinitis with microdialysis measurement of peritendinous prostaglandin E2 concentrations.** Br J Sports Med. 2006; 40 (1): 76-80.

Seven patients with bilateral Achilles tendinitis (14 tendons) who had aggravated symptoms produced by pain inducing activity immediately before the study. Infrared (904 nm wavelength) LLLT (5.4 J per point, power density 20 mW/cm²) and placebo LLLT (0 J) were administered to both Achilles tendons in random blinded order. Ultrasonography Doppler measurements at baseline showed minor inflammation through increased intratendinous blood flow in all 14 tendons and measurable resistive index in eight tendons of 0.91 (95% confidence interval 0.87 to 0.95). Prostaglandin E2 concentrations were significantly reduced 75, 90, and 105 minutes after active LLLT compared with concentrations before treatment ($p = 0.026$) and after placebo LLLT ($p = 0.009$). Pressure pain threshold had increased significantly ($p = 0.012$) after active LLLT compared with placebo LLLT: the mean difference in the change between the groups was 0.40 kg/cm² (95% confidence interval 0.10 to 0.70). LLLT at a dose of 5.4 J per point can reduce inflammation and pain in activated Achilles tendinitis. LLLT may therefore have potential in the management of diseases with an inflammatory component.

Lin YS, Huang MH, Chai CY. **Effects of helium-neon laser on the mucopolysaccharide induction in experimental osteoarthritic cartilage.** Osteoarthritis Cartilage. 2006; 14 (4): 377-383.

Seventy-two rats with three different degrees of papain induced OA over right knee joints were collected for helium-neon (He-Ne) laser treatment. The severity of induced arthritis was measured by ^{99m}Tc bone scan and classified into three groups (I-III) by their radioactivity ratios (right to left knee joints). The rats in each group were further divided into study subgroups (Is, IIs, and IIIs) and control subgroups (Ic, IIc, and IIIc) randomly. The arthritic knees in study subgroups received He-Ne laser treatment, and those in controls received sham laser treatment. The changes of arthritic severity after treatment and follow-up 2 months later were measured. The histopathological changes were evaluated through light microscope after disarticulation of sections (H.E. stain), and the changes of mucopolysaccharide density in cartilage matrix were measured by Optimas scanner analyzer after Alcian

blue (AB) stain. The densities of mucopolysaccharide induced after treatment in arthritic cartilage were compared and correlated with their histopathological changes. The density of mucopolysaccharide rose at the initial stage of induced arthritis, and decreased progressively in later stages. The densities of mucopolysaccharide in treated rats increased upon complete laser treatment more than those of the controls, which is closely related with the improvement in histopathological findings, but conversely with the changes in arthritic severity. He-Ne laser treatment will enhance the biosynthesis of arthritic cartilage, and results in the improvement of arthritic histopathological changes.

Yamaguchi M, Kasai K. **Inflammation in periodontal tissues in response to mechanical forces.** Arch Immunol Ther Exp (Warsz). 2005; 53 (5):388-398.

Orthodontic forces are known to produce mechanical damage and inflammatory reactions in the periodontium and dental pulp, as well as inflammatory mediators, e.g. prostaglandins, interleukin (IL)-1, IL-6, tumor necrosis factor alpha, and receptor activator of nuclear factor kappaB ligand, in the periodontal ligament (PDL) and dental pulp. We have studied the effects of aging on the production of inflammatory mediators in the PDL using in vitro and in vitro methods and found that aging of PDL tissues may be an important factor in the severity of periodontal disease through a higher production of inflammatory mediators in response to mechanical forces. Further, the levels of inflammatory mediators in gingival crevicular fluid, an osmotically mediated inflammatory exudates found in the gingival sulcus, have been shown to be significantly elevated during orthodontic treatment. In order to reduce inflammation, low-level laser therapy has been recently studied in vitro and in vitro by many investigators as a substitute for anti-inflammatory drugs. Clinical and experimental studies have shown that low-level laser irradiation reduces orthodontic post-adjustment inflammation. We believe that orthodontic forces (mechanical forces) may play an important role in periodontal inflammation and that low-level laser therapy may be useful for its inhibition.

Venancio Rde A, Camparis CM, Lizarelli Rde F. **Low intensity laser therapy in the treatment of temporomandibular disorders: a double-blind study.** J Oral Rehabil. 2005 32 (11): 800-807.

