Arch Endocrinol Metab. 2016 Oct;60(5):457-464. doi: 10.1590/2359-3997000000190. Epub 2016 Aug 25.

Low-level laser therapy associated to a resistance training protocol on bone tissue in diabetic rats.

Patrocínio-Silva TL[1], Souza AM[2], Goulart RL[2], Pegorari CF[2], Oliveira JR[2], Fernandes KR[2], Magri AM[2], Pereira RM[3], Ribeiro DA[2], Nagaoka MR[2], Rennó AC[2].

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Abstract

OBJECTIVE:

The present study aimed to evaluate the in vivo response of a resistance training and low-level laser therapy (LLLT) on tibias and femurs of rats with diabetes mellitus (DM).

MATERIALS AND METHODS:

Forty male Wistar rats were randomly distributed into four experimental groups: control group (CG), diabetic group (DG), diabetic trained group (TG) and diabetic trained and laser irradiated group (TLG). DM was induced by streptozotocin (STZ) and after two weeks laser and resistance training started, performed for 24 sessions, during eight weeks. At the end of the experiment, animals were euthanized and tibias and femurs were removed for analysis. Histological, histomorphometrical, immunohistochemistry and mechanical analyses were performed.

RESULTS:

Trained groups, with or without laser irradiation, showed increased cortical area, bone density and biomechanical properties. The immunohistochemical analysis revealed that TG and TLG demonstrated an increased RUNX2 expression. RANK-L immunoexpression was similar for all experimental groups.

CONCLUSION:

In conclusion, it can be suggested that the resistance exercise program stimulated bone metabolism, culminating in increased cortical tibial area, bone mineral content, bone mineral density and biomechanical properties. Furthermore, the association of physical exercises and LLLT produced higher values for bone mineral content and stiffness. Consequently, these data highlight the potential of physical exercise in the management of bone loss due to DM and the possible extra osteogenic stimulus offered by lasertherapy. Further long-term studies should be carried out to provide additional information.

Lasers Med Sci. 2014 Jul;29(4):1357-64. doi: 10.1007/s10103-013-1418-y. Epub 2013 Aug 29.

The effects of low-level laser irradiation on bone tissue in diabetic rats.

Patrocínio-Silva TL[1], de Souza AM, Goulart RL, Pegorari CF, Oliveira JR, Fernandes K, Magri A, Pereira RM, Araki DR, Nagaoka MR, Parizotto NA, Rennó AC.

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Abstract

Diabetes mellitus (DM) leads to a decrease in bone mass and increase the risk of osteoporosis and in this context, many treatments have shown to accelerate bone metabolism. It seems that low-level laser therapy (LLLT) is able of stimulating osteoblast activity and produced increased biomechanical properties. However, its effects on bone in diabetic rats are not fully elucidated. The aim of this study was to evaluate the effects of LLLT on bone formation, immunoexpression of osteogenic factors, biomechanical properties and densitometric parameters in diabetic rats. Thirty male Wistar rats were randomly distributed into three experimental groups: control group, diabetic group, and laser-treated diabetic group. DM was induced by streptozotocin (STZ) and after 1 week laser treatment started. An 830-nm laser was used, performed for 18 sessions, during 6 weeks. At the end of the experiment, animals were euthanized and tibias and femurs were defleshed for analysis. Extensive resorptive areas as a result of osteoclasts activity were noticed in DG when compared to control. Laser-treated animals showed an increased cortical area. The immunohistochemical analysis revealed that LLLT produced an increased RUNX-2 expression compared to other groups. Similar RANK-L immunoexpression was observed for all experimental groups. In addition, laser irradiation produced a statistically increase in fracture force, bone mineral content (BMC) and bone mineral density compared to DG. The results of this study indicate that the STZ model was efficient in inducing DM 1 and producing a decrease in cortical diameter, biomechanical properties and in densitometric variables. In addition, it seems that LLLT stimulated bone metabolism, decreased resorptive areas, increased RUNX-2 expression, cortical area, fracture force, BMD, and BMC. Further studies should be developed to provide additional information concerning the mechanisms of action of laser therapy in diabetic bone in experimental and clinical trials.

