PBM Laser Therapy-Dentistry, Orthodontic

Photobiomodulation, Photomedicine, and Laser Surgery Volume XX, Number XX, 2020 ª Mary Ann Liebert, Inc. Pp. 1–11 DOI: 10.1089 / photob.2019.4779

Comparison of the effects of photobiomodulation with different lasers for orthodontic movement and reduction of the treatment time with fixed applications in novel scientific reports: A systematic overview with meta-analysis

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Abstract
Background: The duration of orthodontic treatment is one of the most important issues that patients consider.
Photobiomodulation (PBM) depends on the exposure of the tissue to certain therapeutic wavelengths of
light in the '' therapeutic window '' (from 600 to 1200 nm). PBM increases cell metabolism, leading to
higher ATP production. Increasing the amount of ATP in well-vascularized bone cells promotes cell proliferation and differentiation and creates a favorable environment for tooth movement.

Objective: The aim of the study is to discuss and compare the use of PBMs to speed up orthodontic movement and reduce treatment time.

Materials and methods: A systematic review was carried out. The literature searches were carried out with Medline (PubMed), Web of Science and Scopus (from September 13th to September 20th, 2019). The Quality Assessment was based on the Jadad scale for reporting on randomized controlled trials for randomized clinical trials and randomized clinical control trials and the Newcastle / Ottawa quality assessment form
for case / control studies.

Results: Thirty-three articles from PubMed, 46 from Scopus, and 5 from Web of Science were selected. After removing duplicates, 82 articles were analyzed. 74 articles were then excluded because they did not meet the inclusion criteria. The remaining eight articles were included in the qualitative synthesis.

Conclusions and Summary: PBM is an efficient, effective, and non-invasive method for expediting orthodontic dental treatment.
Move. PBM should become part of the daily practice of treating various malocclusions as an

additional procedure. Intra-oral use gives better results and introduction to treatment seems to make more sense.

Laser Research: Odontology, Summary and Studies

Reference
Photomedicine and Laser Surgery Volume 30, Number 5, 2012

Laser-GaAlAs (k860 nm) photobiomodulation for the treatment of bisphosphonate-induced osteonecrosis of the jaw

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short version

Objective: The aim of this article is to report on a case of bisphosphonate-induced osteonecrosis (ONJ-BP) of the jaw treated by curettage of the necrotic bone, low-level laser therapy (LLLT), and antibiotic therapy.

Background data: ONJ-BP is characterized by painful ulceration of the oral mucosa, prone to bone necrosis that does not heal within 8 weeks of diagnosis, and is often difficult to treat. No definitive standard of care has been established for ONJ-BP. LLLT improves wound healing, alleviates pain and appears to be a promising treatment modality for patients with ONJ-BP.

The Methods: An 82-year-old man who was taking bisphosphonate intravenously presented after tooth extraction with ONJ-BP. The patient was treated by LLLT using a GaAlAs diode laser with the following settings: wavelength 860 nm, 70 mW, continuous wave and spot size 4 mm2. An energy density of 4.2 J / cm2 per point was applied in combination with antibiotic therapy and curettage of the necrotic bone every 48 hours for 10 days. A reduction in painful symptoms was reported after the second radiation session, and tissue healing was complete by the end of the third week after oral curettage. The patient was followed up for 12 months and had good oral health and quality of life.

Conclusion: The therapeutic protocol used in this study had a beneficial effect on tissue healing and remission of painful symptoms, resulting in better oral health and patient quality of life.

Photomedicine and Laser Surgery Volume 30, Number 3, 2012

Effect of adjuvant low-level laser therapy (LLLT) on the non-surgical treatment of chronic periodontal disease

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short version

Objective: The aim of this double-blind, short-term, controlled clinical study with a split oral cavity was to investigate the effect of low-level laser therapy (LLLT) as a supplement to scaling and root planing (SRP) in the treatment of chronic periodontal disease.

Background data: LLLT is reported to improve the outcome of traditional SRP, but the evidence is still weak.

METHODS: Sixteen patients with a probing pocket depth (PPD) of 4-6 mm with at least three teeth in each quadrant were recruited for the study. The SRP quadrants were then randomly selected for 10 LLLT sessions assigned.