This study aimed to evaluate the effectiveness of low intensity laser therapy (LILT) in 30 patients presenting temporomandibular joint (TMJ) pain and mandibular dysfunction in a random and double-blind research design. The sample, divided into experimental group (1) and placebo group 2, was submitted to the treatment with infrared laser (780 nm, 30 mW, 10 s, 6.3 J/cm²) at three TMJ points. The treatment was evaluated throughout six sessions and 15, 30 and 60 days after the end of the therapy, through visual analogue scale (VAS), range of mandibular movements and TMJ pressure pain threshold. The results showed a reduction in VAS ($p < 0.001$) and through the ANOVA with repeated measures it was observed that the groups did not present statistically significant differences ($P = 0.2060$), as the averages of the evaluation times ($P = 0.3955$) and the interaction groups evaluation times ($P = 0.3024$), considering the MVO. The same occurred for RLE ($P = 0.2988$, $P = 0.1762$ and $P = 0.7970$), LLE ($P = 0.3265$, $P = 0.4143$ and $P = 0.0696$), PPTD ($P = 0.1558$, $P = 0.4695$ and $P = 0.0737$) and PPTE ($P = 0.2376$, $P = 0.3203$ and $P = 0.0624$). For PE, there were not statistically significant differences for groups ($P = 0.7017$) and the interaction groups evaluation times ($P = 0.6678$), even so in both groups the PE varied with time ($P = 0.0069$).

Amat A, Rigau J, Waynant RW, Ilev IK, Tomas J, Anders JJ. **Modification of the intrinsic fluorescence and the biochemical behavior of ATP after irradiation with visible and near-infrared laser light.** J Photochem Photobiol B. 2005; 3; 81 (1): 26-32.

In this work, the effects of visible (655 nm) and near-infrared (830 nm) light on ATP in solution were examined. The addition of irradiated ATP to the hexokinase reaction caused significant differences in the reaction rates and in the Michaelis-Menten kinetic parameters, $k(m)$ and $v(max)$. Irradiated ATP cleavage by hexokinase occurred in less time. Changes were wavelength and dose dependent. Excitation of ATP with a 260 nm wavelength ultraviolet light induced a fluorescence emission that was decreased when Mg^{2+} was added due to ion binding of the phosphates, which are the structures that modify the fluorescence produced by the adenine dipoles. The irradiation of this ATP. Mg^{2+} solution using 655 and 830 nm light increased the fluorescence by a possible displacement of Mg^{2+} from the phosphates. In conclusion, visible and near-infrared light modifies the biochemical behaviour of ATP in the hexokinase reaction and the fluorescence intensity of the molecule thus altering the Mg^{2+} binding strength to the oxygen atoms in the phosphate group. ♦

Shao XH, Yang YP, Dai J, Wu JF, Bo AH. **Effects of He-Ne laser irradiation on chronic atrophic gastritis in rats.** World J Gastroenterol. 2005; 7; 11 (25):3958-3961.

Sixty-three male adult Wistar rats were randomly divided into five groups including normal control group, model control group and three different dosages He-Ne laser groups. The chronic atrophic gastritis (CAG) model in rats was made by pouring medicine which was a kind of mixed liquor including 2% sodium salicylate and 30% alcohol down the throat for 8 wk to stimulate rat gastric mucosa, combining with irregular fasting and compulsive sporting as pathogenic factors; 3.36, 4.80, and 6.24 J/cm² doses of He-Ne laser were used, respectively for three different treatment groups, once a day for 20 d. The pH value of diluted gastric acid was determined by acidimeter, the histopathological changes such as the inflammatory degrees in gastric mucosa, the morphology and structure of parietal cells were observed, and the thickness of mucosa was measured by micrometer under optical microscope. In model control group, the secretion of gastric acid was little, pathologic morphological changes in gastric mucosa such as thinner mucous, atrophic glands, notable inflammatory infiltration were found. After 3.36 J/cm² dose of He-Ne laser treatment for 20 d, the secretion of gastric acid was increased ($P < 0.05$), the thickness of gastric mucosa was significantly thicker than that in model control group ($P < 0.01$), the gastric mucosal inflammation cells were decreased ($P < 0.05$). Morphology, structure and volume of the parietal cells all recuperated or were closed to normal. 3.36 J/cm² dose of He-Ne laser has a significant effect on CAG in rats.

Hawkins D, Abrahamse H. **Biological effects of helium-neon laser irradiation on normal and wounded human skin fibroblasts.** Photomed Laser Surg. 2005; 23(3):251-259.

This study aimed to investigate a number of structural, cellular, and molecular responses to helium neon (632.8 nm) laser irradiation following a single dose of 0.5, 2.5, 5, or 10 J/cm² on normal and wounded human skin fibroblasts. Changes in normal and wounded fibroblast cell morphology were evaluated by light microscopy. Cellular parameters evaluated cell proliferation, cell viability, and cytotoxicity while

molecular parameters assessed the extent of DNA damage. Results: The results clearly demonstrate that LLLT has an effect on normal and wounded human skin fibroblasts. The parameters showed that doses of 0.5, 2.5, 5, and 10 J/cm² were sufficient to produce measurable changes in fibroblast cells. A dose of 10 J/cm² appeared to produce a significant amount of cellular and molecular damage, which could be an important consideration for other therapies, such as photodynamic therapy.