Lasers Med Sci. 2014 Jan;29(1):147-56. doi: 10.1007/s10103-013-1302-9. Epub 2013 Mar 21.

Low-level laser therapy enhances the expression of osteogenic factors during bone repair in rats.

Tim CR[1], Pinto KN, Rossi BR, Fernandes K, Matsumoto MA, Parizotto NA, Rennó AC.
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Abstract

The aim of this study was to evaluate the effects of low-level laser therapy (LLLT) on bone formation, immunoexpression of osteogenic factors, and biomechanical properties in a tibial bone defect model in rats. Sixty male Wistar rats were distributed into bone defect control group (CG) and laser irradiated group (LG). Animals were euthanized on days 15, 30, and 45 post-injury. The histological and morphometric analysis showed that the treated animals presented no inflammatory infiltrate and a better tissue organization at 15 and 30 days postsurgery. Also, a higher amount of newly formed bone was observed at 15 days postsurgery. No statistically significant difference was observed in cyclooxygenase-2 immunoexpression among the groups at 15, 30, and 45 days in the immunohistochemical analysis. Considering RUNX-2, the immunoexpression was statistically higher in the LG compared to the CG at 45 days. BMP-9 immunoexpression was significantly higher in the LG in comparison to CG at day 30. However, there was no expressivity for this immunomarker, both in the CG and LG, at the day 45 postsurgery. No statistically significant difference was observed in the receptor activator of nuclear factor kappa-B ligand immunoexpression among the groups in all periods evaluated. No statistically significant difference among the groups was observed in the maximal load in any period of time. Our findings indicate that laser therapy improved bone healing by accelerating the development of newly formed bone and activating the osteogenic factors on tibial defects, but the biomechanical properties in LG were not improved.

Exp Gerontol. 2012 Feb;47(2):136-42. doi: 10.1016/j.exger.2011.11.005. Epub 2011 Nov 21.

Low level laser therapy (830nm) improves bone repair in osteoporotic rats: similar outcomes at two different dosages.

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Abstract

BACKGROUND AND OBJECTIVE:

The goal of this study was to investigate the effects of low level laser therapy (LLLT) in osteoporotic rats by means of subjective histopathological analysis, deposition of collagen at the site of fracture, biomechanical properties and immunohistochemistry for COX-2, Cbfa-1 and VEGF.

MATERIAL AND METHODS:

A total of 30 female Wistar rats (12weeks-old, ±250g) were submitted to ovariectomy (OVX). Eight weeks after the OVX, a tibial bone defect was created in all animals and they were randomly divided into 3 groups (n=10): control bone defect group (CG): bone defects without any treatment; laser 60J/cm(2) group (L60): animals irradiated with LLLT, at 60J/cm(2) and laser 120J/cm(2) group (L120): animals irradiated with LLLT, at 120J/cm(2).

RESULTS:

In the laser treated groups, at both fluences, a higher amount of newly formed bone was evidenced as well as granulation tissue compared to control. Picrosirius analysis demonstrated that irradiated animals presented a higher deposition of collagen fibers and a better organization of these fibers when compared to other groups, mainly at 120J/cm(2). COX-2, Cbfa-1 or VEGF immunoreactivity was detected in a similar manner either 60J/cm(2) or 120J/cm(2) fluences. However, no differences were shown in the biomechanical analysis.

CONCLUSION:

Taken together, our results support the notion that LLLT improves bone repair in the tibia of osteoporotic rats as a result of stimulation of the newly formed bone, fibrovascularization and angiogenesis.

Photomed Laser Surg. 2006 Apr;24(2):169-78.

Photoengineering of bone repair processes.

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Abstract

OBJECTIVE:

This paper aims to report the state of the art with respect to photoengineering of bone repair using laser therapy.

BACKGROUND DATA:

Laser therapy has been reported as an important tool to positively stimulate bone both in vivo and in vitro. These results indicate that photophysical and photochemical properties of some wavelengths are primarily responsible for the tissue responses. The use of correct and appropriate parameters has been shown to be effective in the promotion of a positive biomodulative effect in healing bone.