The results: The results showed that the areas treated with SRP + LLLT (10 sessions, 830 nm, 100 mW, 3 J per point, 3 J / cm2) compared to the areas treated with SRP alone after 5 weeks and 3 months but did not show a greater reduction in PPD after 6 months. In addition, when comparing the 6 and 12 month data and overall from baseline to 12 months, the sites treated with SRP + LLLT showed a statistically significant increase in mean radiographic bone density. There was a trend of decreasing interleukin (IL) -1b, but the difference between control and laser sites was not statistically significant.

Conclusion: SRP in combination with LLLT improved radiographic bone density and short-term PPD reduction in patients with chronic periodontitis, but did not significantly affect the gingival cavicular fluid of IL-1b or the gingival or plaque index.

Photomedicine and Laser Surgery Volume 29, Number 8, 2011

Influence of super-pulsed laser therapy on healing processes after tooth extraction

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short version

Objective: In this research, the effects of laser therapy on the healing processes after tooth extraction in healthy human subjects were examined, whereby some inflammations, osteogenesis and clinical parameters were assessed.

Background data: Alveolar healing after tooth extraction is a complex repair process involving different types of tissue, including epithelium and bone. Therefore, it can be beneficial to employ techniques that can affect healing of all tissues.

The Methods: Ten healthy human subjects with indications for bilateral tooth extraction took part in the split-mouth study. The subject / patient becomes their own control, eliminating any individual differences in response to laser treatment. These consisted of: 904 nm laser, 33W peak power, 30 KHz, 200 ns, average power 200mW, illuminated area 1 cm2, 200mW / cm2, 15 min, 180 J, 180 J / cm2. In each patient, one post-extraction site was treated with laser radiation, while the other was left untreated as a control. Soft tissue samples were taken from the extraction site before tooth extraction (T0) and 7 days after extraction (T7); the expression of inflammation and osteogenesis parameters was evaluated on these samples.

The results: The super-pulsed laser irradiation prevented the increase in interleukin (IL) -1b, IL-6, IL-10 and cyclooxygenase-2 (COX-2) and induced an insignificant increase in collagen after 7 days after extraction versus the values on the day of extraction; no changes were found in the other parameters examined. The patients reported less pain at the area treated with super-pulsed laser radiation than at the control site.

Conclusion: This study suggests that super-pulsed laser irradiation may be the treatment of choice for patients scheduled for tooth extraction because it offers clinical efficacy, is safe and well tolerated, and can prevent inflammation.

Photomedicine and Laser Surgery Volume 29, Number 4, 2011

Low-level laser therapy in patients with burned mouth syndrome: a pilot study

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short version

Objective: The aim of this study was to investigate the effect of low-level laser therapy (LLLT) on the treatment of Burning Mouth Syndrome (BMS). In addition, the laser effect on the various affected oral sites was compared.

The methods: Eleven subjects with a total of 25 places (tongue, lower lip, upper lip and palate) that were affected by a burning sensation were selected. The affected areas were irradiated with an infrared laser (790 nm) once a week for three consecutive weeks. The probe was kept in contact with the tissue and the mucosal surface was scanned during irradiation. The irradiation time was calculated based on the fluence of 6 J / cm2, the output power of 120mW and the area to be treated. Burn intensity was recorded using a visual analog scale before and after treatment and during the 6-week follow-up. The percentage improvement in symptoms was also determined.

Results: The burn intensity at the end of the laser therapy was statistically lower than at the beginning ($p < 0.01$). Patients reported an 80.4 percent reduction in symptom intensity after laser treatment. There was no statistical difference between the end of treatment and the 6 week follow-up, with the exception of the tongue region.

Conclusion: Among the parameters examined, infrared LLLT turned out to be a valuable alternative for BMS treatment, as it produced a significant and permanent reduction in symptoms.

