ENHANCEMENT OF MICROTUBULE-ASSOCIATED PROTEIN-1 ALPHA GENE EXPRESSION IN OSTEOBLASTS BY LOW LEVEL LASER IRRADIATION

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Abstract
Background: Low level laser irradiation (LLLI) stimulates bone regeneration. However, the molecular mechanisms leading to this is not yet understood. The stepwise subtractive cDNA cloning technology has been developed, coupled with DNA homology searched in DNA database is useful to identify the certain gene.

Aim: In order to understand the mechanism, we attempted to identify genes whose expressions are enhanced by LLLI. MC3T3-E1 osteoblastic cells were irradiated with an 830 nm Ga-Al-As diode laser, and a cDNA library was constructed using subtractive gene cloning.

Material and methods: The cDNA library of osteoblasts which was treated by LLLI was constructed. Nucleotide sequences were analyzed and homology searched in a DNA database using BLASTN program to identify the gene with altered expression. Altered mRNA levels by LLLI were confirmed by reverse transcription polymerase chain reaction (RT-PCR) and real-time PCR.

Results: The DNA sequence of a subtracted gene clone MCL129 indicated high homology (99%) with the microtubule-associated protein 1A (MAP1A) gene. Increase in MAP-1A mRNA level by LLLI was successfully confirmed by RT-PCR and real-time PCR.

Discussion: MAP1A has been shown to promote microtubule assembly and its functional expression. Microtubules play an important role in cell division, cell shape and polarity, cell movement, intracellular transport, signal transduction, and synthesis and secretion of collagen. Thus, enhancement of MAP1A gene expression by LLLI may be one of the molecular mechanisms involved in accelerating bone formation by LLLI.

Conclusion: LLLI irradiation enhances MAP1A gene expression and modulates microtubule assembly and the functional structure of microtubules, in turn, stimulates osteoblastic proliferation and differentiation.
REDUCTION OF CXCR4 EXPRESSION IN RHEUMATOID ARTHRITIS RAT JOINTS BY LOW LEVEL DIODE LASER IRRADIATION

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Abstract

Background: Rheumatoid arthritis (RA) is an inflammatory joint disorder, whose progression leads to the destruction of cartilage and bone. Chemokines and their receptors are potential therapeutic targets in RA. Among these, it has been suggested that CXC chemokine 4 (CXCR4) and its ligand CXC ligand 12 (CXCL12) are involved in RA pathogenesis. Low-level laser irradiation (LLLI) is currently being evaluated for the treatment of RA; however, the molecular mechanisms underlying its effectiveness remain unclear.

Aim: To understand the anti-inflammatory effect of LLLI, we used the collagen-induced arthritis (CIA) rat as RA model and analyzed the gene expression profile in synovial membrane in the hindpaw joints of control, CIA and CIA + LLLI. Expression of CXCR4 and CXCL12 genes were also studied.

Materials and Methods: Total RNA was isolated from the synovial membrane tissue of CIA rat joints or CIA joints treated with LLLI (830 nm Ga-Al-As diode), and gene expression profiles were analyzed by DNA microarray (41,000 rat genes). The mRNA levels were confirmed by reverse transcription polymerase chain reaction (RT-PCR) and real-time PCR. Immunohistochemical examination to examine CXCR4 protein expression was also carried out.

Results: DNA microarray analysis showed that CXCR4 gene expression was increased in CIA tissue and LLLI treatment significantly decreased CIA-induced CXCR4 mRNA levels. In contrast, CXCL12 did not show any significant changes. The microarray data of CXCR4 mRNA levels were further validated using RT-PCR and real-time PCR. Increased CXCR4 mRNA levels by CIA and its reduction following LLLI was successfully confirmed. CXCR4 production was increased in CIA joints and its production was decreased by LLLI.

Conclusion: Decreased CXCR4 expression may be one of the mechanisms in LLLI-mediated reduction of RA inflammation.

ANALYSIS OF THE CURATIVE EFFECT OF GaAlAs DIODE LASER THERAPY IN FEMALE INFERTILITY
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(Received October 13, 2010)
(Accepted November 20, 2010)

Abstract

Background and Aims: During the lifespan of the female, biochemical changes occur in the ovarian environment. These changes are brought about by numerous endogenous and exogenous factors, and can have a profound effect on ovarian oocyte quality. Oocytes of poor quality may be the cause of female infertility and are a major obstacle in successful assisted reproductive technologies (ART). We have previously reported on the efficacy of low reactive laser therapy (LLLT) using a GaAlAs diode laser device which emits laser light of 830 nm at an output of 60 mW to improve the poor quality of oocytes as an adjunctive treatment of refractory female infertility. The aim of this study is to assess the LLLT curative effect.

Subjects and Method: Eight hundred and fourteen female patients who presented at the Ohshiro clinic for treatment of infertility from July 1st, 2000 till December, 2009 were enrolled in the analysis. We analyzed the therapeutic frequency and the therapeutic period (the number of menstrual cycles) between pregnant women and non-pregnant women. Results were expressed as means ± standard error of mean. The statistical difference was determined with the two-sided Student’s t-test and the Mann-Whitney’s U test. Differences with $P < 0.05$ were considered significant.

Result: The mean therapeutic frequency and mean therapeutic period in the subjects who gave birth was $3.3 ± 2.6$ times a month and $5.2 ± 6.1$ months, respectively, which correspond to the whole oogenesis period.

Conclusion: We concluded that laser therapy once per week and a period of 5-6 menstrual cycles might be necessary to gain a good curative effect as the laser effect could last 1 week and the competence of oocytes depends on numerous processes taking place during the whole oogenesis period.

http://www.jstage.jst.go.jp/article/islsm/19/4/19_257/_article


Low-Level Laser Therapy Induces Differential Expression of Osteogenic Genes During Bone Repair in Rats.
Abstract

Abstract Objectives: The aim of this study was to measure the temporal pattern of the expression of osteogenic genes after low-level laser therapy during the process of bone healing. We used quantitative real-time polymerase chain reaction (qPCR) along with histology to assess gene expression following laser irradiation on created bone defects in tibias of rats. Material and Methods: The animals were randomly distributed into two groups: control or laser-irradiated group. Noncritical size bone defects were surgically created at the upper third of the tibia. Laser irradiation started 24 h post-surgery and was performed for 3, 6, and 12 sessions, with an interval of 48 h. A 830 nm laser, 50 J/cm², 30 mW, was used. On days 7, 13, and 25 post-injury, rats were sacrificed individually by carbon dioxide asphyxia. The tibias were removed for analysis. Results: The histological results revealed intense new bone formation surrounded by highly vascularized connective tissue presenting slight osteogenic activity, with primary bone deposition in the group exposed to laser in the intermediary (13 days) and late stages of repair (25 days). The quantitative real-time PCR showed that laser irradiation produced an upregulation of BMP-4 at day 13 post-surgery and an upregulation of BMP4, ALP, and Runx 2 at day 25 after surgery.

Conclusion: Our results indicate that laser therapy improves bone repair in rats as depicted by differential histopathological and osteogenic genes expression, mainly at the late stages of recovery.

PMID: 21306231 [PubMed - as supplied by publisher]

http://www.ncbi.nlm.nih.gov/pubmed/21306231?dopt=Citation

LOW REACTIVE LEVEL LASER THERAPY (LLLT) IN PATIENTS WITH ATOPIC DERMATITIS
- ORAL STEROID THERAPY AND DEGREE OF TENDERNESS ON TENDER SPOTS -

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(Received March 10, 2010)
(accepted September 10, 2010)

Abstract

Aims and background: We investigated what could hinder the effect of treatment with near-infrared laser therapy (830nm) around the stellate ganglion (SGL) in the treatment of atopic dermatitis (AD), the
relationship between the skin symptoms score (SS) and the tenderness score (TS) and potential influence of oral steroid therapy on SS and/or TS.

Subjects and methods: Study subjects comprised patients with serious and moderate AD treated with or without oral steroids: males 164, females 194, total 358. All patients were treated with ordinary medications together with an SGL treatment to improve the patients’ lifestyle. The SS was evaluated by the patients themselves using a scale of 0 to 10. A digital pressure of approximately 5kg was applied to the tender point sites to calculate the tenderness score (TS), which was calculated as follows: 

$$TS = LE + Ax + MSC + SM$$

For the $$\chi^2$$ test, data of SS and TS were first divided into 10 categories by the number of SGL treatments and then two groups by its effect.

Results: In the steroid group, no categories out of ten categories classified by the number of the SGL days showed any significant difference in either the TS or SS, but in the non-steroid group, one category in the male, eight in the female, and nine in the total groups showed a simultaneous statistically significant difference in both the TS and SS.

Conclusions: These results show that the patients with atopic dermatitis should not be treated with long term use of oral steroid except for unavoidable cases.

http://www.jstage.jst.go.jp/article/islsm/19/3/19_149/_article


Efficacy of low-level laser therapy and aluminum hydroxide in patients with chemotherapy and radiotherapy-induced oral mucositis.

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Abstract

This study evaluated the efficacy of low-level laser therapy (LLLT) and aluminum hydroxide (AH) in the prevention of oral mucositis (OM). A prospective, comparative and non-randomized study was conducted with 25 patients with head and neck cancer subjected to radiotherapy (RT) or radiochemotherapy (RCT). Twelve patients received LLLT (830 nm, 15 mW, 12 J/cm²) daily from the 1st day until the end of RT before each sessions during 5 consecutive days, and the other 13 patients received AH 310 mg/5 mL, 4 times/day, also throughout the duration of RT, including weekends. OM was measured using an oral toxicity scale (OTS) and pain was measured using the visual analogue scale (VAS). EORTC questionnaires were administered to the evaluate impact of OM on quality of life. The LLLT group showed lower mean OTS and
VAS scores during the course of RT. A significant difference was observed in pain evaluation in the 13th RT session (p=0.036). In both groups, no interruption of RT was needed. The prophylactic use of both treatments proposed in this study seems to reduce the incidence of severe OM lesions. However, the LLLT was more effective in delaying the appearance of severe OM.

http://www.ncbi.nlm.nih.gov/pubmed/21203698?dopt=Citation


Comparative effects of low-intensity pulsed ultrasound and low-level laser therapy on injured skeletal muscle.


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Abstract

OBJECTIVE: The main purpose of this study was to compare the effects of low-intensity pulsed ultrasound (US) and low-level laser therapy (LLLT) on injured skeletal muscle after cryolesion by means of histopathological analysis and immunohistochemistry for cyclo-oxygenase-2 (COX-2).

BACKGROUND AND METHODS: Thirty-five male Wistar rats were randomly distributed into four groups: intact control group with uninjured and untreated animals; injured control group with muscle injury and no treatment; LLLT-treated group with muscle injury treated with 830-nm laser; and US-treated group with muscle injury treated with US. Treatments started 24 h postsurgery and were performed during six sessions.

RESULTS: LLLT-treated animals presented minor degenerative changes of muscle tissue. Exposure to US reduced tissue injuries induced by cryolesion, but less effectively than LLLT. A large number of COX-2 positive cells were found in untreated injured rats, whereas COX-2 immunoexpression was lower in both LLLT- and US-treated groups.

CONCLUSION: This study revealed that both LLLT and US therapies have positive effects on muscle metabolism after an injury in rats, but LLLT seems to produce a better response.

PMID: 21166589 [PubMed - in process]
Effects of two low-intensity laser therapy protocols on experimental tooth movement.

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Abstract

OBJECTIVE: The purpose of this in vivo study was to determine the effect of two low-intensity laser therapy (LILT) protocols on macroscopic and microscopic parameters of experimental tooth movement.

MATERIALS AND METHODS: To induce experimental tooth movement in rats, 40 cN of orthodontic force was applied to the left first molars. Next, a gallium-aluminum-arsenide (Ga-Al-As) diode laser with a wavelength of 830 nm and power output of 100 mW was applied with fluence of 6000 J/cm(2) on the area around the moved tooth. Two different application protocols were used in the experimental groups: one with daily irradiation and another with irradiation during early stages. Macroscopic and microscopic analyses were performed at days 2 and 7 of tooth movement. The amount of tooth movement was measured with a caliper, and tartrate-resistant acid phosphatase and picrosirius staining were used to enable identification of osteoclasts and immature collagen, respectively.

RESULTS: The amount of tooth movement did not differ between the irradiated and nonirradiated groups on days 2 and 7 of the experiment. On day 2, no difference was observed in the number of osteoclasts or the percentage of immature collagen. On day 7, there was an increase in the number of osteoclasts after daily applications of LILT, while two applications produced no significant difference from control. The amount of immature collagen on the tension side significantly increased in the nonirradiated group and when LILT was applied for only 2 d, whereas it was shown to be inhibited by daily LILT applications (p<0.05).

