Research Citations – 810nm Diode Laser

1. Stimulatory Effect Of Low-Level Laser Irradiation On The Proliferation Of Human Periodontal Ligament Fibroblasts (PDLF).

Kreisler, M., Christoffers, A. B., Willershausen, B. and D'Hoedt, B. (2003), Effect of low-level GaAlAs laser irradiation on the proliferation rate of human periodontal ligament fibroblasts: an in vitro study. Journal of Clinical Periodontology, 30: 353–358. doi: 10.1034/j.1600-051X.2003.00001

.Abstract
Aim: The aim of this in vitro study was to evaluate a potential stimulatory effect of low-level laser irradiation on the proliferation of human periodontal ligament fibroblasts (PDLF).

Materials and Methods: PDLF obtained from third molar periodontal ligaments were cultured under standard conditions and spread on 96-well tissue culture plates. Subconfluent monolayers were irradiated with an 809-nm diode laser operated at a power output of 10 mW in the continuos wave (cw) mode at energy fluences of 1.96–7.84 Jcm–2. The variable irradiation parameters were the time of exposure (75–300 s per well) and the number of irradiations (1–3). After laser treatment, the cultures were incubated for 24 h. The proliferation rate of the lased and control cultures was determined by means of fluorescence activity of a reduction–oxidation (REDOX) indicator (Alamar Blue® Assay) added to the cell culture. Proliferation, expressed in relative fluorescence units (RFU), was determined 24, 48 and 72 h after irradiation.

Results: The irradiated cells revealed a considerably higher proliferation activity than the controls. The differences were significant up to 72 h after irradiation (Mann–Whitney U-test, $p<0.05$).

Conclusion: A cellular effect of the soft laser application is clearly discernible. Clinical studies are needed to evaluate whether the application of low-level laser therapy might be beneficial in regenerative periodontal therapy

2. 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-ß1 (TGF-β1) by human osteoblast-like cells (HOB). Cells derived from human mandibular bone were exposed to GaAlAs diodelaserat dosages of 1.5 or 3 J/cm2 and then seeded onto titanium discs. Non-irradiated cultures served as controls. After 1, 3 and 24 h, 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 24 h and then exposed to laser irradiation 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-β1 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-β1production were significantly greater ($P<0.05$) on the samples exposed to 3 J/cm2. However, alkaline phosphatase activity did not differ significantly among the three groups. These results showed that in response to LLLT, HOB cultured on titanium implant material had a tendency towards increased cellular attachment, proliferation, differentiation and production of TGF-β1, indicating that in vitro LLLT can modulate the activity of cells and tissues surrounding implant material.
Keywords

3. Effect of low-power laser irradiation on cell growth and procollagen synthesis of cultured fibroblasts

Pereira, A. N., Eduardo, C. d. P., Matson, E. and Marques, M. M. (2002), Effect of low-power laser irradiation on cell growth and procollagen synthesis of cultured fibroblasts. Lasers Surg. Med., 31: 263–267. doi: 10.1002/lsm.10107 -This work was carried out at School of Dentistry, University of São Paulo, São Paulo, Brazil.

Abstract
Background and Objectives

In dentistry, low-power lasers have been used in the treatment of dentin hypersensitivity, gingivitis, periodontitis, and different forms of oral ulcers. This in vitro study focuses on the biostimulation of NIH-3T3 fibroblasts by a low-power Ga–As-pulsed laser.

Study Design/Materials and Methods

We have studied cell growth and procollagen synthesis of cultured fibroblasts submitted to low-power laser irradiation with energy densities varying from 3 to 5 J/cm^2 over a period of 1–6 days. The light source was a 120 mW Ga–As diode laser ($\lambda = 904$ nm). Growth curves and procollagen immunoprecipitation were obtained.

Results

Irradiation of 3 and 4 J/cm^2 increased the cell numbers about threefold to sixfold comparing to control cultures. However, this effect was restricted to a small range of energy densities since 5 J/cm^2 had no effect on cell growth. The energy density of 3 J/cm^2 remarkably increased cell growth, with no effect on procollagen synthesis, as demonstrated by the immunoprecipitation analysis.

Conclusions

Our results showed that a particular laser irradiation stimulates fibroblast proliferation, without impairing procollagen synthesis. Lasers Surg. Med. 31:263–267, 2002.

4. Effect of low level diode laser irradiation of human oral mucosa fibroblasts in vitro

Loevschall, H. and Arenholt-Bindslev, D. (1994), Effect of low level diode laser irradiation of human oral mucosa fibroblasts in vitro. Lasers Surg. Med., 14: 347–354. doi: 10.1002/lsm.1900140407

A standardized LLL set-up was developed (812 nm, 4.5 ± 0.5 mW/cm2). Cultures in petridishes were divided into eight groups (1 group served as control). On day 6 after seeding, routine growth medium was replaced with PBS for 1/2 hour. At the beginning of this period, LLL irradiation was performed for 0, 1, 3, 10, 32, 100, 316, or 1,000 seconds, respectively—corresponding to the radiant exposures 0, 4.5, 13.5, 45, 144, 450, 1,422, 4,500 mJ/cm2. Subsequently the cells received 3H-dT in fresh medium for 16 hours DNA-incorporation. Scintillations from tritium and total protein concentration per culture dish were determined. The individual 3H-cpm/protein-concentration ratios were calculated in % of control. Three experiments were performed (N = 151). Following LLL exposure the H-cpm/protein ratio was increased with maximum cpm/protein ratio (132.5% ± 10.6% SEM) in the group receiving 450 mJ/cm2 ($P < 0.03$ nonparametric Kruskal Wallis one-way ANOVA-test). This study demonstrated an increased incorporation on tritiated thymidine in cultured human oral fibroblasts following LLL exposure and suggests that LLL irradiation can induce increased DNA Synthesis.