Photomedicine and Laser Surgery Volume 29, Number 1, 2011

Prevention of induced oral mucositis with low-level laser therapy in bone marrow transplant patients: a randomized clinical trial

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short version

Background data and objective: Patients who have received high doses of chemotherapy, either alone or in combination with whole-body radiation, often report oral mucositis (OM) as the weakest side effect. The aim of this study was to investigate the clinical effects of low-level laser therapy (LLLT) on the prevention of conditioning-induced OM in hematopoietic stem cell transplantation (HSCT).

The methods: We randomized 42 patients who underwent autologous or allogeneic HSCT. A low-level InGaAlP diode laser was used, which emitted light at 660 nm, 40 mW and 4 J / cm2. An assessment of the OM was carried out using the World Health Organization scale.

Results and Conclusion: In the LLLT group, 57.1% of the patients had an OM grade 0, 9.6% a grade 1 and 33.3% a grade 2, while in the control group only 4.8% of the patients were free of OM (grade 0). Our results suggest that the preventative use of LLLT in patients who have undergone HSCT is an effective tool in reducing the incidence of OM.

Photomedicine and Laser Surgery, Aug 2006, Volume 24, No. 4: 522-527

TMJ arthralgia and low level laser therapy

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abstract

Objective: This case report describes the treatment of a patient with an arthralgia of the temporomandibular joint caused by intervertebral disc displacement.

Background data: The aim of the treatment of TMJ osteoarthritis is pain relief by promoting the natural healing ability of the musculoskeletal system.

The Methods: This report describes the complex treatment of TMJ arthralgia. Low-level laser therapy (LLLT) was chosen for its anti-inflammatory and analgesic effects. The laser therapy was carried out with the GaAlAs diode laser with an output power of 400 mW, which emitted radiation with a wavelength of 830 nm and an energy density of 15 J / cm2; the laser radiation was applied to four target points in 10 sessions in contact mode. Physiotherapy was recommended to this patient to prevent injury to intra-articular tissue caused by incorrect movement when opening the mouth. Splint stabilization and prosthetic treatment were used

The Results: Five applications of LLLT resulted in a reduction in pain in the temporomandibular joint area on the visual analog scale of 20 to 5 mm. The anti-inflammatory effect of the laser was

confirmed by a thermographic examination. Before treatment, the temperature differences between the normal TMJ and the TMJ with arthralgia were greater than 0.5Â ° C. After completing the LLLT, however, the temperatures in the areas around the TMJ were balanced.

Conclusion: This study demonstrated the effectiveness of a complex non-invasive treatment in patients with TMJ arthralgia. The analgesic and anti-inflammatory effects of LLLT were confirmed by infrared thermography.

Photomedicine and Laser Surgery, June 2006, Volume 24, No. 3: 358-365

Effect of GaAlA's laser on the induction of reactive dentinogenesis in human teeth

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short version

Objective: This study examined the biomodulatory effect of the gallium aluminum arsenate laser (GaAlAs) in pulp cells on reactive dentinogenesis and on the expression of collagen type III (Col III), tenascin (TN) and fibronectin (FN) in irradiated tooth tissues and controls (not irradiated).

Background data: Several studies indicate a biomodulatory influence of low-intensity laser radiation on inflammatory and reparative processes in biological tissues.

The Methods: Sixteen human premolar teeth were selected (after extraction for orthodontic reasons) and divided into irradiated and control groups. Class V black cavity preparations were performed in both groups. A GaAlAs laser (670 nm, 50 mW) with an energy density of 4 J / cm2 was used for the irradiated group. Soon after, the cavities were restored with a glass ionomer and the extractions performed after 14 and 42 days.

The results: The histological changes were observed with a light microscope; In the irradiated group, a less intense inflammatory reaction was found in comparison to the controls. Only the irradiated group of 42 days had an area associated with reactive dentinogenesis. According to immunohistochemical analysis using the streptoavidin-biotin complex (SABC) method, the expression of Col III, TN and FN was greater in the irradiated groups.

Conclusion: Our results suggest that a GaAlAs laser with an energy density of 4 J / cm2 and a wavelength of 670 nm, after preparing a cavity, induces biomodulation in the pulp cells and expression of collagen, but not collagen of the extracellular matrix, caused.

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Effect of weak GaAlAs laser irradiation on the rate of proliferation of human periodontal ligament fibroblasts: an in vitro study.