METHODS:

A series of papers reporting the effects of laser therapy on bone cells and tissue are presented, and new and promising protocols developed by our group are presented.

RESULTS:

The results of our studies and others indicate that bone irradiated mostly with infrared (IR) wavelengths shows increased osteoblastic proliferation, collagen deposition, and bone neorformation when compared to nonirradiated bone. Further, the effect of laser therapy is more effective if the treatment is carried out at early stages when high cellular proliferation occurs. Vascular responses to laser therapy were also suggested as one of the possible mechanisms responsible for the positive clinical results observed following laser therapy. It still remains uncertain if bone stimulation by laser light is a general effect or if the isolate stimulation of osteoblasts is possible.

CONCLUSION:

It is possible that the laser therapy effect on bone regeneration depends not only on the total dose of irradiation, but also on the irradiation time and the irradiation mode. The threshold parameter energy density and intensity are biologically independent of one another. This independence accounts for the success and the failure of laser therapy achieved at low-energy density levels.

Lasers Med Sci. 2015 Jul;30(5):1569-74. doi: 10.1007/s10103-015-1752-3. Epub 2015 May 15.

Low-level laser therapy on bone repair: is there any effect outside the irradiated field?

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Abstract

The biological effects of local therapy with laser on bone repair have been well demonstrated; however, this possible effect on bone repair outside the irradiated field has not been evaluated. The aim of this study was to investigate the effect of low-level laser therapy (LLLT) (λ = 830 nm) on repair of surgical bone defects outside the irradiated field, in rats. Sixty Wistar rats were submitted to osteotomy on the left femur and randomly separated into four groups (n = 15): group I, control, bone defect only; group II, laser applied on the right femur (distant dose); group III, laser applied locally on the bone defect and also on the right femur (local and distant doses); and group IV, laser applied locally on the left femur (local dose). Laser groups received applications within a 48-h interval in one point per session of density energy (DE) = 210 J/cm(2), P = 50 mW, t = 120 s, and beam diameter of 0.028 cm. Five animals of each group were euthanized 7, 15, and 21 days after surgery. Histologic analysis in all groups showed new bone formation in the region of interest (ROI) at 7 days. After 15 days, bone remodeling with a decrease of bone neoformation in the marrow area was observed in all groups. After 21 days, advanced bone remodeling with new bone mostly located in the cortical area was observed. The histomorphometric analysis showed at 7 days a significant increase of bone formation in groups III and IV compared to groups I and II. At days 15 and 21, histomorphometric analysis showed no significant differences between them. Laser therapy presented a positive local biostimulative effect in the early stage of bone healing, but the LLLT effect was not observed a long distance from the evaluated area.

Iran Red Crescent Med J. 2015 Dec 28;17(12):e32076. doi: 10.5812/ircmj.32076. eCollection 2015.

Effect of Pulsed Wave Low-Level Laser Therapy on Tibial Complete Osteotomy Model of Fracture Healing With an Intramedullary Fixation.

Mostafavinia A[1], Masteri Farahani R[1], Abbasian M[2], Vasheghani Farahani M[3], Fridoni M[4], Zandpazandi S[5], Ghoreishi SK[6], Abdollahifar MA[1], Pouriran R[5], Bayat M[1].

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Abstract

BACKGROUND:

Fractures pose a major worldwide challenge to public health, causing tremendous disability for the society and families. According to recent studies, many in vivo and in vitro experiments have shown the positive effects of PW LLLT on osseous tissue.

OBJECTIVES:

The aim of this study was to evaluate the outcome of infrared pulsed wave low-level laser therapy (PW LLLT) on the fracture healing process in a complete tibial osteotomy in a rat model, which was stabilized by an intramedullary pin.

MATERIALS AND METHODS:

This experimental study was conducted at Shahid Beheshti University of Medical Sciences in Tehran, Iran. We performed complete tibial osteotomies in the right tibias for the population of 15 female rats. The rats were divided randomly into three different groups: I) Control rats with untreated bone defects; II) Rats irradiated by a 0.972 J/cm(2) PW LLLT; and III) Rats irradiated by a 1.5 J/cm(2) PW LLLT. The right tibias were collected six weeks following the surgery and a three-point bending test was performed to gather results. Immediately after biomechanical examination, the fractured bones were prepared for histological examinations. Slides were examined using stereological method.