CONCLUSION: The tested LILT protocols were unable to accelerate tooth movement. Even though the number of osteoclasts increased when LILT was applied daily, the repair at the tension zone was inhibited.

PMID: 21142720 [PubMed - in process]
THE EFFECT OF GaAlAs LASER IRRADIATION ON THE RECOVERY PROCESS OF MUSCULAR STRENGTH FOLLOWING MUSCLE FATIGUE

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(Received October 5, 2009)  
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Abstract

Low reactive-level laser therapy (LLLT) has been reported to reduce chronic and acute pain. Recently, some studies have shown that LLLT may also delay skeletal muscle fatigue during high-intensity exercise. We have hypothesized that laser irradiation may also attenuate muscle fatigue or pain experienced after sports or exercise. However, only a few reports have described the use of lasers in sports medicine. This study was conducted to determine the effectiveness of LLLT in aiding the recovery from exercise-induced skeletal muscle fatigue. Subjects and Methods: Isometric plantar flexion was repeatedly performed on 9 students until the force output declined to 50% maximal voluntary contraction (MVC). Subjects were assigned to perform 3 experiments under different LLLT conditions: laser irradiation to the neck (NKL), to the muscle (MSL), and no laser irradiation (CON). MVC and muscle hardness, girth, blood oxygen saturation, and heart rate were measured during the pre-exercise, post-exercise, and recovery phases. The neck and muscle were irradiated for 15 s using the Oh-Lase HT 2001 semiconductor laser (830 nm; 60 mW, continuous wave), immediately after MVC measurement during the post-exercise phase.

Results: The total exercise time and mean output forces were analyzed using repeated-measures and one-factor ANOVA with post-hoc tests; no significant differences were observed among the 3 conditions for the pre and post-exercise MVC levels before irradiation (NKL, 68.1% MVC; MSL, 66.4% MVC; CON, 66.1% MVC). However, the MVC at 5 and 10 min after exercise was significantly greater in the NKL and MSL groups than in the CON group (MVC after 5 min: 80.4%, 76.9%, and 69.7% for the NKL, MSL, and CON groups, respectively; MVC after 10 min: 81.8%, 81.2%, and 74.4%). Further, no significant differences were observed in the MVC recorded at 15 and 30 min. Therefore, compared to the CON group, the NKL and MSL groups exhibited early muscle-strength recovery from fatigue caused by repeated contractions.

Conclusion: We concluded that LLLT at the parameters used in the present study effectively promoted the recovery of the isometric force output after muscle fatigue induced by repeated contractions.
especially in the acute-exhaustion phase.

http://www.jstage.jst.go.jp/article/isism/19/1/19_11_/article

Effects of near-infra-red laser irradiation on adenosine triphosphate and adenosine diphosphate contents of rat brain tissue

Neuroscience Letters
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Low-power, near-infra-red laser irradiation has been used to relieve patients from various kinds of pain, though the precise mechanisms of such biological actions of the laser have not yet been resolved. To investigate the cellular mechanisms by near-infra-red laser on the nervous system, we examined the effect of 830-nm laser irradiation on the energy metabolism of the rat brain. The diode laser was applied for 15 min with an irradiance of 4.8 W/cm(2). Tissue adenosine triphosphate (ATP) content of the irradiated area in the cerebral cortex was 19% higher than that of the non-treated area, whereas the adenosine diphosphate (ADP) content showed no significant difference. Laser irradiation at another wavelength (652 nm) had no effect on either ATP or ADP contents. The temperature of the tissue was increased by 4.4-4.7 degrees C during the irradiation of both wavelengths. These results suggest that the increase in tissue ATP content did not result from the thermal effect, but from a specific effect of the laser operated at the 830-nm wavelength.
830 nm laser irradiation induces varicosity formation, reduces mitochondrial membrane potential and blocks fast axonal flow in small and medium diameter rat dorsal root ganglion neurons: implications for the analgesic effects of 830 nm laser.

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Abstract

We report the formation of 830 nm (cw) laser-induced, reversible axonal varicosities, using immunostaining with beta-tubulin, in small and medium diameter, TRPV-1 positive, cultured rat DRG neurons. Laser also induced a progressive and statistically significant decrease (p<0.005) in MMP in mitochondria in and between static axonal varicosities. In cell bodies of the neuron, the decrease in MMP was also statistically significant (p<0.05), but the decrease occurred more slowly. Importantly we also report for the first time that 830 nm (cw) laser blocked fast axonal flow, imaged in real time using confocal laser microscopy and JC-1 as mitotracker. Control neurons in parallel cultures remained unaffected with no varicosity formation and no change in MMP. Mitochondrial movement was continuous and measured along the axons at a rate of 0.8 microm/s (range 0.5-2 microm/s), consistent with fast axonal flow. Photoacceptors in the mitochondrial membrane absorb laser and mediate the transduction of laser energy into electrochemical changes, initiating a secondary cascade of intracellular events. In neurons, this results in a decrease in MMP with a concurrent decrease in available ATP required for nerve function, including maintenance of microtubules and molecular motors, dyneins and kinesins, responsible for fast axonal flow. Laser-induced neural blockade is a consequence of such changes and provide a mechanism for a neural basis of laser-induced pain relief. The repeated application of laser in a clinical setting modulates nociception and reduces pain. The application of laser therapy for chronic pain may provide a non-drug alternative for the management of chronic pain.

PMID: 17374099 [PubMed - indexed for MEDLINE]
Abstract

Background and Objective

Treating patients with a Gallium-Aluminum-Arsenide (GaAlAs) infrared (IR) diode laser reduces muscle spasm and increases mobility in the muscles. The effect of low intensity laser irradiation on nerve function, growth, and repair mechanisms is a contentious area of research. We have addressed one aspect of this controversy by systematically examining the influence of 830 nm laser radiation on neurotransmitter release in neuromuscular junctions (NMJ) of the mouse diaphragm.

Study Design/Materials and Methods

Thirty adult mice were studied. Diode laser GaAlAs 830 nm (4 and 12 J/cm²) was used. Neurotransmitter release was studied by conventional intracellular recording techniques on curarized muscles or high magnesium media. The quantal content, amplitude, and latency of the end-plate potentials (EPPs) were analyzed. Frequency and amplitude were evaluated for the miniature end-plate potentials (MEPPs). Facilitation of the neurotransmitter release was also evaluated by paired pulse stimulation.

Results and Conclusions

The irradiated (12 J/cm²) muscles showed a significant reduction in quantal content ($P = 0.01$) and EPP amplitude ($P = 0.04$), but the latency, spontaneous transmitter release (MEPPs) and paired pulse facilitation did not change. No alterations were observed in NMJ irradiated with 4 J/cm². We conclude that 830 nm diode laser irradiation (at a dose of 12 J/cm²) can affect the evoked neurotransmitter release in the mouse motor endplates. Lasers Surg. Med. 35:236–241, 2004. © 2004 Wiley-Liss, Inc.


Effect of 830 nm laser phototherapy on osteoblasts grown in vitro on Biosilicate scaffolds.

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Abstract

Objective: The purpose of this study was (i) to develop a method for successfully seeding osteoblasts onto a glass-ceramic scaffold designed for use in clinical settings, and (ii) to determine whether the application of laser phototherapy at 830 nm would result in osteoblast proliferation on the glass-ceramic scaffold. Background: The use of bioscaffolds is considered a promising strategy for a number of clinical applications where tissue healing is sub-optimal. As in vitro osteoblast growth is a slow process, laser phototherapy could be used to stimulate osteoblast proliferation on bioscaffolds. Methods: A methodology was developed to seed an osteoblastic (MC3T3) cell line onto a novel glass-ceramic scaffold. Seeded scaffolds were irradiated with a single exposure of 830 nm laser at 10 J/cm² (at diode). Non-irradiated seeded scaffolds acted as negative controls. Cell proliferation was assessed seven days after irradiation. Results: Osteoblastic MC3T3 cells were successfully grown on discs composed of a
glass-ceramic composite. Laser irradiation produced a 13% decrease in MC3T3 cell proliferation on glass-ceramic discs (mean ± SD = 0.192 ± 0.002) compared with control (non-irradiated) discs (mean ±SD = 0.22 ± 0.002). **Conclusions:** Despite successful seeding of bioscaffolds with osteoblasts, laser phototherapy resulted in a reduction in cell growth compared to non-irradiated controls. Future research combining laser phototherapy and glass-ceramic scaffolds should take into account possible interactions of the laser with matrix compounds.


**Effect of 830 nm low-level laser therapy in exercise-induced skeletal muscle fatigue in humans.**


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**Abstract**

This study aimed to investigate the effect of 830 nm low-level laser therapy (LLLT) on skeletal muscle fatigue. Ten healthy male professional volleyball players entered a crossover randomized double-blinded placebo-controlled trial. Active LLLT (830 nm wavelength, 100 mW output, spot size 0.0028 cm(2), 200 s total irradiation time) or an identical placebo LLLT was delivered to four points on the biceps humeri muscle immediately before exercises. All subjects performed voluntary biceps humeri contractions with a load of 75% of the maximum voluntary contraction (MVC) force until exhaustion. After active LLLT the mean number of repetitions was significantly higher than after placebo irradiation [mean difference 4.5, standard deviation (SD) +/- 6.0, P = 0.042], the blood lactate levels increased after exercises, but there was no significant difference between the treatments. We concluded that 830 nm LLLT can delay the onset of skeletal muscle fatigue in high-intensity exercises, in spite of increased blood lactate levels.


PMID: 18649044 [PubMed - indexed for MEDLINE]

The effect of 300 mW, 830 nm laser on chronic neck pain: a double-blind, randomized, placebo-controlled study.

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Comment in:
- Pain. 2006 Sep;124(1-2):5-6.

Abstract

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.


PMID: 16806710 [PubMed - indexed for MEDLINE]


Irradiation at 830 nm stimulates nitric oxide production and inhibits pro-inflammatory cytokines in diabetic wounded fibroblast cells.

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Abstract

BACKGROUND AND OBJECTIVE: Wound healing in diabetic patients remains a chief problem in the clinical setting and there is a strong need for the development of new, safe, reliable therapies. This study aimed to establish the effect of irradiating diabetic wounded fibroblast cells (WS1) in vitro on pro-inflammatory cytokines and the production of nitric oxide (NO).

MATERIALS AND METHODS: Normal, wounded and diabetic wounded WS1 cells were exposed to an 830 nm laser with 5 J/cm(2) and incubated for a pre-determined amount of time. Changes in cellular viability, proliferation and apoptosis were evaluated by the Trypan blue assay, VisionBlue fluorescence assay and caspase 3/7 activity respectively. Changes in cytokines (interleukin–IL-6, IL-1 beta and tumour necrosis factor-alpha, TNF-alpha) were determined by ELISA. NO was determined spectrophotometrically and reactive oxygen species (ROS) was evaluated by immunofluorescent staining.

RESULTS: Diabetic wounded WS1 cells showed no significant change in viability, a significant increase in proliferation at 24 and 48 hours (P<0.001 and P<0.01 respectively) and a decrease in apoptosis 24 hours post-irradiation (P<0.01). TNF-alpha levels were significantly decreased at both 1 and 24 hours (P<0.05), while IL-1 beta was only decreased at 24 hours (P<0.05). There was no significant change in IL-6. There was an increase in ROS and NO (P<0.01) 15 minutes post-irradiation.

CONCLUSION: Results show that irradiation of diabetic wounded fibroblast cells at 830 nm with 5 J/cm(2) has a positive effect on wound healing in vitro. There was a decrease in pro-inflammatory cytokines (IL-1 beta and TNF-alpha) and irradiation stimulated the release of ROS and NO due to what appears to be direct photochemical processes.

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Defocused diode laser therapy (830 nm) in the treatment of unresponsive skin ulcers: a preliminary trial.

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Abstract

BACKGROUND: Skin ulcers with compromised healing remain a major problem for plastic and dermatological surgeons. Low incident levels of laser energy have been shown to increase the blood flow
rate and volume and to accelerate the wound healing process, thus raising the possibility in augmenting treatment for skin ulcers.

METHODS: Preliminary controlled experiments with a 830 nm GaAlAs diode laser in axial pattern flap survival in the rat model showed statistically significant improvement in survival for the irradiated versus unirradiated control animals. In the present study, a newly developed defocused GaAlAs diode laser (830 nm, continuous wave, 669 mW/cm(2)) was applied once or twice per week in an uncontrolled study of five patients (aged between 5 and 81 years old, average 46.6 years old, doses from 6.3 J/cm(2) to 21 J/cm(2)) with previously unresponsive ulcers of various aetiologies.