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J Parodontol Clinic. 2003 Apr; 30 (4): 353-8.

short version

Objective: The aim of this in vitro study was to investigate the potential stimulating effect of weak laser irradiation on the proliferation of human periodontal ligant fibroblasts (PDLF).

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

Results: The irradiated cells showed a significantly 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 recognizable. Clinical studies are needed to evaluate whether the use of low-level laser therapy could be beneficial in regenerative periodontal therapy.

The effects of low-level laser irradiation on osteoblastic cells

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Clinical Orthodontics Res. 2001 Feb; 4 (1): 3-14.

Low-level laser therapy has been used in the treatment of many conditions for which numerous clinical effects have been reported, including promoting healing of both hard and soft tissue lesions. However, low-level laser therapy as a treatment modality remains controversial. The effects of the wavelength, the type of radiation, the energy output, the energy level, the energy intensity and the exposure regime of the low-level laser therapy remain unexplained. Furthermore, no specific therapeutic window for the dosimetry and the mechanism of action at the level of the individual cell types has been determined. The aim of this study was to examine the effects of low level laser irradiation on the human osteosarcoma cell line SAOS-2.

The cells were irradiated with a continuous wave GaAlAs diode laser (830 nm, net power of 90 mW, energy levels of 0.3, 0.5, 1, 2 and 4 joules) as a single or daily dose for up to 10 days.

The viability of the cells was not affected by the laser irradiation, the viability of all experimental groups being more than 90%. No significant influence on cell proliferation or activation by one of the investigated energy levels and different exposure regimes was found. Weak laser irradiation resulted in a heat shock reaction at an energy level of 2 J. No significant early or late effects of laser irradiation on protein expression and alkaline phosphatase activity were found. The examination of the intracellular calcium concentration showed a tendency towards a transient positive change after exposure. A weak laser irradiation was not able to to stimulate the osteosarcoma cells used for this research at the gross cell population level. The heat shock reaction and the increased intracellular calcium content suggest that the cells respond to weak laser radiation. More research is needed using different cell and animal models to more accurately determine the effects of low levels of laser irradiation at the cellular level. These effects should be investigated more thoroughly before low-level laser therapy can be considered as a potential accelerator stimulus for orthodontic tooth movement. More research is needed using different cell and animal models to more accurately determine the effects of low levels of laser irradiation at the cellular level. These effects should be investigated more thoroughly before low-level laser therapy can be considered as a potential accelerator stimulus for orthodontic tooth movement. More research is needed using different cell and animal models to more accurately determine the effects of low levels of laser irradiation at the cellular level. These effects should be investigated more thoroughly before low-level laser therapy can be considered as a potential accelerator stimulus for orthodontic tooth movement.

Patients with moderate chemotherapy-induced mucositis: pain therapy with low-intensity lasers.

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International Nursing Report; VOL: 52 (1); Pp. 68-72 / 200503 /
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short version

Objective: To study the effect of LLLT on pain relief in patients who have developed COM.

Background data: Intensive cancer therapy usually affects malignant and normal cells with high replication rates. Cells of the gastrointestinal tract are therefore often affected by cytotoxins. This often leads to the development of chemotherapy-induced oral mucositis (COM). COM is the inflammatory response of the oral mucosa to chemotherapy drugs. Low-level laser therapy (LLLT) has been shown to be effective in treating and repairing biologically damaged tissue and in reducing pain. LLLT has also proven to be an efficient method for preventing oral mucositis.

The methods: The study was carried out as a clinical test with a sample of 13 adult patients who were treated oncologically. Patients were treated for a period of 5 days and pain was measured before and after each laser application. The laser used was an AsGaAl laser with a wavelength of 830 nm and a power of 250 mW. The energy delivered was 35 J cm (-2).

Analysis: The results were analyzed using the Wilcoxon test.

The Results: There was a significant (P = 0.007) 67% decrease in the average daily pain experience before and after each treatment, confirming that LLLT can relieve pain in patients who have developed COM.

Limitations of the study: The small number of COM patients in the hospital did not allow a control group to be included in the study, which is why the results contain a potential placebo effect.