RESULTS:

PW LLLT significantly caused an increase in maximum force (N) of biomechanical repair properties for osteotomized tibias in the first and second laser groups (30.0 ± 15.9 and 32.4 ± 13.8 respectively) compared to the control group (8.6 ± 4.5) LSD test, P = 0.019,

P = 0.011 respectively). There was a significant increase in the osteoblast count of the first and second laser groups (0.53 ± 0.06, 0.41 ± 0.06 respectively) compared to control group (0.31 ± 0.04) (LSD test, P = 0001, P = 0.007 respectively).

CONCLUSIONS:

This study confirmed the efficacy of PW LLLT on biomechanical strength, trabecular bone volume, callus volume, and osteoblast number of repairing callus in a complete tibial osteotomy animal model at a relatively late stage of the bone healing process.

KEYWORDS:

Biomechanical Phenomena; Histology; Low-Level Laser Therapy; Osteotomy; Rats; Tibial Fracture

Photodiagnosis Photodyn Ther. 2015 Dec;12(4):575-80. doi: 10.1016/j.pdpdt.2015.06.002. Epub 2015 Jun 10.

Effects of antimicrobial photodynamic therapy and surgical endodontic treatment on the bacterial load reduction and periapical lesion healing. Three years follow up.

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Abstract

Besides the advances in endodontics, there are situations in which surgery is necessary to retain a tooth that otherwise would be extracted. This study analyzes the microbial reduction after conventional periapical surgery followed by antimicrobial photodynamic therapy (aPDT) in 3 years follows up. Twenty-eight teeth needing periapical surgery were enrolled in this study. Microbiological samples were taken after: (1) accessing the lesion, (2) surgical procedure, and (3) aPDT. The teeth received a full mucoperiosteal flap, osteotomy with a high-speed bur, manual curettage of lesion and of the root, root-end resection and retrograde cavities prepared using ultrasonic retro-tips. After the conventional procedure the cavities received an aqueous solution of methylene blue (60 μM, 3 min) and were irradiated with a diode laserλ=660 nm (6 min, 15 J). After aPDT, a retrograde filling with mineral trioxide aggregate, flap re-positioning, and sutures conventionally ended the procedure. In all the cases, a periapical X-ray exam was taken before and after the surgical procedure. The microbiological samples showed an overall significant reduction, surgical procedure achieved a mean reduction of about 3.5 log while aPDT achieved a 5 log reduction. After 36 months of follow up the patients had, in average a reduction of 78% of the periapical lesion area. It appears that surgical endodontic treatment associated with antimicrobial photodynamic therapy highly improves the microbial reduction compared to the traditional technique and this could directly affect the treatment prognosis and periapical lesion healing.

Acta Ortop Bras. 2014;22(2):71-4. doi: 10.1590/1413-78522014220200438.

Laser therapy in bone repair in rats: analysis of bone optical density.

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Abstract

OBJECTIVE:

To investigate, by digital radiology, the bone regeneration process in rats submitted to femoral osteotomy and treated with low power laser therapy.

METHODS:

Forty-five Wistar rats were subjected to transverse osteotomy of the right femur and divided randomly into three experimental groups (n = 15): animals not treated with laser therapy G (C), animals that received laser therapy with λ: 660nm G (660nm) and animals that received laser therapy with λ: 830nm G (830nm). Animals were sacrificed after 7, 14 and 21 days. The bone calluses were evaluated by digital X-ray at 65 kVp, 7mA and 0.032 s exposures.

RESULTS:

The values obtained were submitted to variance analysis (ANOVA) followed by the Tukey-Kramer test. The significance level adopted was 5%. The groups G (C), G (660nm), and G (830nm) at the 7(th) day showed a significant bone development, with $p < 0.0116$; the groups G (C), G (660nm), and G (830nm) at the 14(th) day showed values of $p < 0.0001$; at the 21(st) day,a higher degree of bone repair were observed in group G (830nm), and G (660nm), with $p < 0.0169$.