RESULTS: In all five patients, the ulcers healed completely between 3 weeks and 7 months (22.8 +/- 19.3 weeks), without recurrence during a minimum 12-month follow-up.

CONCLUSIONS: Defocused 830 nm diode laser therapy was well tolerated, and was very effective in the treatment of this small number of compromised skin ulcers of different aetiologies and in a large range of patient ages. Further controlled studies in larger populations are required. Defocused diode laser therapy nonetheless appears to be a very useful adjunctive method in the treatment of slow-to-heal and non-healing skin ulcers.


GaAlAs (830 nm) low-level laser enhances peripheral endogenous opioid analgesia in rats.

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Abstract

BACKGROUND: Low-level laser therapy (LLLT) has been reported to relieve pain with minimal side effects. Recent studies have demonstrated that opioid-containing immune cells migrate to inflamed sites and release beta-endorphins to inhibit pain as a mode of peripheral endogenous opioid analgesia. The present study investigates whether LLLT may enhance peripheral endogenous opioid analgesia.

METHODS: The effect of LLLT on opioid analgesia and production was evaluated in vivo in a rat model of inflammation as well as in vitro in Jurkat cells, a human T-cell leukemia cell line. mRNA expression of the beta-endorphin precursors proopiomelanocortin and corticotrophin releasing factor was assessed by reverse transcription polymerase chain reaction.

RESULTS: LLLT produced an analgesic effect in inflamed peripheral tissue which was transiently antagonized by naloxone. Beta-endorphin precursor mRNA expression increased with LLLT, both in vivo and in vitro.
CONCLUSION: This study demonstrates that LLLT produces analgesic effects in a rat model of peripheral inflammation. We further revealed an additional mechanism of LLLT-mediated analgesia via enhancement of peripheral endogenous opioids. These findings suggest that LLLT induces analgesia in rats by enhancing peripheral endogenous opioid production in addition to previously reported mechanisms.

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PMID: 18081143 [PubMed - indexed for MEDLINE]


830-nm irradiation increases the wound tensile strength in a diabetic murine model.

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Abstract

BACKGROUND AND OBJECTIVE: The purpose of this study was to investigate the effects of low-power laser irradiation on wound healing in genetic diabetes.

STUDY DESIGN/MATERIALS AND METHODS: Female C57BL/KsJ-db/db mice received 2 dorsal 1 cm full-thickness incisions and laser irradiation (830 nm, 79 mW/cm(2), 5.0 J/cm(2)/wound). Daily low-level laser therapy (LLLT) occurred over 0-4 days, 3-7 days, or nonirradiated. On sacrifice at 11 or 23 days, wounds were excised, and tensile strengths were measured and standardized.

RESULTS: Nontreated diabetic wound tensile strength was 0.77 +/- 0.22 g/mm(2) and 1.51 +/- 0.13 g/mm(2) at 11 and 23 days. After LLLT, over 0-4 days tensile strength was 1.15 +/- 0.14 g/mm(2) and 2.45 +/- 0.29 g/mm(2) (P = 0.0019). Higher tensile strength at 23 days occurred in the 3- to 7-day group (2.72 +/- 0.56 g/mm(2) LLLT vs. 1.51 +/- 0.13 g/mm(2) nontreated; P < or = 0.01).

CONCLUSION: Low-power laser irradiation at 830 nm significantly enhances cutaneous wound tensile strength in a murine diabetic model. Further investigation of the mechanism of LLLT in primary wound healing is warranted.

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PMID: 11295756 [PubMed - indexed for MEDLINE]
Effect of 830-nm laser light on the repair of bone defects grafted with inorganic bovine bone and decalcified cortical osseous membrane.


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Abstract

OBJECTIVE: The aim of this study was to assess histologically the effect of LLLT (lambda830 nm) on the repair of standardized bone defects on the femur of Wistar albinus rats grafted with inorganic bovine bone and associated or not to decalcified bovine cortical bone membrane.

BACKGROUND DATA: Bone loss may be a result of several pathologies, trauma or a consequence of surgical procedures. This led to extensive studies on the process of bone repair and development of techniques for the correction of bone defects, including the use of several types of grafts, membranes and the association of both techniques. There is evidence in the literature of the positive effect of LLLT on the healing of soft tissue wounds. However, its effect on bone is not completely understood.

MATERIALS AND METHODS: Five randomized groups were studied: Group I (Control); Group IIA (Gen-ox); Group IIB (Gen-ox + LLLT); Group IIIA (Gen-ox + Gen-derm) and Group IIIB (Gen-ox + Gen-derm + LLLT). Bone defects were created at the femur of the animals and were treated according to the group. The animals of the irradiated groups were irradiated every 48 h during 15 days; the first irradiation was performed immediately after the surgical procedure. The animals were irradiated transcutaneously in four points around the defect. At each point a dose of 4 J/cm² was given (phi approximately 0.6 mm, 40 mW) and the total dose per session was 16 J/cm². The animals were humanely killed 15, 21, and 30 days after surgery. The specimens were routinely processed to wax, serially cut, and stained with H&E and Picrosirius stains and analyzed under light microscopy.

RESULTS: The results showed evidence of a more advanced repair on the irradiated groups when compared to non-irradiated ones. The repair of irradiated groups was characterized by both increased bone formation and amount of collagen fibers around the graft within the cavity since the 15th day after surgery, through analysis of the osteoconductive capacity of the Gen-ox and the increment of the cortical repair in specimens with Gen-derm membrane.

CONCLUSION: It is concluded that LLLT had a positive effect on the repair of bone defect submitted the implantation of graft.

PMID: 14709224 [PubMed - indexed for MEDLINE]
Effects of low-level laser therapy on pain and scar formation after inguinal herniation surgery: a randomized controlled single-blind study.

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Abstract

OBJECTIVE: The aim of this study was to investigate the efficacy of an infrared GaAlAs laser operating with a wavelength of 830 nm in the postsurgical scarring process after inguinal-hernia surgery.

BACKGROUND: Low-level laser therapy (LLLT) has been shown to be beneficial in the tissue-repair process, as previously demonstrated in tissue culture and animal experiments. However, there is lack of studies on the effects of LLLT on postsurgical scarring of incisions in humans using an infrared 830-nm GaAlAs laser.

METHOD: Twenty-eight patients who underwent surgery for inguinal hernias were randomly divided into an experimental group (G1) and a control group (G2). G1 received LLLT, with the first application performed 24 h after surgery and then on days 3, 5, and 7. The incisions were irradiated with an 830-nm diode laser operating with a continuous power output of 40 mW, a spot-size aperture of 0.08 cm² for 26 s, energy per point of 1.04 J, and an energy density of 13 J/cm². Ten points per scar were irradiated. Six months after surgery, both groups were reevaluated using the Vancouver Scar Scale (VSS), the Visual Analog Scale, and measurement of the scar thickness.

RESULTS: G1 showed significantly better results in the VSS totals (2.14 +/- 1.51) compared with G2 (4.85 +/- 1.87); in the thickness measurements (0.11 cm) compared with G2 (0.19 cm); and in the malleability (0.14) compared with G2 (1.07). The pain score was also around 50% higher in G2.

CONCLUSION: Infra-red LLLT (830 nm) applied after inguinal-hernia surgery was effective in preventing the formation of keloids. In addition, LLLT resulted in better scar appearance and quality 6 mo postsurgery.

PMID: 19821701 [PubMed - indexed for MEDLINE]
Comparative study of the effects of low-intensity pulsed ultrasound and low-level laser therapy on bone defects in tibias of rats.

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Abstract

The aim of this study was to investigate and to compare the effects of low intensity ultrasound (LIPUS) and low-level laser therapy (LLLT) during the process of bone healing by means of histopathological and morphometric analysis. The animals were randomly distributed into three groups of 30 animals each: the control group (bone defect without treatment); the laser-treated group: (bone defect treated with laser), and the LIPUS-treated (bone defect treated with ultrasound). Each group was further divided into three different subgroups (n = 10) and on days 7, 13, and 25 post-injury, rats were killed with an intraperitoneal injection of general anesthetic. The rats were treated with a 30-mW/cm² low-intensity pulsed ultrasound and a 830-nm laser at 50 J/cm². The results showed intense new bone formation surrounded by highly vascularized connective tissue presenting a slight osteogenic activity, with primary bone deposition being observed in the group exposed to laser in the intermediary (13 days) and late stages of repair (25 days). This was confirmed by morphometric analysis in which significant statistical differences (p < 0.05) were noticed when compared to the control. No remarkable differences were noticed in the specimens treated with ultrasound with regard to the amount of newly formed bone in comparison to the control group. Taken together, our results indicate that laser therapy improves bone repair in rats as depicted by histopathological and morphometric analysis, mainly at the late stages of recovery. Moreover, it seems that this therapy was more effective than US to accelerate bone healing.

PMID: 20521077 [PubMed - indexed for MEDLINE]


Low-level laser therapy in chronic autoimmune thyroiditis: a pilot study.

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Abstract

BACKGROUND AND OBJECTIVES: Chronic autoimmune thyroiditis (CAT) remains the most common cause of acquired hypothyroidism. There is currently no therapy that is capable of regenerating CAT-damaged thyroid tissue. The objective of this study was to gauge the value of applying low-level
laser therapy (LLLT) in CAT patients based on both ultrasound studies (USs) and evaluations of thyroid function and thyroid autoantibodies.

STUDY DESIGN/MATERIALS AND METHODS: Fifteen patients who had hypothyroidism caused by CAT and were undergoing levothyroxine (LT4) treatment were selected to participate in the study. Patients received 10 applications of LLLT (830 nm, output power 50 mW) in continuous mode, twice a week, using either the punctual technique (8 patients) or the sweep technique (7 patients), with fluence in the range of 38-108 J/cm². USs were performed prior to and 30 days after LLLT. USs included a quantitative analysis of echogenicity through a gray-scale computerized histogram index (EI). Following the second ultrasound (30 days after LLLT), LT4 was discontinued in all patients and, if required, reintroduced. Triiodothyronine, thyroxine (T4), free T4, thyrotropin, thyroid peroxidase (TPOAb) and thyroglobulin (TgAb) antibodies levels were assessed before LLLT and then 1, 2, 3, 6, and 9 months after LT4 withdrawal.

RESULTS: We noted all patients' reduced LT4 dosage needs, including 7 (47%) who did not require any LT4 through the 9-month follow-up. The LT4 dosage used pre-LLLT (96 +/- 22 microg/day) decreased in the 9th month of follow-up (38 +/- 23 microg/day; P < 0.0001). TPOAb levels also decreased (pre-LLLT = 982 +/- 530 U/ml, post-LLLT = 579 +/- 454 U/ml; P = 0.016). TgAb levels were not reduced, though we did observe a post-LLLT increase in the EI (pre-LLLT = 0.99 +/- 0.09, post-LLLT = 1.21 +/- 0.19; P = 0.001).

CONCLUSION: The preliminary results indicate that LLLT promotes the improvement of thyroid function, as patients experienced a decreased need for LT4, a reduction in TPOAb levels, and an increase in parenchymal echogenicity.

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PMID: 20662037 [PubMed - indexed for MEDLINE]
STUDY DESIGN: Ten rabbits underwent bone lengthening according to the following protocol: Latency - 3 days; Activation - 7 days 0.7 mm/d; and Consolidation - 10 days. The control group was composed of 4 rabbits. The experimental group, composed of 6 rabbits, received infrared GaAlAs LLLT (wavelength=830 nm, P=40 mW) according to the following protocol: point dose of 10 J/cm(2) applied directly on the bone site that underwent DO during bone consolidation at 48-hour intervals.

RESULTS: The percentage of newly formed bone was greater in the LLLT group (57.89%) than in the control group (46.75%) (p=0.006).

CONCLUSION: The results suggest that LLLT had a positive effect on the percentage of newly formed bone. Better-quality bone sites may allow early removal of the osteogenic distractors, thus shortening total treatment time.

PMID: 20038884 [PubMed - indexed for MEDLINE]


Effects of low-level laser therapy on bone formed after distraction osteogenesis.
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Abstract

This study evaluated the effect of low-level laser therapy (LLLT) on the chemical composition, crystallinity and crystalline structure of bone at the site of distraction osteogenesis. Five rabbits were subjected to distraction osteogenesis (latency = 3 days; rate and frequency = 0.7 mm/day for 7 days; consolidation = 10 days), and three were given LLLT with arsenide-gallium-aluminum (AsGaAl; 830 nm, 40 mW): 10 J/cm(2) dose per spot, applied directly to the distraction osteogenesis site during the consolidation stage at 48 h intervals. Samples were harvested at the end of the consolidation stage. X-ray fluorescence and X-ray diffraction were used to analyze chemical composition, crystallinity and crystalline structure of bone at the distraction osteogenesis site. The analysis of chemical composition and calcium (Ca) and phosphorus (P) ratios revealed greater mineralization in the LLLT group. Diffractograms showed that the crystalline structure of the samples was similar to that of hydroxyapatites. Crystallinity percentages were greater in rabbits that were given LLLT. Crystallinity (41.14% to 54.57%) and the chemical composition of the bone at the distraction osteogenesis site were similar to the that of the control group (42.37% to 49.29%). The results showed that LLLT had a positive effect on the biomodulation of newly formed bone.