Implications for Nursing: The authors see the value for the patient in better and faster treatment with a drastic reduction in painful mucositis as the most important benefit.

Low-level laser for the prevention and therapy of oral mucositis induced by chemotherapy or radiation therapy.

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Current Opinion in Oncology; VOL: 17 (3); Pp. 236-40 / 200505 /
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short version

PURPOSE OF THE REVIEW: Oral mucosal inflammation is a common morbid condition associated with chemotherapy or radiation therapy for which there is no standard prophylaxis or treatment. There is increasing evidence that the use of a low-level laser can reduce the severity of mucositis associated with chemotherapy or radiation therapy. The purpose of this review is to examine the evidence available for this.

LATER FINDING: For most approaches commonly used to prevent or treat chemotherapy- or radiation-associated oral mucositis, a recently appointed panel of experts could not find sufficient levels of evidence to recommend or suggest their use. As for low level laser therapy, the results are difficult to assess and compare due to the variability of interoperators and the difficulty of conducting clinical studies in the field. Nonetheless, the evidence in favor of low-level laser therapy is mounting.

SUMMARY: Based on literature data, it is reasonable to conclude that the evidence that low-level laser therapy can be useful for reducing the severity of chemotherapy- or radiation therapy-associated mucositis is substantial, if only there have been few controlled studies in the field of prevention.

Low-level laser therapy after molar extraction

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ABSTRACT
The aim of the study was to examine the various frequencies of the weak laser radiation (diode - 670 nm and helium-neon 632.8 nm) on the healing process after extractions of human molars. Frequencies of 5 Hz, 292 Hz and 9000 Hz were used in the experiments. Monitoring of secretory IgA and albumin levels in saliva and changes in bone density were used as objective markers for the biostimulatory effect. The subjective evaluation of the therapy was observed using a scale (from - negative therapeutic effect; ++++ excellent treatment effect).

Changes in sIgA, albumin levels and bone density were compared in a group of 150 patients (non-laser therapy - 30 patients). The differences in the concentrations of salivary markers (sIgA and albumin) proved to be significant when comparing the irradiated and non-irradiated groups and when comparing the groups that were irradiated with different modulating frequencies.

Significant differences were observed between the increase in sIgA or albumin and the subjective feeling of treatment. The bone density after the extraction and six months after the surgical treatment was examined with dental digital radiovisiography. No significant differences were found between bone density in irradiated and non-irradiated groups, which may be due to the therapy regimen we used.

Keywords: dentistry, low level laser radiation, secretory IgA, albumin

INTRODUCTION Tooth
extractions are part of the daily work of the dentist in his practice. There are many reasons for tooth extraction, e.g. wearing, periodontal disease, retention or semi-retention tooth, etc. After the extraction we observe the wound, and wound healing is one of the fundamental biological processes that allows the organism to be preserved after tissue damage 1, 2. The regeneration takes place in three overlapping phases 3.

Inflammatory phase: lasts several hours, the damaged tissue is infiltrated with the infiltration of leukocytes and macrophages and the migration of fibroblasts, which also occurs and lasts from 1 to 3 days.
Proliferation phase: between the second and fourth day - neovascularization, type III collagen synthesis occurs between Day 2 and 16th
phase of tissue reconstruction: On the 9th to 60th day, type III collagen is replaced by type I collagen, the number of blood vessels is reduced and the reconstruction of the fiber tissue then takes 6 to 12 months3.
After the extraction, the open space of the spongiosis is filled with blood clots. The vein regrows cells from healing bone marrow. These cells are converted into osteoblasts. The bone is gradually strengthened by lamellar bone. This primary cancellous structure is transformed into compact cortical or lamellar bones, depending on the local conditions. The formation of the cortical layer, the secondary spongiosis and the medullary canals takes about 4 months. This is followed by the last phase of bone differentiation, in which the bone is converted into Haversian systems and secondary osteons arise. The remodeling proceeds from the underside of the defect and the edges of the defect into the central part of the wound. Neovascularization begins in the extraction pocket. The oxygen supply increases. The oxygen is required for collagen synthesis and wound epithelialization 4,5. The components required for collagen synthesis are provided by phagocytes through damaged tissue. One after the other, the collagen is converted into a certain form, further cell division stops and the veins created by the neovascularization are made smaller. The wound surface is epithelialized and the tissue healed 4.