Al-Watban FA, Delgado GD. **Burn healing with a diode laser: 670 nm at different doses as compared to a placebo group.** Photomed Laser Surg. 2005; 23 (3):245-250. A number of male Sprague-Dawley rats were randomly assigned to several groups. Anesthesia (a mixture of ketamine HCl and Xylocaine) was administered intraperitoneally. Burn on both flanks was created using a preheated metal probe and measured daily using a caliper. The right side of the treated rats was irradiated five times and three times per week. Slopes from the actual burn areas were obtained and compared against the control with the healing rate calculated and expressed in percent. In reference to the control group, no significant difference in healing was observed. In comparing both treatment schedules, there was likewise no significant difference at any day in both age-groups. Notably in younger rats, accelerated healing was observed with the highest rate in the lower range of doses (1 and 5 J/cm²), 12.4% and 11.6%, respectively. This experiment affirms that the beneficial effect on burn healing in rats is indeed affected by an interplay of several factors.

Merli LA, Santos MT, Genovese WJ, Faloppa F. **Effect of low-intensity laser irradiation on the process of bone repair.** Photomed Laser Surg. 2005;232:212-215. The effect of low-intensity laser (GaAsAl) irradiation on bone repair in the femurs of mice was investigated. An experimental model of hole injury with surgery drills was used in 20 mouse femurs followed by a study of the effect of low-energy laser irradiation on bone repair. The experimental model was divided into two groups. The first (10 left femurs) received laser irradiation immediately after injury and was followed for different time intervals (24, 48, and 72 h). The right femurs (control group) underwent hole injury but no laser irradiation. The rats were sacrificed after 14 days and the results were analyzed using a quantitative histometrical method. The Mann-Whitney test was used to perform the statistical analysis. Histometrical analysis revealed a more rapid accumulation of reparative new bone in the hole injury of the laser-irradiated legs.

Makihara E, Makihara M, Masumi S, Sakamoto E. **Evaluation of facial thermographic changes before and after low-level laser irradiation.** Photomed Laser Surg. 2005; 232:191-195.

Nine healthy subjects underwent irradiation using the continuous wave setting of a CO₂ laser with a power output of 1.0 W. The laser tip was positioned 10 cm above the skin over the right TMJ area for 10 min. The actual fluence on the facial surface was 7.64 J/cm². Variation of the facial temperature was evaluated by using thermography. The facial temperature 10 min after stopping irradiation was higher than that after 10 min of irradiation applied to the opposite side. The warmer area was found not only over the TMJ area but also over the temporal area, forehead area, and eyelid area on both sides. These results suggested that low-level laser irradiation had a long-lasting effect on facial cutaneous tissues.

Maiya GA, Kumar P, Rao L. **Effect of low intensity helium-neon (He-Ne) laser irradiation on diabetic wound healing dynamics.** Photomed Laser Surg. 2005; 232:187-190.

A circular 4 cm² excisional wound was created on the dorsum of the experimentally (Alloxan)-induced diabetic rats. In the study group (N = 24) the wound was treated with He-Ne laser (632.8 nm wavelength) at a dose of 4.8 J/cm² for 5 days a week until the wound healed completely. The control group (N = 24) was sham-irradiated. The results were statistically analyzed by an independent t test for biochemical analysis and the nonparametric Mann-Whitney U test for histopathological parameters. The analysis of the biochemical parameters and histopathological parameters of the wounds showed that the laser-treated group healed faster and better as compared to the control group (p < 0.0001). The laser-treated group healed on average by the 18th day whereas, the control group healed on average by the 59th day.

Ferreira DM, Zangaro RA, Villaverde AB, Cury Y, Frigo L et al. **Analgesic effect of He-Ne (632.8 nm) low-level laser therapy on acute inflammatory pain.** Photomed Laser Surg. 2005; 232:177-181.