CONCLUSION:

Based on the radiographic findings, G (830nm) showed more complete bone regeneration, as shown in the gray shades of the images. Level of Evidence II, Individual Study With Experimental Design.

Int J Oral Maxillofac Surg. 2014 Jul;43(7):868-73. doi: 10.1016/j.ijom.2014.02.015. Epub 2014 Mar 25.

Does low-level laser therapy decrease swelling and pain resulting from orthognathic surgery?

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Abstract

Low-level laser therapy (LLLT) could be an alternative for the treatment of swelling and pain after orthognathic surgery, but there is a paucity of data in the literature on the effects of its use. This study verified the efficacy of an LLLT protocol to reduce swelling and pain after orthognathic surgery. Ten healthy patients who underwent a bilateral sagittal split with Le Fort I osteotomy were randomly selected for this study. The LLLT protocol consisted of intraoral and extraoral application to one side of the face after surgery (irradiated side); application to the other side was simulated (non-irradiated side). The irradiated and non-irradiated sides were compared regarding the swelling coefficient and were assessed for pain using a visual analogue scale. There were no significant differences between the irradiated and non-irradiated sides regarding swelling and pain in the immediate postoperative assessment. Swelling decreased significantly on the irradiated side in the postoperative assessments on days 3, 7, 15, and 30. Self-reported pain was less intense on the irradiated side at the 24-h (1.2 vs. 3.4) and 3-day (0.6 vs. 2.1) assessments, but at 7 days after surgery neither side showed pain. This LLLT protocol can improve the tissue response and reduce the pain and swelling resulting from orthognathic surgery.

TRIAL REGISTRATION:

ClinicalTrials.gov NCT01530100.

Med Oral Patol Oral Cir Bucal. 2014 Jul 1;19(4):e327-34.

Low-level laser effect in patients with neurosensory impairment of mandibular nerve after sagittal split ramus osteotomy. Randomized clinical trial, controlled by placebo.

Führer-Valdivia A[1], Noguera-Pantoja A, Ramírez-Lobos V, Solé-Ventura P.
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Abstract

OBJECTIVE:

Evaluate the effect on the application of low level laser therapy, in patients that have been previously intervened with a sagittal ramus split osteotomy and present neurosensory impairment due to this surgery, compared with placebo.

STUDY DESIGN:

This preliminary study is a randomized clinical trial, with an experimental group (n=17) which received laser light and a control group (n=14), placebo. All participants received laser applications, divided after surgery in days 1, 2, 3, 5, 10, 14, 21 and 28. Neurosensory impairment was evaluated clinically with 5 tests; visual analog scale (VAS) for pain and sensitivity, directional and 2 point discrimination, thermal discrimination, each one of them performed before and after surgery on day 1, and 1, 2 and 6 months. Participants and results evaluator were blinded to intervention. Variables were described with absolute frequencies, percentages and medians. Ordinal and dichotomous variables were compared with Mann Whitney's and Fisher's test respectively.

RESULTS:

RESULTS demonstrate clinical improvement in time, as well as in magnitude of neurosensory return for laser group; VAS for sensitivity reached 5 (normal), 10 participants recovered initial values for 2 point discrimination (62,5%) and 87,5% recovered directional discrimination at 6 months after surgery. General VAS for sensitivity showed 68,75% for laser group, compared with placebo 21,43% (p-value = (0.0095)). Left side sensitivity (VAS) showed 3.25 and 4 medians for placebo and laser at 2 months, respectively (p-value = (0.004)).

CONCLUSION:

Low-level laser therapy was beneficial for this group of patients on recovery of neurosensory impairment of mandibular nerve, compared to a placebo.

Iran Red Crescent Med J. 2015 Dec 28;17(12):e32076. doi: 10.5812/ircmj.32076. eCollection 2015.

Effect of Pulsed Wave Low-Level Laser Therapy on Tibial Complete Osteotomy Model of Fracture Healing With an Intramedullary Fixation.