A normal consequence of using elevators in extractions is that neighboring teeth become sensitive and difficult to chew. It is known from the literature that after extraction the alveolus is irradiated together with the lingual and buccal bone wall 6. Faster coagulation, fewer postoperative complaints and faster healing would be expected 7,8, 9. In our study we decided to use the to objectively evaluate the actual effect of low-level laser radiation on the healing process after extraction of the lower human molars 1,3,5, 7,8,9,10. The aim of the study was to

LASER EQUIPMENT

Low-level diode lasers, wavelength 670 nm, output power 20 mW and HeNe, wavelength 632.8 nm, power 5 mW were used for laser therapy (Fig. 1). We used the following laser frequencies:

Diode laser 670 nm, frequency 292 Hz
Diode laser 670 nm, frequency 9000 Hz
Diode laser 670 nm, frequency 5 Hz
He-Ne laser biostimulation, frequency 5 Hz
Control group - no laser radiation.

The use of low-level lasers is currently quite widespread in dental practices 2,13. These lasers are usually not only equipped with the continuous beam but also with the adjustable frequency setting. Often enough they have preset Nogier frequencies, Mastalier-adapted for dentistry (A = 292Hz, B = 584Hz, C = 1168Hz, D = 2336Hz, E = 4672Hz, F = 9344Hz, G = 146Hz). The knowledge available in the field of biostimulating laser therapy does not give a clear answer to the question of what is better for the organism: the use of a continuous beam, the switching between several different frequencies or the use of a beam modulated to an exact frequency. Recommended frequency levels for diagnoses in dentistry that can be found in the literature,

Smékal, Mašková: continuous (CW) beam, 5 Hz
Mastelier: 292 Hz - "A" frequency per Nogier
3000-9000 Hz per Navrátil
9300 Hz according to the travel guide for Oralaser Oralia Konstanz Switzerland

TEST ARRANGEMENT

We focused on the monitoring of 150 healthy patients between the ages of 18 and 65 after the extraction of their lower molars (Reason for extraction: semi-retention of the third lower molars, teeth 48,47,46,36,37, 38). All patients, including the control group, were briefly informed about the anti-inflammatory, analgesic, regenerative and immunomodulatory effects of the laser before the use of the laser. In accordance with the Helsinki Declaration of 1964 and 1989, they declared themselves ready to participate in this project in an informed manner. The patients were randomly divided into five groups. The patients in each group were treated with a low-level diode laser or with reading light after extraction (group 5 - placebo effect)

Group 1 (30 patients) - low-level diode laser, frequency, 292Hz, (Diode GaAIAs, wavelength 670nm, output power 20mW), density 1.5 J / cm2
Group 2 (30 patients) - low-level diode laser, frequency, 9000 Hz, (Diode GaAIAs, wavelength 670 nm, output power 20 mW), density 1.5 J / cm2
Group 3 (30 patients) - low-level diode laser, 670 nm, frequency 5 Hz, (Diode GaAIAs, wavelength 670 nm , Output power 20 mW), density 1.5 / J cm2
group 4 (30 patients) - He-Ne biostimul laser, wavelength 632.8 nm, power 5 mW), frequency 5 Hz, density 1.5 J / cm2
group 5, control (30 patients), was not laser treated at all after extraction.

OBJECTIVE AND SUBJECTIVE DETERMINATION OF THE TREATMENT EFFECT

Extraction method

We applied local anesthesia (Supracain, Léciva, Czech Rep., Mepivastesin, ESPE, BRD) and extracted the molar. We used scissors and (or) elevators. Immediately after the extraction, we irradiated the patients in groups 1 - 4 with the appropriate lasers and the appropriate frequencies and energy

density 1.5 J / cm2 1.9. The socket was irradiated along with the lingual and buccal bone wall. We inserted the dose in the central part of the wound. The patients were then irradiated with the laser for the next 4 days.