PMID: 19548055 [PubMed - indexed for MEDLINE]
Measurements of jaw movements and TMJ pain intensity in patients treated with GaAlAs laser.

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Abstract

The aim of this study was to evaluate the effectiveness of low-level laser therapy (LLLT) on the improvement of the mandibular movements and painful symptoms in individuals with temporomandibular disorders (TMD). Forty patients were randomly divided into two groups (n=20): Group 1 received the effective dose (GaAlAs laser λ 830 nm, 40 mW, 5J/cm²) and Group 2 received the placebo application (0 J/cm²), in continuous mode on the affected condyle lateral pole: superior, anterior, posterior, and posterior-inferior, twice a week during 4 weeks. Four evaluations were performed: E1 (before laser application), E2 (right after the last application), E3 (one week after the last application) and E4 (30 days after the last application). The Kruskal-Wallis test showed significant more improvements (p<0.01) in painful symptoms in the treated group than in the placebo group. A significant improvement in the range of mandibular movements was observed when the results were compared between the groups at E4. Laser application can be a supportive therapy in the treatment of TMD, since it resulted in the immediate decrease of painful symptoms and increased range of mandibular movements in the treated group. The same results were not observed in the placebo group.

PMID: 20976388 [PubMed - in process]


Role of 830 nm low reactive level laser on the growth of an implanted glioma in mice.

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Abstract
The effect of low reactive level laser therapy (LLLT: 830 nm, 60 mW, continuous wave) was studied using the model of a glioma implanted in mice. Two different models were used. In the first model, therapies were applied post the first day of glioma implantation; in the second model, post the fourteenth day of glioma implantation. Using the first model, therapies were designed as follows. 1) control group (no therapy), 2) direct LLLT (15 seconds twice per day; on the skin covering the implanted glioma), 3) indirect LLLT (15 seconds twice per day; on abdominal skin area rather than the site of the implanted glioma), 4) indirect LLLT (30 seconds twice per day), 5) anti-cancer drug (ACNU) group, 6) mouse beta-interferon (Mu-beta-IFN) group, 7) direct LLLT plus Mu-beta-IFN group, 8) ACNU plus Mu-beta-IFN group, 9) indirect LLLT (15 seconds twice per day) plus ACNU plus Mu-beta-IFN group. Using the second model, therapies were designed as follows. 1) control group (no therapy), 2) indirect LLLT (15 seconds twice per day), 3) indirect LLLT (15 seconds twice per day) plus Mu-beta-IFN group, 4) Mu-beta-IFN plus ACNU group. Our results indicated that, applied on the first day after glioma implantation, both direct and indirect LLLT were effective in inhibiting the tumor growth. In addition, it appeared that the effect of LLLT might be dose-dependent. Finally, the group of direct LLLT plus Mu-beta-IFN was most effective in limiting the tumor growth and the incidence of growth as compared with the other groups. (ABSTRACT TRUNCATED AT 250 WORDS)

PMID: 8126974 [PubMed - indexed for MEDLINE]

Title: Low-level laser irradiation promotes the recovery of atrophied gastrocnemius skeletal muscle in rats.
Authors: Nakano, Jiro / Kataoka, Hideki / Sakamoto, Jyunya / Origuchi, Tomoki / Okita, Minoru / Yoshimura, Toshiro
Issue Date: Sep-2009 Publisher: Wiley-Blackwell Citation: Experimental Physiology, 94(9), pp.1005-1015; 2009

Abstract: Low-level laser (LLL) irradiation promotes proliferation of muscle satellite cells, angiogenesis and expression of growth factors. Satellite cells, angiogenesis and growth factors play important roles in the regeneration of muscle. The objective of this study was to examine the effect of LLL irradiation on rat gastrocnemius muscle recovering from disuse muscle atrophy. Eight-week-old rats were subjected to hindlimb suspension for 2 weeks, after which they were released and recovered. During the recovery period, rats underwent daily LLL irradiation (Ga-Al-As laser; 830 nm; 60 mW; total, 180 s) to the right gastrocnemius muscle through the skin. The untreated left gastrocnemius muscle served as the control. In conjunction with LLL irradiation, 5-bromo-2-deoxyuridine (BrdU) was injected subcutaneously to label the nuclei of proliferating cells. After 2 weeks, myofibre diameters of irradiated muscle increased in comparison with those of untreated muscle, but did not recover back to normal levels. Additionally, in the superficial region of the irradiated muscle, the number of capillaries and fibroblast growth factor levels exhibited significant elevation relative to those of untreated muscle. In the deep region of irradiated muscle, BrdU-positive nuclei of satellite cells and/or myofibres increased significantly relative to those of the untreated muscle. The results of this study suggest that LLL irradiation can promote recovery from disuse muscle atrophy in association with proliferation of satellite cells and angiogenesis.

Description: The definitive version is available at www.blackwell-synergy.com and www.expphysiol.org.
Keywords: Low-level laser / disuse muscle atrophy / satellite cell URI: http://hdl.handle.net/10069/23728
Version: author
Effects of low-level laser therapy and orthodontic tooth movement on dental pulps in rats.

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Abstract

OBJECTIVES: To describe the microscopic pulpal reactions resulting from orthodontically induced tooth movement associated with low-level laser therapy (LLLT) in rats.

MATERIALS AND METHODS: Forty-five young male Wistar rats were randomly assigned to three groups. In group I (n = 20), the maxillary right first molars were submitted to orthodontic movement with placement of a coil spring. In group II (n = 20), the teeth were submitted to orthodontic movement plus LLLT at 4 seconds per point (buccal, palatal, and mesial) with a GaAlAs diode laser source (830 nm, 100 mW, 18 J/cm(2)). Group III (n = 5) served as a control (no orthodontic movement or LLLT). Groups I and II were divided into four subgroups according to the time elapsed between the start of tooth movement and sacrifice (12 hours, 24 hours, 3 days, and 7 days).

RESULTS: Up until the 3-day period, the specimens in group I presented a thicker odontoblastic layer, no cell-free zone of Weil, pulp core with differentiated mesenchymal and defense cells, and a high concentration of blood vessels. In group II, at the 12- and 24-hour time points, the odontoblastic layer was disorganized and the cell-free zone of Weil was absent, presenting undifferentiated cells, intensive vascularization with congested capillaries, and scarce defense cells in the cell-rich zone. In groups I and II, pulpal responses to the stimuli were more intense in the area underneath the region of application of the force or force/laser.

CONCLUSIONS: The orthodontic-induced tooth movement and LLLT association showed reversible hyperemia as a tissue response to the stimulus. LLLT leads to a faster repair of the pulpal tissue due to orthodontic movement.

PMID: 19852650 [PubMed - indexed for MEDLINE]

Effect of low-level laser therapy and calcitonin on bone repair in castrated rats: a densitometric study.

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Abstract

OBJECTIVE: To investigate the healing of bone defects in male rats treated with salmon calcitonin, low-level laser therapy (LLLT), or both.

BACKGROUND: Healing of bone defects still represents a challenge to health professionals in several areas. In this article, the effect of calcitonin in combination with LLLT on bone repair was studied. Densitometry was used as a valuable tool for the measurement of bone regeneration.

METHODS: Sixty male Wistar rats underwent bilateral castration surgery before the creation of a surgical bone defect. The animals were randomly divided into four groups: control, treated with calcitonin (Ca), treated with LLLT (La), and treated with calcitonin and LLLT (CaLa). Groups Ca and CaLa received 2 IU/kg of synthetic salmon calcitonin intramuscularly three times a week. Groups La and CaLa received laser therapy using a gallium-aluminum-arsenide laser (10 mW, 20 J/cm(2), wavelength 830 nm). Control animals were submitted to sham irradiation. The animals were sacrificed 7, 14, and 21 days after surgery, and bone defects were analyzed using densitometry.

RESULTS: The CaLa group had a higher degree of bone regeneration 14 and 21 days after surgery.

CONCLUSIONS: The La and CaLa had significantly higher bone mineral density than the control and Ca groups.

PMID: 19712023 [PubMed - indexed for MEDLINE]
OBJECTIVE: This study aimed to investigate the effect of diode laser (830 nm) irradiation on the viability of ischemic random skin flaps in rats, as well as to determine the most effective site for applying laser radiation to speed healing.

BACKGROUND DATA: Low-level laser therapy (LLLT) has recently been used to improve the viability of ischemic random skin flaps in rats.

MATERIALS AND METHODS: Seventy Wistar rats were used and divided into seven groups of 10 rats each: group 1, sham laser treatment; group 2, which received irradiation at 1 point 5 cm from the flap's cranial base; group 3, which received irradiation at 2 points (5 and 7.5 cm from the flap's base); group 4, which received irradiation at 3 points (2.5, 5 and 7.5 cm from the flap's base); group 5, which received irradiation at 1 point 2.5 cm from the flap's base; group 6, which received irradiation at 2 points (2.5 and 5 cm from the flap's base); and group 7, which received irradiation at 1 point 7.5 cm from the flap's base. The animals were subjected to laser therapy at an energy density of 36 J/cm(2) for 72 sec immediately after surgery, and one time on each of the four subsequent days. The percentage of necrotic skin flap area was calculated on the seventh postoperative day using a paper template.

RESULTS: The results showed that the rats in group 5 had the highest increase in skin flap viability, with a statistically significant difference compared to the other groups. Statistically significant differences were not seen between any of the other groups.

CONCLUSION: The diode laser was effective in increasing skin flap viability in rats, and laser irradiation of a point 2.5 cm from the cranial base flap was found to be the most effective.

PMID: 19025409 [PubMed - indexed for MEDLINE]

(wavelength 830 nm, continuous wave, power 50 mW) in skin contact at a dose of 6 J/point. The placebo control group was treated with an ineffective probe (power 0.5 mW) of the same appearance. Before examinations and immediately, 2 wk, and 2 mo after completing the therapy, thermography was performed (bilateral comparative thermograph by AGA infrared camera); joint flexion, circumference, and pressure sensitivity were measured; and the visual analogue scale was recorded.

RESULTS: In the group treated with active LLLT, a significant improvement was found in pain (before treatment [BT]: 5.75; 2 mo after treatment : 1.18); circumference (BT: 40.45; AT: 39.86); pressure sensitivity (BT: 2.33; AT: 0.77); and flexion (BT: 105.83; AT: 122.94). In the placebo group, changes in joint flexion and pain were not significant. Thermographic measurements showed at least a 0.5 degrees C increase in temperature--and thus an improvement in circulation compared to the initial values. In the placebo group, these changes did not occur.

CONCLUSION: Our results show that LLLT reduces pain in KOA and improves microcirculation in the irradiated area.

PMID: 19530911 [PubMed - indexed for MEDLINE]


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Effect of soft laser and bioactive glass on bone regeneration in the treatment of bone defects (an experimental study).


Department of Oral Medicine and Periodontology, Faculty of Dentistry, Mansoura University, Mansoura, Egypt.

Abstract

This study aimed to investigate the influence of low-power gallium-aluminium-arsenide (GaAlAs) laser [830 nm, continuous wave (CW), 40 mW and fluence 4 J/cm(2)] on the healing of surgically created bone defects in rats treated with bioactive glass graft material. Surgical bone defects were created in the mandibles of 36 Wistar rats divided into two groups, each consisting of 18 rats. Group I was treated with bioactive glass plus laser irradiation. Group II was treated with graft material only. The animals were killed at 4 weeks, 8 weeks and 12 weeks postoperatively for histological examination. Laser irradiation had significantly accelerated bone healing at 4 weeks and 8 weeks in comparison with that at the sites not irradiated. However at 12 weeks, complete healing of the defects had occurred with no difference detected. Our results have confirmed the positive effect of soft laser in accelerating bone regeneration.

PMID: 18626570 [PubMed - indexed for MEDLINE]

Carpal tunnel syndrome treated with a diode laser: a controlled treatment of the transverse carpal ligament.

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Abstract

OBJECTIVE: The purpose of this placebo-controlled study was to investigate the therapeutic effects of the 830-nm diode laser on carpal tunnel syndrome (CTS).