Mostafavinia A[1], Masteri Farahani R[1], Abbasian M[2], Vasheghani Farahani M[3], Fridoni M[4], Zandpazandi S[5], Ghoreishi SK[6], Abdollahifar MA[1], Pouriran R[5], Bayat M[1].

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Abstract

BACKGROUND:

Fractures pose a major worldwide challenge to public health, causing tremendous disability for the society and families. According to recent studies, many in vivo and in vitro experiments have shown the positive effects of PW LLLT on osseous tissue.

OBJECTIVES:

The aim of this study was to evaluate the outcome of infrared pulsed wave low-level laser therapy (PW LLLT) on the fracture healing process in a complete tibial osteotomy in a rat model, which was stabilized by an intramedullary pin.

MATERIALS AND METHODS:

This experimental study was conducted at Shahid Beheshti University of Medical Sciences in Tehran, Iran. We performed complete tibial osteotomies in the right tibias for the population of 15 female rats. The rats were divided randomly into three different groups: I) Control rats with untreated bone defects; II) Rats irradiated by a 0.972 J/cm(2) PW LLLT; and III) Rats irradiated by a 1.5 J/cm(2) PW LLLT. The right tibias were collected six weeks following the surgery and a three-point bending test was performed to gather results. Immediately after biomechanical examination, the fractured bones were prepared for histological examinations. Slides were examined using stereological method.

RESULTS:

PW LLLT significantly caused an increase in maximum force (N) of biomechanical repair properties for osteotomized tibias in the first and second laser groups (30.0 ± 15.9 and 32.4 ± 13.8 respectively) compared to the control group (8.6 ± 4.5) LSD test, P = 0.019,

P = 0.011 respectively). There was a significant increase in the osteoblast count of the first and second laser groups (0.53 ± 0.06, 0.41 ± 0.06 respectively) compared to control group (0.31 ± 0.04) (LSD test, P = 0001, P = 0.007 respectively).

CONCLUSIONS:

This study confirmed the efficacy of PW LLLT on biomechanical strength, trabecular bone volume, callus volume, and osteoblast number of repairing callus in a complete tibial osteotomy animal model at a relatively late stage of the bone healing process.

J Photochem Photobiol B. 2016 Jun;159:179-85. doi: 10.1016/j.jphotobiol.2016.03.041. Epub 2016 Mar 29.

Low level laser therapy accelerates bone healing in spinal cord injured rats.

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Abstract

Bone loss occurs rapidly and consistently after the occurrence of a spinal cord injury (SCI), leading to a decrease in bone mineral density (BMD) and a higher risk of fractures. In this context, the stimulatory effects of low level laser therapy (LLLT) also known as photobiomodulation (PBM) have been highlighted, mainly due to its osteogenic potential. The aim of the present study was to evaluate the effects of LLLT on bone healing using an experimental model of tibial bone defect in SCI rats. Twenty-four female Wistar rats were randomly divided into 3 groups: Sham group (SG), SCI control group (SC) and SCI laser treated group (SL). Two weeks after the induction of the SCI, animals were submitted to surgery to induce a tibial bone defect. Treatment was performed 3days a week, for 2weeks, at a single point over the area of the injury, using an 808nm laser (30mW, 100J/cm(2); 0.028cm(2), 1.7W/cm², 2.8J). The results of the histological and morphometric evaluation demonstrated that the SL group showed a larger amount of newly formed bone compared to the SC group. Moreover, a significant immunoexpression of runt-related transcription factor 2 (RUNX2) was observed in the SL group. There was no statistical difference in the biomechanical evaluation. In conclusion, the results suggest that LLLT accelerated the process of bone repair in rats with complete SCI.

J Photochem Photobiol B. 2016 Jan;154:8-15. doi: 10.1016/j.jphotobiol.2015.10.028. Epub 2015 Oct 31.

Effects of low level laser therapy on inflammatory and angiogenic gene expression during the process of bone healing: A microarray analysis.