Determination of sIgA and albumin levels

An unstimulated saliva sample (approx. 1-1.5 ml) was obtained from each patient before treatment and on the fifth day. The quantitative determination of the secretory IgA and albumin was based on the principle of radial diffusion of saliva sIgA or albumin from the circular pit into a layer of agar gel with a monospecific antagonist. The resulting circular precipitate was scored after 96 hours when an end point of immunodiffusion was reached. The size of the ring depends on the concentration of the test protein, in our case sIgA and albumin. The concentration of the sample is read directly from the reference table in the kit. The use of the Binding Site commercial kit enables the rapid determination of sIgA and albumin in saliva and guarantees the reproducibility and standardization of the method. The sIgA and albumin concentrations after treatment were related to the values obtained from the first saliva sample and expressed as a percentage using the student test at the level of significance P = 0.05. The level of the first sample was considered 100% (Fig.2).

Bone density

As an additional marker for the analysis of the biostimulating effect of the laser, we evaluated the changes in bone density 6 months after the extraction. To obtain the X-ray image, we used the method of dental digital radiography (Radio Visio Graph - RVG, Trophy, France). Isometric images were taken in order to have the possibility of comparing the measurements using the fixed point measurement method. We can measure up to 7 specific dimensions. The method itself is non-invasive, as only 15% of the radiation exposure is required to obtain a conventional X-ray 14.

For the evaluation, we used digital images that were taken immediately after the extraction and continuously after 6 months. In order to record the integration in the entire area of the extraction wound, we used the method of RVG sectional images, which we took laterally through the extraction wound 7. For this reason, we recorded 3-5 sections depending on the area of the extraction bone. The cuts were 2 mm apart. For each slice we have created a density histogram that characterizes the density distributed over the slice. The histograms were evaluated with the computer software program Sigma Scan and Sigma Scan Pro (Jandel, Germany) (Fig. 3).

Subjective response of the patient to treatment

In order to evaluate fewer postoperative complaints, we have prepared a special card with relevant information about the patient: personal and health information, type of tooth and a 5-degree scale of the patient's sensation of - no change ++++ excellent results:

- no change
+ less post-operative discomfort
++ better subjective feeling
+++ best subjective feeling
++++ excellent result

RESULTS SIgA and albumin levels:

There was a significant difference between patients who were irradiated with the laser and the

control group (Count 1.) The levels of sIgA and albumin increased compared to the control group. The comparison of the control group with the patient groups treated with laser therapy who were irradiated with different frequencies (graph 2) shows the most significant increase in patients who received a laser frequency of 292 Hz, 9000 Hz and for both the albumin and sIgA levels and for 5 Hz for the sIgA level were treated. Bone density: The results are available in the form of a graph in which the density values of the individual sections for patients after the extraction and after 6 months as well as the difference between these two periods are compiled (graph 3).

Subjective response of the patient to the treatment
The better feeling of the patient after the laser therapy was observed. After laser therapy, the patients felt more comfortable with all laser types and different frequencies (Figure 4).

DISCUSSION AND CONCLUSION
The low-level laser has no influence on the process of osseous integration. This effect was observed in rats with He-Ne laser radiation 12 during fracture healing. We did not find any differences in bone density compared to the control group.

The frequencies recommended in the literature for wound healing often vary 1,8,9,10

Different frequencies can have different effects on sIgA and albumin levels 8,9,15. It is therefore important to use frequencies that increase both sIgA and albumin levels, or at least have no negative effect. We found significant differences in sIgA and albumin levels between patients who were exposed and those who were not.

The highest increase in sIgA and albumin levels was found in the group treated with the frequency of 9000 Hz. An increase in the marker values compared to the control group was found even in groups that were treated with other frequencies (5 Hz, 292 Hz).

Laser therapy objectively improves extraction wound healing and can be recommended as the method of choice16,17. We consider the healing of extraction wounds with the laser not only because of the subjective feeling of the patients, who accept the laser therapy largely positively due to its non-invasiveness and painlessness, but also because of the objectively proven changes in the sIgA and albumin level 8.15 as contributing.

ACKNOWLEDGMENTS
This research was supported by Grant Agency Ministry of Health of the Czech Republic No. 4091-3.

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