BACKGROUND DATA: Many articles in the literature have demonstrated that low-level laser therapy (LLLT) may help to alleviate various types of nerve pain, especially for CTS treatment. We placed an 830-nm laser directly above the transverse carpal ligament, which is between the pisiform and navicular bones of the tested patients, to determine the therapeutic effect of LLLT.

MATERIALS AND METHODS: Thirty-six patients with mild to moderate degree of CTS were randomly divided into two groups. The laser group received laser treatment (10 Hz, 50% duty cycle, 60 mW, 9.7 J/cm(2), at 830 nm), and the placebo group received sham laser treatment. Both groups received treatment for 2 wk consisting of a 10-min laser irradiation session each day, 5 d a week. The therapeutic effects were assessed on symptoms and functional changes, and with nerve conduction studies (NCS), grip strength assessment, and with a visual analogue scale (VAS), soon after treatment and at 2-wk follow-up.

RESULTS: Before treatment, there were no significant differences between the two groups for all assessments (p > 0.05). The VAS scores were significantly lower in the laser group than the placebo group after treatment and at follow-up (p < 0.05). After 2 wk of treatment, no significant differences were found in grip strengths or for symptoms and functional assessments (p > 0.05). However, there were statistically significant differences in these variables at 2-wk follow-up (p < 0.05). Regarding the findings of NCS, there was no statistically significant difference between groups after treatment and at 2-wk follow-up.

CONCLUSIONS: LLLT was effective in alleviating pain and symptoms, and in improving functional ability and finger and hand strength for mild and moderate CTS patients with no side effects.

PMID: 19025407 [PubMed - indexed for MEDLINE]

Effect of infrared laser irradiation on amino acid neurotransmitters in an epileptic animal model induced by pilocarpine.

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Abstract

OBJECTIVE: The aim of the present study was to investigate the effect of daily laser irradiation on the levels of amino acid neurotransmitters in the cortex and hippocampus in an epileptic animal model induced by pilocarpine.

BACKGROUND DATA: It has been claimed that at specific wavelengths and energy densities, laser irradiation is a novel and useful tool for the treatment of peripheral and central nervous system injuries and disorders.

MATERIALS AND METHODS: Adult male albino rats were divided into three groups: control rats, pilocarpinized rats (epileptic animal model), and pilocarpinized rats treated daily with laser irradiation (90 mW at 830 nm) for 7 d. The following parameters were assayed in cortex and hippocampus: amino acid neurotransmitters (excitatory: glutamic acid and aspartate; and inhibitory: gamma-aminobutyric acid [GABA], glycine, and taurine) by high-performance liquid chromatography (HPLC), glucose content, and the activity of alanine aminotransferase (ALT) and aspartate aminotransferase (AST), using a spectrophotometer.

RESULTS: Significant increases in the concentrations of glutamic acid, glutamine, glycine, and taurine were recorded in the cortices of pilocarpinized rats, and they returned to initial levels after laser treatment. In the hippocampus, a moderate increase in aspartate accompanied by a significant increase in glycine were observed in the epileptic animal model, and these dropped to near-control values after laser treatment. In addition, a significant increase in cortical AST activity and a significant decrease in ALT activity and glucose content were obtained in the pilocarpinized animals and pilocarpinized rats treated with laser irradiation. In the hippocampus, significant decreases in the activity of AST and ALT and glucose content were recorded in the epileptic animals and in the epileptic animals treated with laser irradiation.

CONCLUSION: Based on the results obtained in this study, it may be suggested that nearinfrared laser irradiation may reverse the neurochemical changes in amino acid neurotransmitters induced by pilocarpine.

PMID: 19025405 [PubMed - indexed for MEDLINE]


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Abstract

BACKGROUND: Oral mucositis (OM) is one of the most frequent complications of chemotherapy for which there is no standard therapy; treatment is mostly conservative. This study was conducted to determine whether low-intensity laser therapy (LLLT) can reduce the duration of chemotherapy-induced OM.

PROCEDURE: A placebo-controlled randomized trial was carried out using LLLT or placebo (sham treatment). Children and adolescents with cancer receiving chemotherapy or hematopoietic stem-cell transplantation between October 2005 and May 2006 were eligible as soon as they developed OM. Patients received intervention for 5 days. The LLLT group was treated with laser GaAlAs, wavelength (lambda): 830 nm (infrared), power: 100 mW, dose: 4 J/cm, and placebo group underwent sham treatment. The grade of OM was clinically assessed by the National Cancer Institute, Common Toxicity Criteria scale.

RESULTS: Twenty-one patients developed OM and were evaluable for analysis; 18 (86%) patients had a diagnosis of leukemia or lymphoma and 3(14%) had solid tumors. The mean age was 8.2 (+/-3.1) years. Nine patients were randomized in the laser group and 12 in the placebo-control group. Once OM was diagnosed, the patients had daily OM grading assessments before laser or sham application and thereafter until complete healing of the lesions. On day 7 after OM diagnosis, 1/9 of patients remained with lesions in laser group and 9/12 of patients in the placebo-control group (P=0.029). In the laser group, the mean of OM duration was 5.8+/-2 days and in the placebo group was 8.9+/-2.4 days (P=0.004).

CONCLUSIONS: Our study has shown evidence that laser therapy in addition to oral care can decrease the duration of chemotherapy-induced OM. Our results confirm the promising results observed in adult cancer patients and should encourage pediatric oncologists to use laser therapy as first-line option in children with chemotherapy-induced OM.

PMID: 19125084 [PubMed - indexed for MEDLINE]


High-power diode laser in the disinfection in depth of the root canal dentin.

de Souza EB, Cai S, Simionato MR, Lage-Marques JL.
Abstract

OBJECTIVE: The objective of this study was to evaluate the disinfection degree of dentine caused by the use of diode laser after biomechanical procedures.

STUDY DESIGN: Thirty teeth were sectioned and roots were autoclaved and incubated for 4 weeks with a suspension of Enterococcus faecalis. The specimens were randomly divided into 3 groups (n = 10): G1, instrumented with rotary files, irrigated with 0.5% sodium hypochlorite and 17% EDTA-T, and then irradiated by 830-nm diode laser at 3 W; G2, the same procedures as G1 but without laser irradiation; and G3, irrigation with saline solution (control). Dentin samples of each third were collected with carbide burs and aliquots were sowed to count viable cells.

RESULTS: The disinfection degree achieved was 100% in G1 and 98.39% in G2, when compared to the control group (G3).

CONCLUSION: Diode laser irradiation provided increased disinfection of the deep radicular dentin in the parameters and samples tested.

PMID: 18585615 [PubMed - indexed for MEDLINE]


Evaluation of low-level laser therapy of osteoblastic cells.

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Abstract

OBJECTIVE: The purpose of the present study was to evaluate the effect of biomodulation on osteoblastic cells using a gallium-aluminium-arsenide diode laser.

BACKGROUND DATA: Low-level laser therapy (LLLT) is a non-pharmacological therapeutic resource to which biological tissues respond well, producing such effects as the acceleration of bone formation and bone repair.

MATERIALS AND METHODS: Osteoblastic cell cultures (OFCOL II) were irradiated with a gallium-aluminium-arsenide diode laser (GaAlAs lambda = 830 nm; 50 mW; 3 J/cm(2); 600-microm-diameter optical fiber) and divided into two groups: group 1--irradiated cells, and group 2--non-irradiated cells.
Irradiation occurred at 24-h intervals for a total of 3 d. After each interval, the cells were marked with Mito Tracker Orange dye to assess the biostimulatory effect on mitochondrial activity and cell proliferation using an MTT assay.

RESULTS: Intense grouping of mitochondria in the perinuclear region was observed at 24 h and 48 h following irradiation. Changes from a filamentous to a granular appearance in mitochondrial morphology and mitochondria distributed throughout the cytoplasm were observed 72 h following proliferation. Such changes led to an in vitro proliferation process, as confirmed by the MTT assay.

CONCLUSION: LLLT has shown itself capable of altering mitochondrial activity and the population of OFCOL II cells.

PMID: 18754721 [PubMed - indexed for MEDLINE]


Infrared laser light further improves bone healing when associated with bone morphogenetic proteins and guided bone regeneration: an in vivo study in a rodent model.

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Abstract

OBJECTIVE: This study assessed histologically the effect of laser photobiomodulation on the repair of surgical defects created in the femurs of Wistar rats treated or not treated with bone morphogenetic proteins (BMPs) and organic bovine bone graft.

BACKGROUND DATA: This paper is part of an ongoing series of works in which biomaterials and/or guided bone regeneration (GBR) are used in association with laser photobiomodulation. Several previous reports from our group have shown that the use of laser photobiomodulation improves the treatment of bone defects.

MATERIALS AND METHODS: Forty-eight adult male Wistar rats were divided into four randomized groups: group 1 (controls, n = 12); group 2 (laser photobiomodulation, n = 12); group 3 (BMPs + organic bovine bone graft + GBR, n = 12); and group 4 (BMPs + organic bovine bone graft + GBR + laser photobiomodulation, n = 12). The irradiated groups received seven irradiations every 48 h, the first immediately after the surgical procedure. Laser photobiomodulation (830 nm, 40 mW, CW, phi approximately 0.6 mm) consisted of a total of 16 J/cm2 per session at four points (4 J/cm2 each) equally spaced around the periphery of the defect. The animals were sacrificed after 15, 21, and 30 d, and the
specimens were routinely embedded in wax and stained with hematoxylin and eosin and Sirius red stains and analyzed under light microscopy.

RESULTS: The results showed histological evidence of increased deposition of collagen fibers (at 15 and 21 d), as well as an increased amount of well-organized bone trabeculi at the end of the experimental period (30 d) in irradiated animals compared to non-irradiated controls.

CONCLUSION: We concluded that the use of laser photobiomodulation in association with BMPs, organic bovine bone grafts, and GBR increases the positive biomodulating effects of laser energy.

PMID: 18341420 [PubMed - indexed for MEDLINE]


Effect of lower-level laser therapy on rabbit tibial fracture.

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Abstract

OBJECTIVE: The purpose of the study was to demonstrate the biological effects of low-level laser therapy (LLLT) on tibial fractures using radiographic, histological, and bone density examinations.

METHODS: Fourteen New Zealand white rabbits with surgically induced mid-tibial osteotomies were included in the study. Seven were assigned to a group receiving LLLT (LLLT-A) and the remaining seven served as a sham-treated control group (LLLT-C). A low-energy laser apparatus with a wavelength of 830 nm, and a sham laser (a similar design without laser diodes) were used for the study. Continuous outflow irradiation with a total energy density of 40 J/cm² and a power level of 200 mW/cm² was directly delivered to the skin for 50 seconds at four points along the tibial fracture site. Treatment commenced immediately postsurgery and continued once daily for 4 weeks.

RESULTS: Radiographic findings revealed no statistically significant fracture callus thickness difference between the LLLT-A and LLLT-C groups (p > 0.05). However, the fractures in the LLLT-A group showed less callus thickness than those in LLLT-C group 3 weeks after treatment. The average tibial volume was 14.5 mL in the LLLT-A group, and 11.25 mL in the LLLT-C group. The average contralateral normal tibial volume was 7.1 mL. Microscopic changes at 4 weeks revealed an average grade of 5.5 and 5.0 for the LLLT-A group and the LLLT-C group, respectively. The bone mineral density (BMD) as ascertained using a grey scale (graded from 0 to 256) showed darker coloration in the LLLT-A group (138) than in the LLLT-C group (125).
CONCLUSION: The study suggests that LLLT may accelerate the process of fracture repair or cause increases in callus volume and BMD, especially in the early stages of absorbing the hematoma and bone remodeling. Further study is necessary to quantify these findings.

PMID: 18158750 [PubMed - indexed for MEDLINE]


Effectiveness of low-level laser therapy in temporomandibular joint disorders: a placebo-controlled study.

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Abstract

OBJECTIVE: Low-level laser therapy (LLLT) treatment for pain caused by temporomandibular joint disorders (TMD) was investigated in a controlled study comparing applied energy density, subgroups of TMD, and duration of disorders.

BACKGROUND DATA: Although LLLT is a physical therapy used in the treatment of musculoskeletal disorders, there is little evidence for its effectiveness in the treatment of TMD.

METHODS: The study group of 61 patients was treated with 10 J/cm(2) or 15 J/cm(2), and the control group of 19 patients was treated with 0.1 J/cm(2). LLLT was performed by a GaAlAs diode laser with output of 400 mW emitting radiation wavelength of 830 nm in 10 sessions. The probe with aperture 0.2 cm(2) was placed over the painful muscle spots in the patients with myofascial pain. In patients with TMD arthralgia the probe was placed behind, in front of, and above the mandibular condyle, and into the meatus acusticus externus. Changes in pain were evaluated by self-administered questionnaire.