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Abstract

The process of bone healing as well as the expression of inflammatory and angiogenic genes after low level laser therapy (LLLT) were investigated in an experimental model of bone defects. Sixty Wistar rats were distributed into control group and laser group (830nm, 30mW, 2,8J, 94seg). Histopathological analysis showed that LLLT was able to modulate the inflammatory process in the area of the bone defect and also to produce an earlier deposition of granulation tissue and newly formed bone tissue. Microarray analysis demonstrated that LLLT produced an up-regulation of the genes related to the inflammatory process (MMD, PTGIR, PTGS2, Ptger2, IL1, 1IL6, IL8, IL18) and the angiogenic genes (FGF14, FGF2, ANGPT2, ANGPT4 and PDGFD) at 36h and 3days, followed by the decrease of the gene expression on day 7. Immunohistochemical analysis revealed that the subjects that were treated presented a higher expression of COX-2 at 36h after surgery and an increased VEGF expression on days 3 and 7 after surgery. Our findings indicate that LLLT was efficient on accelerating the development of newly formed bone probably by modulating the inflammatory and angiogenic gene expression as well as COX2 and VEGF immunoexpression during the initial phase of bone healing.

Clin Oral Implants Res. 2000 Dec;11(6):540-5.

Biostimulation of bone marrow cells with a diode soft laser.

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Abstract

In recent years, the use of low-intensity red light in regeneration of soft tissue has been increasingly pursued. As far as hard tissue is concerned, the biostimulating effect of laser has already been demonstrated successfully in more rapid healing of tibial bone fractures in mice at a dosage of 2.4 J. However, the effect of light of a low dose laser directly on osteoblasts has not been investigated yet. The aim of this study was to determine the effect of continuous wave diode laser irradiation on osteoblasts derived mesenchymal cells. Three groups of 10 cultures each were irradiated 3 times (days 3, 5, 7) with a pulsed diode soft laser with a wavelength of 690 nm for 60 s. Another 3 groups of 10 cultures each were used as control groups. A newly developed method employing the fluorescent antibiotic tetracycline was used to compare bone growth on these culture substrates after a period of 8, 12 and 16 days, respectively. It was found that all lased cultures demonstrated significantly more fluorescent bone deposits than the non-lased cultures. The difference was significant, as tested by the Tukey Test ($P < 0.0001$) in the cultures examined after 16 days. Hence it is concluded that irradiation with a pulsed diode soft laser has a biostimulating effect on osteoblasts in vitro, which might be used in osseointegration of dental implants.

Biomaterials. 2005 Jun;26(17):3503-9.

Effect of laser therapy on attachment, proliferation and differentiation of human osteoblast-like cells cultured on titanium implant material.

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Abstract

The aim of this in vitro study was to investigate the effect of low-level laser therapy (LLLT) on the attachment, proliferation, differentiation and production of transforming growth factor-ss(1) (TGF-beta(1)) by human osteoblast-like cells (HOB). Cells derived from human mandibular bone were exposed to GaAlAs diode laser at dosages of 1.5 or 3 J/cm(2) and then seeded onto titanium discs. Non-irradiated cultures served as controls. After 1, 3 and 24h, cells were stained and the attached cells were counted under a light microscope. In order to investigate the effect of LLLT on cell proliferation after 48, 72 and 96 h, cells were cultured on titanium specimens for 24h and then exposed to laserirradiation for three consecutive days. Specific alkaline phosphatase activity and the ability of the cells to synthesize osteocalcin after 10 days were investigated using p-nitrophenylphosphate as a substrate and the ELSA-OST-NAT immunoradiometric kit, respectively. Cellular production of TGF-beta(1) was measured by an enzyme-linked immunosorbent assay (ELISA), using commercially available kits. LLLT significantly enhanced cellular attachment ($P<0.05$). Greater cell proliferation in the irradiated groups was observed first after 96 h. Osteocalcin synthesis and TGF-beta(1) production were significantly greater ($P<0.05$) on the samples exposed to 3 J/cm(2). However, alkaline phosphatase activity did not differ significantly among the three groups. These results showed that in response to LLLT, HOB culturedon titanium implant material had a tendency towards increased cellular attachment, proliferation, differentiation and production of TGF-beta(1), indicating that in vitro LLLT can modulate the activity of cells and tissues surrounding implant material.