Male Wistar rats were used. Three complementary experiments were done. (1) The inflammatory reaction was induced by the injection of carrageenin into one of the hind paws. Pain threshold and volume increase of the edema were measured by a pressure gauge and plethysmography, respectively. (2) The involvement of peripheral opioid receptors on the analgesic effect of the laser was evaluated by simultaneous injection of carrageenin and naloxone into one hind paw. (3) Hyperalgesia was induced by injecting PGE₂ for the study of the effect of the laser on the sensitization increase of nociceptors. A He-Ne laser (632.8 nm) of 2.5 J/cm² was used for irradiation. It was found that He-Ne stimulation increased the pain threshold by a factor between 68% and 95% depending on the injected drug. We also observed a 54% reduction on the volume increase of the edema when it was irradiated. He-Ne LLLT inhibits the sensitization increase of nociceptors on the inflammatory process. The analgesic effect seems to involve hyperalgesic mediators instead of peripheral opioid receptors.

Stein A, Benayahu D, Maltz L, Oron U. **Low-level laser irradiation promotes proliferation and differentiation of human osteoblasts in vitro.** Photomed Laser Surg. 2005; 232:161-166.

Cultured osteoblast cells were irradiated using He-Ne laser irradiation (632 nm; 10 mW power output). On the second and third day after seeding the osteoblasts were exposed to laser irradiation. The effect of irradiation on osteoblast proliferation was quantified by cell count and colorimetric MTT (dimethylthiazol tetrazolium bromide) assay 24 and 48 h after second irradiation. A significant 31-58% increase in cell survival (MTT assay) and higher cell count in the once-irradiated as compared to nonirradiated cells was monitored. Differentiation and maturation of the cells was followed by osteogenic markers: alkaline phosphatase (ALP), osteopontin (OP), and bone sialoprotein (BSP). A two-fold enhancement of ALP activity and expression of OP and BSP was much higher in the irradiated cells as compared to non-irradiated osteoblasts. We conclude that LLLT promotes proliferation and maturation of human osteoblasts in vitro.

Kaviani A, Fateh M, Nooraie RY, Alinagi-zadeh MR, Ataie-Fashtami L. **Low-level laser therapy in management of postmastectomy lymphedema.** Lasers Med Sci. 2006; 212:90-94.

The aim of this paper was to study the effects of low-level laser therapy (LLLT) in the treatment of postmastectomy lymphedema. Eleven women with unilateral postmastectomy lymphedema were enrolled in a double-blind controlled trial. Patients were randomly assigned to laser and sham groups and received laser or placebo irradiation (GaAs laser device with a wavelength of 890 nm and fluence of 1.5 J/cm²) over the arm and axillary areas. Changes in patients' limb circumference, pain score, range of motion, heaviness of the affected limb, and desire to continue the treatment were measured before the treatment and at follow-up sessions (weeks 3, 9, 12, 18, and 22) and were compared to pretreatment values. Results showed that of the 11 enrolled patients, eight completed the treatment sessions. Reduction in limb circumference was detected in both groups, although it was more pronounced in the laser group up to the end of 22nd week. Desire to continue treatment at each session and baseline score in the laser group was greater than in the sham group in all sessions. Pain reduction in the laser group was more than in the sham group except for the weeks 3 and 9. No substantial differences were seen in other two parameters between the two treatment groups. In conclusion, despite our encouraging results, further studies of the effects of LLLT in management of postmastectomy lymphedema should be undertaken to determine the optimal physiological and physical parameters to obtain the most effective clinical response.

Dundar U, Evcik D, Samli F, Pusak H, Kavuncu V. **The effect of gallium arsenide aluminum laser therapy in the management of cervical myofascial pain syndrome: a double blind, placebo-controlled study.** Clin Rheumatol. 2006 Oct 5; [Epub ahead of print]

The efficacy of low-level laser therapy (LLLT) in myofascial pain syndrome (MPS) seems controversial. A prospective, double-blind, randomized controlled trial was conducted in patients with chronic MPS in the neck to evaluate the effects of low-level 830-nm gallium arsenide aluminum (Ga-As-Al) laser therapy. The study group consisted of 64 MPS patients. The patients were randomly assigned into two groups. In group 1 (n = 32), Ga-As-Al laser treatment was applied over three trigger points bilaterally for 2 min over each point once a day for 15 days during a period of 3 weeks. In group 2 (n = 32), the same treatment protocol was given, but the laser instrument was switched off during applications. All patients in both groups performed daily isometric exercise and stretching exercises for cervical region. Parameters were measured at baseline and after 4 weeks. All patients were evaluated with respect to pain (at rest, movement, and night) and assessed by visual analogue scale, measurement of active range of motion using an inclinometer and a goniometer, and the neck disability index. In both groups, statistically significant improvements were detected in all outcome measures compared with baseline (p < 0.05). However, no significant differences were obtained between the two groups (p > 0.05). In conclusion, although the laser therapy has no superiority over placebo groups in this study, we cannot exclude the possibility of effectivity with another treatment regimen including different laser wavelengths and dosages (different intensity and density and/or treatment interval).

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