RESULTS: Application of 10 J/cm(2) or 15 J/cm(2) was significantly more effective in reducing pain compared to placebo, but there were no significant differences between the energy densities used in the study group and between patients with myofascial pain and temporomandibular joint arthralgia. Results were marked in those with chronic pain.

CONCLUSION: The results suggest that LLLT (application of 10 J/cm(2) and 15 J/cm(2)) can be considered as a useful method for the treatment of TMD-related pain, especially long lasting pain.

PMID: 17803388 [PubMed - indexed for MEDLINE]

Effects of a single near-infrared laser treatment on cutaneous wound healing: biometrical and histological study in rats.

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Abstract

BACKGROUND: Low intensity laser therapy has been recommended to support the cutaneous repair; however, so far studies do not have evaluated the tissue response following a single laser treatment. This study investigated the effect of a single laser irradiation on the healing of full-thickness skin lesions in rats.

METHODS: Forty-eight male rats were randomly divided into three groups. One surgical lesion was created on the back of rats using a punch of 8mm in diameter. One group was not submitted to any treatment after surgery and it was used as control. Two energy doses from an 830-nm near-infrared diode laser were used immediately post-wounding: 1.3 J cm(-2) and 3 J cm(-2). The laser intensity 53 m W cm(-2) was kept for both groups. Biometrical and histological analyses were accomplished at days 3, 7 and 14 post-wounding.

RESULTS: Irradiated lesions presented a more advanced healing process than control group. The dose of 1.3 J cm(-2) leaded to better results. Lesions of the group irradiated with 1.3 J cm(-2) presented faster lesion contraction showing quicker re-epithelization and reformed connective tissue with more organized collagen fibers.

CONCLUSIONS: Low-intensity laser therapy may accelerate cutaneous wound healing in a rat model even if a single laser treatment is performed. This finding might broaden current treatment regimens.

PMID: 17475503 [PubMed - indexed for MEDLINE]

Abstract

BACKGROUND AND OBJECTIVE: We previously reported that low-intensity laser irradiation stimulated bone nodule formation through enhanced cellular proliferation and differentiation. However, the mechanisms of irradiation are unclear. Thus, we attempted to determine the responsibility of insulin-like growth factor (IGF)-I for the action observed.

STUDY DESIGN/MATERIALS AND METHODS: Osteoblast-like cells were isolated from fetal rat calvariae and cultured with rat recombinant (r) IGF-I, IGF-I-antibody (Ab), and/or the cells were irradiated once (3.75 J/cm(2)) with a low-intensity Ga-Al-As laser (830 nm). The number and area of bone nodules formed in the culture were analyzed, and IGF-I expression was also examined.

RESULTS: Treatment with rIGF-I significantly stimulated the number and area of bone nodules. This stimulatory effect was quite similar to those by laser irradiation, and this stimulation was abrogated dose-dependently by treatment with IGF-I-Ab. Moreover, laser irradiation significantly increased IGF-I protein and gene expression.

CONCLUSION: The stimulatory effect of bone nodule formation by low-intensity laser irradiation will be at least partly mediated by IGF-I expression.

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PMID: 17659585 [PubMed - indexed for MEDLINE]


Anti-Inflammatory Effect of Low-Level Laser and Light-Emitting Diode in Zymosan-Induced Arthritis

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Abstract Objective: The aim of this work was to investigate the effect of low-level laser therapy (LLLT) and light-emitting diode (LED) on formation of edema, increase in vascular permeability, and articular joint hyperalgesia in zymosan-induced arthritis.

Background Data: It has been suggested that low-level laser and LED irradiation can modulate inflammatory processes.

Material and Methods: Arthritis was induced in male Wistar rats (250-280 g) by intra-articular injection of zymosan (1 mg in 50 μL of a sterile saline solution) into one rear knee joint. Animals were irradiated immediately, 1 h, and 2 h after zymosan administration with a semiconductor laser (685 nm and 830 nm) and an LED at 628 nm, with the same dose (2.5 J/cm(2)) for laser and LED. In the positive control group,
animals were injected with the anti-inflammatory drug dexamethasone 1 h prior to the zymosan administration. Edema was measured by the wet/dry weight difference of the articular tissue, the increase in vascular permeability was assessed by the extravasation of Evans blue dye, and joint hyperalgesia was measured using the rat knee-joint articular incapacitation test.

**Results:** Irradiation with 685 nm and 830 nm laser wavelengths significantly inhibited edema formation, vascular permeability, and hyperalgesia. Laser irradiation, averaged over the two wavelengths, reduced the vascular permeability by 24%, edema formation by 23%, and articular incapacitation by 59%. Treatment with LED (628 nm), with the same fluence as the laser, had no effect in zymosan-induced arthritis.

**Conclusion:** LLLT reduces inflammatory signs more effectively than LED irradiation with similar irradiation times (100 sec), average outputs (20 mW), and energy doses (2 J) in an animal model of zymosan-induced arthritis. The anti-inflammatory effects of LLLT appear to be a class effect, which is not wavelength specific in the red and infrared parts of the optical spectrum.

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**Noninvasive laser neurolysis in carpal tunnel syndrome**

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The peripheral nervous system is photosensitive, the scientific rationale for this study which determines the efficacy and safety to laser light exposure in 30 cases with CTS. Nine joules of energy over 5 points (7-15 treatments) reversed CTS in 77% of cases with three-fold normalization of CMAP. A photobiologic response was seen in 80%. This unique and novel approach is cost-effective and has a role in future management of CTS.

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**Treatment of repetitive use carpal tunnel syndrome**

Smith CF, Vangsness CT, Anderson T & Good W (1995)


A randomized, double-blind study was initiated in 1990 to evaluate an eight-point conservative treatment program in carpal tunnel syndrome. 160 patients were delineated with symptoms of carpal tunnel syndrome and these patients were then divided into two groups. Both groups were subjected to an ergonomically correct eight-point work modification program. A counterfeit LLLT unit was used in Group A, while an actual LLLT unit was used in Group B. Groups A and B were statistically significantly different in terms of return to work, conduction study improvement, and certain range of motion.

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**The short-term effects of low-level lasers as adjunct therapy in the treatment of periodontal inflammation**
OBJECTIVES: The aim of this split-mouth, double-blind controlled clinical trial was to study the effects of irradiation with low-level lasers as an adjunctive treatment of inflamed gingival tissue.

MATERIALS AND METHODS: 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.

RESULTS: 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.

CONCLUSION: Additional treatment with low-level lasers reduced periodontal gingival inflammation.


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OBJECTIVE: The purpose of our report is to present the effect of low-level laser therapy on Candida albicans growth and palatal inflammation in two patients with denture stomatitis. BACKGROUND DATA: The most common oral mucosal disorder in denture wearers is denture stomatitis, a condition that is usually associated with the presence of the yeast Candida albicans. Different treatment methods have been suggested to treat this symptom, none of which is proven to be absolutely effective.

METHODS: Two denture-wearing patients, both with palatal inflammation diagnosed as Newton type II denture stomatitis were treated with low-power semiconductor diode laser (BTL-2000, Prague, Czech Republic) at different wavelengths (685 and 830 nm) for 5 d consecutively. In both patients, palatal mucosa and acrylic denture base were irradiated in noncontact mode (probe distance of 0.5 cm from irradiated area) with different exposure times-5 min (830 nm, 3.0 J/cm2, 60 mW) and 10 min (685 nm, 3.0 J/cm2, 30 mW). The effect of laser light on fungal growth in vivo was evaluated after the final treatment using the swab method and semiquantitative estimation of Candida albicans colonies growth on agar plates. The severity of inflammation was evaluated using clinical criteria.

RESULTS: After lowlevel laser treatment, the reduction of yeast colonies on the agar plates was observed and palatal inflammation was diminished.

CONCLUSION: LLLT is effective in the treatment of denture stomatitis. Further placebo controlled studies are in progress.
Efficacy of low power laser therapy in fibromyalgia: a single-blind, placebo-controlled trial

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Low energy lasers are widely used to treat a variety of musculoskeletal conditions including fibromyalgia, despite the lack of scientific evidence to support its efficacy. A randomised, single-blind, placebo-controlled study was conducted to evaluate the efficacy of low-energy laser therapy in 40 female patients with fibromyalgia. Patients with fibromyalgia were randomly allocated to active (Ga-As) laser or placebo laser treatment daily for two weeks except weekends. Both the laser and placebo laser groups were evaluated for the improvement in pain, number of tender points, skinfold tenderness, stiffness, sleep disturbance, fatigue, and muscular spasm. In both groups, significant improvements were achieved in all parameters (p<0.05) except sleep disturbance, fatigue and skinfold tenderness in the placebo laser group (p>0.05). It was found that there was no significant difference between the two groups with respect to all parameters before therapy whereas a significant difference was observed in parameters as pain, muscle spasm, morning stiffness and tender point numbers in favour of laser group after therapy (p<0.05). None of the participants reported any side effects. Our study suggests that laser therapy is effective on pain, muscle spasm, morning stiffness, and total tender point number in fibromyalgia and suggests that this therapy method is a safe and effective way of treatment in the cases with fibromyalgia.

Laser-Accelerated INFLAMMATION/PAIN REDUCTION AND HEALING

by Richard Martin, BS, CLT

Practical Pain Management, Nov/Dec 2003

Injured cells and tissues have greater affinity for LLLT than healthy cells and tissues. LLLT in the treatment of inflammation, pain and healing is a highly integrated process, but the author separates those processes categorically for identification.

Acute Inflammation Reduction (flowchart provided in the original article) – After injury, tissues initiate a series of biological responses and cellular membrane reactions which manifest in a combination of edema, inflammation, pain and functional debility. LLLT mediates by: (1) Stabilizing cellular membranes; (2) Enhancing molecule ATP production and synthesis; (3) Stimulating vasodilation via increased Histamine, Nitric Oxide and Serotonin; (4) Accelerating leukocytic activity; (5) Increasing Prostaglandin synthesis; (6) Reducing Interleukin-1; (7) Enhancing lymphocyte response; (8) Increasing angiogenesis; (9) Modulation temperature; (10) Enhancing superoxide dismutase levels; and (11) Decreasing C-reactive protein and neopterin levels.
Pain Reduction (flowchart provided in the original article) – Evidence justifies a conclusion that LLLT reduces pain by combination of processes: (1) Increase in b-Endorphins; (2) Blocked depolarization of C-fiber afferent nerves; (3) Increased nitric oxide production; (4) Increased nerve cell action potential; (5) Axonal sprouting and nerve cell regeneration; (6) Decreased Bradykinin levels; (7) Increased release of acetylcholine; and (8) Ion channel normalization.

Tissue Healing – LLLT enhances wound healing by: (1) Enhanced leukocyte infiltration; (2) Increased macrophage activity; (3) Increased neovascularization; (4) Increased fibroblast proliferation; (5) Keratinocyte proliferation; (6) Early epithelialization; (7) Growth factor increases; (8) Enhanced cell proliferation and differentiation, and (9) Greater healed wound tensile strength.

Low-level laser therapy for symptoms induced by breast cancer treatments.

Sub-category: Palliative/Supportive Therapy

Category: Local/Regional Therapy

Meeting: 2010 Breast Cancer Symposium

Session Type and Session Title: General Poster Session B

Abstract No: 112

Author(s): K. Yamada, H. Kaise, A. Ogata, N. Ueda, M. Oda, S. Komatsu, F. Kimura, M. Hosonaga, K. Miyahara, N. Kohno; Department of Breast Oncology, Tokyo Medical University Hospital, Tokyo, Japan

Abstract:
**Background:** The progresses of multidisciplinary therapy have led to the improvement of prognosis for cancer patients. Many kinds of systemic chemotherapies and endocrine therapies are performed for breast cancer patients. However it is a fact that these cancer treatments induce peripheral neuropathy (PN), hot flash (HF) and joint pain (JP) in many patients. We generally try to control these symptoms, PH due to taxanes (especially paclitaxel), and HF due to LH-RH, and JP due to aromatase inhibitors by medication. However many patients are still anxious about these symptoms. We investigated the efficacy and safety of diode laser therapy for breast cancer women who have intractable PN, HF and JP induced by systemic chemotherapies and endocrine therapies. **Methods:** After approval of the ethics committee of Tokyo Medical University Hospital, 34 women, median age 50 years, were treated for PN, HF and JP by an 830 nm GaAlAs Diode laser therapy system from November 2007. The effect of this treatment was evaluated using the 10-point scale Brief Pain Index (BPI) questionnaire before and after irradiation. **Results:** After laser irradiation, the BPI score decreased an average of 4 points in half of the patients suffering from PN, and reached 2 points or less in all patients with JP. No cases had increases in BPI or adverse events after laser therapy. **Conclusions:** The results of this study suggest that low-level laser therapy (LLLT) for peripheral neuropathy, hot flash and joint pain is effective and safe. The mechanism, however, is still unknown. In this article we introduce the efficacy and safety of LLLT for symptoms induced by breast cancer treatments.