5. Bacterial Reduction in Periodontal Pockets Through Irradiation with a Diode Laser: A Pilot Study

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A. MORITZ, N. GUTKNECHT, O. DOERTBUDAK, K. GOHARKHAY, U. SCHOOP, P. SCHAUER, and W. SPERR. Journal of Clinical Laser Medicine & Surgery. FEBRUARY 1997, 15(1): 33-37. doi:10.1089/clm.1997.15.33.

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ABSTRACT

This study examines the application of a diode laser with a wavelength of 805 nm for periodontal treatment. While the use of the diode laser in this field has not been investigated so far, several authors have reported on the use of neodymium:yttrium-aluminum-garnet (Nd:YAG) laser for such applications. The aim of this study was to examine the immediate effect of the diode laser in reducing the bacterial concentration in periodontal pockets. Important periodontal indices (PBI, CPITN) were assessed in 50 patients to obtain initial values for a planned long-term study and to select appropriate periodontal pockets for this study. The periodontal pockets were required to have a minimum depth of 4 mm. Only proximal pockets were included in this study. The patients were subdivided into two groups. After microbiological samples had been collected with sterile paper tips, the group selected for laser treatment was subjected to scaling. One week after scaling, the patients underwent laser treatment. One week later, a second series of microbiological samples were obtained and the patients were subjected again to scaling; this time, however, they did not undergo laser treatment after 1 week. Two weeks after scaling, another series of microbiological samples was collected. The microbiological samples were evaluated to verify bacterial elimination from the periodontal pockets. A comparison between the initial and the final bacterial counts revealed that irradiation with the diode laser facilitates considerable bacterial elimination, especially of *Actinobacillus actinomycetemcomitans*, from periodontal pockets.

6.Treatment of periodontal pockets with a diode laser

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Background and Objective

The aim of this study is to examine the long-term effect of diode laser therapy on periodontal pockets with regard to its bactericidal abilities and the improvement of periodontal condition.

Study Design/Materials and Methods: Fifty patients were randomly subdivided into two groups (laser-group and control-group) and microbiologic samples were collected. There have been six appointments for 6 months following an exact treatment scheme. After evaluating periodontal indices (bleeding on probing, Quigley-Hein) including pocket depths and instruction of patients in oral hygiene and scaling therapy of all patients, the deepest pockets of each quadrant of the laser-group's patients were microbiologically examined. Afterwards, all teeth were treated with the diode laser. The control-group received the same treatment but instead of laser therapy were rinsed with H_2O_2. Each appointment also included a hygienic check-up. After 6 months the final values of the periodontal indices and further microbiologic samples were measured. The total bacterial count as well as specific bacteria, such as Actinobacillus actinomycetemcomitans, Prevotella intermedia, and Porphyromonas gingivalis, were assessed semiquantitatively.

Results

The bacterial reduction with diode laser therapy was significantly better than in the control group. The index of bleeding on probing improved in 96.9% in the laser-group, whereas only 66.7% in the control group. Pocket depths could be more reduced in the laser group than in the control group.

Conclusion

The diode laser reveals a bactericidal effect and helps to reduce inflammation in the periodontal pockets in addition to scaling. The diode laser therapy, in combination with scaling, supports healing of the periodontal pockets through eliminating bacteria. Lasers Surg. Med. 22:302–311, 1998. © 1998 Wiley-Liss, Inc

7. Diode Laser (980 nm) in Oral and Maxillofacial Surgical Procedures: Clinical Observations Based on Clinical Applications

GEORGE ROMANOS and GEORG-HUBERTUS NENTWIG. Journal of Clinical Laser Medicine & Surgery. OCTOBER 1999, 17(5): 193-197. doi:10.1089/clm.1999.17.193.

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ABSTRACT

Objective: The aim of this study was to examine the wound healing of soft tissue after the application of a diode laser (980 nm) in oral surgical procedures. *Summary Background Data:* Like the CO_2 laser, the diode laser can be used for soft tissue surgery without extensive experience in the field of oral surgical. *Methods:* A diode laser was used to treat a yariety of oral soft tissue lesions in 22 patients. The oral surgical procedures included removal of soft tissue tumors, frenectomies, excision of gingival hyperplasias, vestibuloplasties, hemangioma removal, and periimplant soft tissue surgery. The laser was used in both pulsed and continuous modes, with and without contact to the tissue. Intraoperative and postoperative clinical observations are reported. *Results:* Our preliminary clinical findings include sufficient hemostasis and precise incision margin with all of the surgical procedures. The coagulation properties, associated with the use of a diode laser, were particularly beneficial during removal of vascular lesions. The postoperative advantages, i.e., lack of swelling, bleeding, pain or, scar tissue formation, and the good wound healing were observed in all of the clinical applications and were dependent only on the laser physical parameters used. *Conclusions:* The clinical application of the diode (980 nm) laser in oral and maxillofacial surgical procedures seems to be of beneficial effect for daily practice.