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**LLLT with trigger points technique: clinical study on 243 patients**

Simunovic Z


Among the various methods of application techniques in LLLT (He-Ne 632.8 nm visible red or infrared 820-830 nm continuous wave and 904 nm pulsed emission) there are very promising “trigger points”, i.e., myofascial zones of particular sensibility and of highest projection of focal pain points, due to ischemic conditions. The effect of LLT and the results obtained after clinical treatment of >200 patients (headaches and facial pain, skeletomuscular ailments, myogenic neck pain, shoulder and arm pain, epicondylitis, tenosynovitis, low back and radicular pain, Achilles tendonitis) to whom the “trigger points” were applied were better than expected. It was also observed that rigidity decreases, mobility is restored (functional recovery), and spontaneous or induced pain decreases or even disappears, by movement. LLLT improves local microcirculation and it can also improve oxygen supply to hypoxic cells in the treated areas and can remove collected waste products. Normalization of the microcirculation interrupts the “circulus vitiosus” of the origin of the pain and its development (Melzak: muscular tension→pain→increased tension→increased pain, etc.). Results measured according to VAS/VRS/PTM: in acute pain, diminished >70%; in chronic pain >60%. Clinical effectiveness depends on correctly applied energy dose over/under dosage produces opposite, negative effects on cellular metabolism. No negative effects were noted and the use of analgesic drugs could be reduced or completely excluded. LLLT may be used as monotherapy or as a supplement to other therapeutic procedures for pain treatment.
Effect of low level laser therapy (830 nm) with different therapy regimes on the process of tissue repair in partial lesion calcaneous tendon

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BACKGROUND AND OBJECTIVE: Calcaneous tendon is one of the most damaged tendons, and its healing may last from weeks to months to be completed. In the search after speeding tendon repair, low intensity laser therapy has shown favorable effect. To assess the effect of low intensity laser therapy on the process of tissue repair in calcaneous tendon after undergoing a partial lesion.

STUDY DESIGN/MATERIALS AND METHODS: Experimentally controlled randomized single blind study. Sixty male rats were used randomly and were assigned to five groups containing 12 animals each one; 42 out of 60 underwent lesion caused by dropping a 186 g weight over their Achilles tendon from a 20 cm height. In Group 1 (standard control), animals did not suffer the lesion nor underwent laser therapy; in Group 2 (control), animals suffered the lesion but did not undergo laser therapy; in Groups 3, 4, and 5, animals suffered lesion and underwent laser therapy for 3, 5, and 7 days, respectively. Animals which suffered lesion were sacrificed on the 8th day after the lesion and assessed by polarization microscopy to analyze the degree of collagen fibers organization.

RESULTS: Both experimental and standard control Groups presented significant values when compared with the control Groups, and there was no significant difference when Groups 1 and 4 were compared; the same occurred between Groups 3 and 5.

CONCLUSION: Low intensity laser therapy was effective in the improvement of collagen fibers organization of the calcaneous tendon after undergoing a partial lesion.

Efficacy of low-level laser therapy in the management of neck pain: a systematic review and meta-analysis of randomised placebo or active-treatment controlled trials

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

METHODS: We searched computerised databases comparing efficacy of LLLT using any wavelength with placebo or with active control in acute or chronic neck pain. Effect size for the primary outcome, pain intensity, was defined as a pooled estimate of mean difference in change in mm on 100 mm visual analogue scale.
FINDINGS: We identified 16 randomised controlled trials including a total of 820 patients. In acute neck pain, results of two trials showed a relative risk (RR) of 1.69 (95% CI 1.22-2.33) for pain improvement of LLLT versus placebo. Five trials of chronic neck pain reporting categorical data showed an RR for pain improvement of 4.05 (2.74-5.98) of LLLT. Patients in 11 trials reporting changes in visual analogue scale had pain intensity reduced by 19.86 mm (10.04-29.68). Seven trials provided follow-up data for 1-22 weeks after completion of treatment, with short-term pain relief persisting in the medium term with a reduction of 22.07 mm (17.42-26.72). Side-effects from LLLT were mild and not different from those of placebo.

INTERPRETATION: We show that LLLT reduces pain immediately after treatment in acute neck pain and up to 22 weeks after completion of treatment in patients with chronic neck pain. FUNDING: None.

Systematic review of the literature of low-level laser therapy (LLLT) in the management of neck pain

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BACKGROUND AND OBJECTIVES: Low-level laser therapy (LLLT) is widely used in the treatment of musculoskeletal pain. However, there is controversy over its true efficacy. We aimed to determine the efficacy of LLLT in the treatment of neck pain through systematically reviewing the literature.

STUDY DESIGN/MATERIALS AND METHODS: A search of computerized bibliographic databases covering medicine, physiotherapy, allied health, complementary medicine, and biological sciences was undertaken from date of inception until February 2004 for randomized controlled trials of LLLT for neck pain. A comprehensive list of search terms was applied and explicit inclusion criteria were developed a priori. Twenty studies were identified, five of which met the inclusion criteria.

RESULTS: Significant positive effects were reported in four of five trials in which infrared wavelengths (lambda = 780, 810-830, 904, 1,064 nm) were used. Heterogeneity in outcome measures, results reporting, doses, and laser parameters precluded formal meta-analysis. Effect sizes could be calculated for only two of the studies.

CONCLUSIONS: This review provides limited evidence from one RCT for the use of infrared laser for the treatment of acute neck pain (n = 71) and chronic neck pain from four RCTs (n = 202). Larger studies are required to confirm the positive findings and determine the most effective laser parameters, sites and modes of application. © 2005 Wiley-Liss, Inc.

THE USE OF LASER THERAPY AND ADDITIONAL THERAPEUTIC MODALITIES AFTER ARTHROSCOPY OF THE KNEE AT ALPINE SKI TEAM
We review different kinds of injuries in the alpine ski sport concentrate on the injuries of the ligamentar part of the knees and meniscs in slovenian ski team. After the description of the injuries is a detailed presentation of the rehabilitational procedures from the first day of the injury till the return in to the competition arena. We explain the modalities of the rehabilitational procedures and their influence in the tissues, their main and side effects. Our main attention is focused on the use of the biostimulative lasers of higher power – 1,2 W and wavelength of 830 nm and their influence speedy recovery of the patients and their success in later competitions.

Effectiveness of low-level laser therapy in temporomandibular joint disorders: a placebo-controlled study

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OBJECTIVE: Low-level laser therapy (LLLT) treatment for pain caused by temporomandibular joint disorders (TMD) was investigated in a controlled study comparing applied energy density, subgroups of TMD, and duration of disorders.

BACKGROUND DATA: Although LLLT is a physical therapy used in the treatment of musculoskeletal disorders, there is little evidence for its effectiveness in the treatment of TMD. METHODS: The study group of 61 patients was treated with 10 J/cm(2) or 15 J/cm(2), and the control group of 19 patients was treated with 0.1 J/cm(2). LLLT was performed by a GaAlAs diode laser with output of 400 mW emitting radiation wavelength of 830 nm in 10 sessions. The probe with aperture 0.2 cm(2) was placed over the painful muscle spots in the patients with myofascial pain. In patients with TMD arthralgia the probe was placed behind, in front of, and above the mandibular condyle, and into the meatus acusticus externus. Changes in pain were evaluated by self-administered questionnaire.

RESULTS: Application of 10 J/cm(2) or 15 J/cm(2) was significantly more effective in reducing pain compared to placebo, but there were no significant differences between the energy densities used in the study group and between patients with myofascial pain and temporomandibular joint arthralgia. Results were marked in those with chronic pain. CONCLUSION: The results suggest that LLLT (application of 10 J/cm(2) and 15 J/cm(2)) can be considered as a useful method for the treatment of TMD-related pain, especially long lasting pain.

Effect of low-level laser therapy on inflammatory reactions during wound healing: comparison with meloxicam

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OBJECTIVE: This study evaluated the action of low-level laser therapy (LLLT) on the modulation of inflammatory reactions during wound healing in comparison with meloxicam. BACKGROUND DATA: LLLT has been recommended for the postoperative period because of its ability to speed healing of wounds. However, data in the literature are in disagreement about its anti-inflammatory action. METHODS: Standardized circular wounds were made on the backs of 64 Wistar rats. The animals were divided into four groups according to the selected postoperative therapy: group A-control; group B-administration of meloxicam; and groups C and D-irradiation with red (lambda = 685 nm) and infrared (lambda = 830 nm) laser energy, respectively. The animals were killed at 12, 36, and 72 h and 7 days after the procedure. RESULTS: Microscopic analysis revealed significant vascular activation of irradiated sites in the first 36 h. Only group B showed decreases in the intensity of polymorphonuclear infiltrates and edema. Group D showed a higher degree of organization and maturation of collagen fibers than the other groups at 72 h. The animals in group C showed the best healing pattern at 7 days. The anti-inflammatory action of meloxicam was confirmed by the results obtained in this research. The quantification of interleukin-1beta (IL-1beta) mRNA by real-time polymerase chain reaction (PCR) did not show any reduction in the inflammatory process in the irradiated groups when compared to the other groups. CONCLUSIONS: LLLT improves the quality of histologic repair and is useful during wound healing. However, with the methods used in this study the laser energy did not minimize tissue inflammatory reactions.

Low-Level Laser Therapy Facilitates Superficial Wound Healing in Humans: A Triple-Blind, Sham-Controlled Study

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OBJECTIVE: Low-level laser therapy (LLLT) has been promoted for its beneficial effects on tissue healing and pain relief. However, according to the results of in vivo studies, the effectiveness of this modality varies. Our purpose was to assess the putative effects of LLLT on healing using an experimental wound model. DESIGN AND SETTING: We 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: Twenty-two healthy subjects (age = 21 +/- 1 years, height = 175.6 +/- 9.8 cm, mass = 76.2 +/- 14.2 kg). MEASUREMENTS: Two standardized 1.27-cm(2) abrasions were induced on the anterior forearm. After wound cleaning, standardized digital photos were recorded. Each subject then received LLLT (8 J/cm(2); 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. RESULTS: A group x wound x 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 (P < .05). No group x wound x time differences were detected for chromatic red or luminance.
CONCLUSIONS: 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.

Dose and wavelength of laser light have influence on the repair of cutaneous wounds

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OBJECTIVE: The objective of the present study was to compare histologically the effect of GaAlAs (lambda 830 nm, phi approximately 2 mm(2), 35 mW) and InGaAlP (lambda 685 nm, phi approximately 2 mm(2), 35 mW) lasers, alone or in association with doses of 20 or 50 J/cm(2) on cutaneous wounds in the dorsum of the Wistar rat. Background Data: The healing time of surgical wounds is of extreme importance and it is usually associated with a post-operative period free of infection and with less pain and inflammation.

MATERIALS AND METHODS: Sixty Wistar rats were divided into seven groups: Group I – control (non-irradiated); Group II – lambda 685 nm, 20 J/cm(2); Group III – lambda 830 nm, 20 J/cm(2); Group IV – lambda 685 nm and lambda 830 nm, 20 J/cm(2); Group V – lambda 685 nm, 50 J/cm(2)); Group VI – lambda 830 nm, 50 J/cm(2); and Group VII – lambda 685 nm and 830 nm, 50 J/cm(2). The animals were sacrificed 3, 5, and 7 days after surgery.

RESULTS: Light microscopic analysis using H&E and Picrosírius stains showed that, at the end of the experimental period, irradiated subjects showed increased collagen production and organization when compared to non-irradiated controls. Inflammation was still present in all groups at this time.

CONCLUSION: Group IV (lambda 830 nm and lambda 685 nm, 20 J/cm(2)) presented better results at the end of the experimental period. It is concluded that low-level light therapy (LLLT) can have a positive biomodulatory effect on the repair of cutaneous wounds.

Wound healing of animal and human body sport and traffic accident injuries using low-level therapy treatment; a randomized clinical study of seventy-four patients with control group

Simunovic Z, Ivankovich AD, Depolo A.


The main objective was to assess the efficacy of low level laser therapy (LLLT) on wound healing in rabbits and humans. The initial research was a randomized controlled animal study, to evaluate the effects of laser irradiation on the healing of surgical wounds in rabbits. The application of LLLT on the human body is analogous to those of similar physiologic structure in animal tissue. This study was continued on humans, 74 patients with injuries to the following anatomic locations: ankle and knee, bilaterally, Achilles tendon; epicondylitis; shoulder; wrist; interphalangeal joints of hands, unilaterally. All patients
has surgery prior to LLLT. Two laser devices were used: infrared diode laser (GaAlAs) 830 nm continuous wave for treatment of trigger points (TPs) and HeNe 632.8 nm combined with diode laser 904 nm pulsed wave for scanning procedure. Both were applied as monotherapy during the study. Results were observed and measured according to these clinical parameters: redness, heat, pain, swelling and loss of function, and finally submitted to statistical analysis via chi2 test. Results: After comparing the healing process between two groups of patients, the following results were noted: wound healing was significantly accelerated (25%-35%) in the patients treated with LLLT. Pain relief and functional recovery of those treated with LLLT were significantly improved compared to untreated patients. In addition to accelerated wound healing, LLLT for postoperative sport-and traffic-related injuries avoids side effects of drugs, accelerates functional recovery, allows earlier return to work, training and sport competition.

_Laser and Sports Medicine in Plastic and Reconstructive Surgery_

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Flap survival with diode laser therapy: Skin flap or graft surgery are major procedures in plastic and reconstructive surgery. Skin flap necrosis has been a problem. The author reported on the enhanced blood flow following the low reactive laser therapy in skin flaps. The 830 nm diode laser (20 – 60 mw) irradiated flaps showed a greater perfusion, a greater number of blood vessels, and a higher rate of survival areas than the control flaps in the rat models and clinical cases. Improvement of wound healing with diode laser therapy: Diode laser therapy was indicated for traumatic skin ulcers from sport activities and traffic accidents which were resistant to conservative treatment. The diode laser system with a wavelength of 830 nm and output power of 150or 1000mw in continuous wave was applied with the non-contact method to the area on the wound for one minute once a day every day during the treatment period. The diode laser was used successfully for the rapid enhanced healing of traumatic skin ulcers.

Discussion: Most injured patients hope to avoid a surgical operation, trying instead conservative treatments. The diode laser therapy improved the flap circulation and wound healing of severe skin ulcers. This therapy has been applied for temporomandibular joint pain and favorable results were obtained. The diode laser therapy proved to be particularly effective for pain attenuation. The diode laser therapy offers an additional convenient, safe, and side-effect free method. On the other hand, the Q-switched Nd:YAG laser system consistently achieved good results concomitant with easy and safe operation, with lightening of the target lesions.

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Laakso et al

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PLASMA ACTH AND §-ENDORPHIN LEVELS IN RESPONSE TO LOW LEVEL LASER THERAPY (LLLT) FOR MYOFASCIAL TRIGGER POINTS

ABSTRACT

The mechanism by which laser phototherapy (Low Level Laser Therapy - LLLT) induces analgesia in the treatment of chronic pain is not understood. To investigate a possible role for opioids in this treatment, a double-blind, placebo-controlled study was designed to compare the effect of two dosages (1 J/cm² and 5 J/cm²) of an infrared (IR) laser (820 nm), a visible red laser (670 nm) and a near-monochromatic light emitting device (660 nm, 30 nm bandwidth) on trigger points. Fifty-six consenting subjects with chronic pain conditions exhibiting myofascial trigger points in the neck and upper trunk region underwent six experimental sessions over a two week period. Blood samples were withdrawn before and after treatment on three of six appointments. Plasma was assayed for §-ENDORPHIN (radioimmunoassay, RIA) and adrenocorticotropin hormone (ACTH - two-site immunoradiometric assay, IRMA) to assess opioid response. ACTH was shown to have a cumulative response to treatment with 1 J/cm² infrared laser (p < 0.001) and 5 J/cm² red laser (p < 0.05) responding significantly. §-endorphin was noted to be significantly elevated between days one and four (p < 0.05) in subjects who received IR (5 J/cm²) laser. Results indicated that the analgesic response to phototherapy may be mediated through hormonal/opioid mechanisms, and that responses to LLLT are dose and wavelength dependent. A mechanism by which peripheral stimulation using LLLT may elicit activity in the central pathways is proposed.

EFFECT OF POWER OUTPUT AND ENERGY DENSITY

To understand the results of this study further, one must understand that LLLT conforms to the Arndt-Schultz principle which implies that very low doses of laser have no effect on cells, low doses stimulate cell processes, high doses inhibit cell processes, and that even higher doses result in photodynamic damage of cells. The results of this study appear to confirm this notion. That is, there may not have been sufficient photonic energy to stimulate responses using 660 nm near-monochromatic red light or low dose 670 nm (red) laser. This may explain why the Pearson correlation coefficient between ACTH and §-endorphin levels for near-monochromatic red light was less than half that observed for the remaining treatment groups (Table 3). Power output may have been the critical factor in this study and future studies should control for this.

CONCLUSIONS

This study has confirmed that responses to LLLT are dose, power output and wavelength-dependent. The fact that low dose (1 J/cm²) IR laser (820 nm) and high dose (5 J/cm²) red laser (670 nm) resulted in a cumulative pre-treatment increase in ACTH and high dose (5 J/cm²) IR laser resulted in increases in plasma §-endorphin levels over the duration of the study suggests that localised, peripheral phototherapy of trigger points can induce cumulative activation of central hormonal/opioid pathways capable of regulating immune function. This was likely to have occurred through a link between mast cell degranulation, or stimulation of cytokine-mediated CRH release by altering macrophage responsiveness. As high dose (5 J/cm²) LLLT resulted in potentiation of overall levels of §-endorphin and ACTH, it is suggested that the therapeutic window of doses for LLLT treatment of trigger points could be extended to include 5 J/cm². This would need to be validated by conducting adjunctive studies on subjective pain responses. It is acknowledged that power density may have resulted in the fact that neither low dose nor high dose near-monochromatic red light (660 nm) was found to be capable of eliciting significant changes.
in blood biochemistry. The suggestion that the laser is a necessary requirement for phototherapy of trigger points remains to be confirmed.


**Effect of low power laser treatment on a traumatized disc in a rat model.**

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**Abstract**

This study investigated the effects of low power laser on the healing process of a traumatized disc in an animal model. The experimental design consisted of 14 rats divided into the following three groups: Animals in group I (n = 5) served as controls with no surgery. Animals in group II (n = 5), the sham group, received a surgically created defect in the disc at L4/L5 level and received no other treatment. Animals in the third group (n = 4) received a similar defect to L4/L5 in similar fashion as described for animals in the sham group (group II) with the exception that they received laser of 830 nm wavelength treatment or irradiation for a period of 4 weeks. The animals were euthanized at 30 days post-implantation using overdose of isoflurane. The discs were then harvested in addition to the vital organs, the reproductive organs, and sample of the adjacent skeletal muscles. The hard and soft tissues were evaluated histopathologically by following laboratory standard techniques. The results of this study indicated that the discs of the laser treated animals healed in a greater magnitude than the sham group. Image analysis revealed that there was more disc formation in the laser irradiated animals than the sham. In conclusion, data obtained from this study demonstrated that laser irradiation delivered on traumatized discs resulted in a remarkable increase in discs regeneration and healing following trauma.

PMID: 19141889 [PubMed - in process]


**Effect of 830 nm low-level laser therapy applied before high-intensity exercises on skeletal muscle recovery in athletes.**
Abstract

Our aim was to investigate the immediate effects of bilateral, 830 nm, low-level laser therapy (LLLT) on high-intensity exercise and biochemical markers of skeletal muscle recovery, in a randomised, double-blind, placebo-controlled, crossover trial set in a sports physiotherapy clinic. Twenty male athletes (nine professional volleyball players and eleven adolescent soccer players) participated. Active LLLT (830 nm wavelength, 100 mW, spot size 0.0028 cm(2), 3-4 J per point) or an identical placebo LLLT was delivered to five points in the rectus femoris muscle (bilaterally). The main outcome measures were the work performed in the Wingate test: 30 s of maximum cycling with a load of 7.5% of body weight, and the measurement of blood lactate (BL) and creatine kinase (CK) levels before and after exercise. There was no significant difference in the work performed during the Wingate test (P > 0.05) between subjects given active LLLT and those given placebo LLLT. For volleyball athletes, the change in CK levels from before to after the exercise test was significantly lower (P = 0.0133) for those given active LLLT (2.52 U l(-1) +/- 7.04 U l(-1)) than for those given placebo LLLT (28.49 U l(-1) +/- 22.62 U l(-1)). For the soccer athletes, the change in blood lactate levels from before exercise to 15 min after exercise was significantly lower (P < 0.01) in the group subjected to active LLLT (8.55 mmol l(-1) +/- 2.14 mmol l(-1)) than in the group subjected to placebo LLLT (10.52 mmol l(-1) +/- 1.82 mmol l(-1)). LLLT irradiation before the Wingate test seemed to inhibit an expected post-exercise increase in CK level and to accelerate post-exercise lactate removal without affecting test performance. These findings suggest that LLLT may be of benefit in accelerating post-exercise recovery.

PMID: 19057981 [PubMed - indexed for MEDLINE]
Paper Abstract

An experimental procedure of antitumoral interstitial diode laser hyperthermia was achieved in a series of 30 Swiss nu/nu mice (10 weeks old, 25 g weight). The tumor model was a subcutaneous HT29 colonic carcinoma. The diode laser (830 nm) was applied through a 300 micrometers optic fiber implanted in the tumor and delivered at different powers as follow: group 1 -- 0.2 W (n equals 5); group 2 -- 0.5 W (n equals 4); group 3 -- 0.8 W (n equals 4); group 4 -- 1.0 W (n equals 4); group 5 -- 1.2 W (n equals 4); group 6 -- 1.5 W (n equals 4); group 7 -- 1.8 W (n equals 5). The exposure time was 900 sec (360 to 1,620 J). According to the different laser applications the temperature range was 48.2 degree(s)C to 73.7 degree(s)C in the center of the tumor and 42.0 degree(s)C to 63.5 degree(s)C in its peripheral part. The tumor was removed 24 h after laser treatment. The largest necrosis diameter evaluated by macroscopic and histological sections were 8, 11, 13.25, 17.65, 18, 18.25 and 18.5 mm in the group 1, 2, 3, 4, 5, 6, 7, respectively. In the groups 6 and 7 (1.5 and 1.8 W) all animals died after treatment, the death being explained by extensive hyperthermia. Our results suggest that 1.0 W/900 sec might be the most effective condition for treating this tumor model in Swiss nu/nu mice.

Infrared laser photobiomodulation (lambda 830 nm) on bone tissue around dental implants: a Raman spectroscopy and scanning electronic microscopy study in rabbits.
Source

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Abstract

OBJECTIVE:

The aim of this study was to assess, through Raman spectroscopy, the incorporation of calcium hydroxyapatite (CHA; approximately 960 cm\(^{-1}\)), and scanning electron microscopy (SEM), the bone quality on the healing bone around dental implants after laser photobiomodulation (lambda830 nm).

BACKGROUND DATA:

Laser photobiomodulation has been successfully used to improve bone quality around dental implants, allowing early wearing of prostheses.

METHODS:

Fourteen rabbits received a titanium implant on the tibia; eight of them were irradiated with lambda830 nm laser (seven sessions at 48-h intervals, 21.5 J/cm\(^2\) per point, 10 mW, phi approximately 0.0028 cm\(^2\), 86 J per session), and six acted as control. The animals were sacrificed 15, 30, and 45 days after surgery. Specimens were routinely prepared for Raman spectroscopy and SEM. Eight readings were taken on the bone around the implant.

RESULTS:

The results showed significant differences on the concentration of CHA on irradiated and control specimens at both 30 and 45 days after surgery (p < 0.001).

CONCLUSION:

It is concluded that infrared laser photobiomodulation does improve bone healing, and this may be safely assessed by Raman spectroscopy or SEM.

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17508844

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Ga-Al-As laser irradiation inhibits neuronal activity associated with inflammation.

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Source

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Abstract

A Ga-Al-As diode system that produces low-energy red light (830 nm, 40 mW) has been used for the treatment of many kinds of pain. The mechanism of action of this new laser irradiation for analgesia was studied in anesthetized rats. The effect of laser irradiation of the saphenous nerve was studied by recording neuronal activity at the L4 dorsal root filaments after the injection of a chemical irritant, turpentine. Laser irradiation inhibited both the asynchronous firing by that was induced by turpentine and increased part of the slow components of the action potentials. Thus, the laser irradiation selectively inhibited nociceptive signals at peripheral nerves.

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7863838

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