DIODE LASER THERAPY ON PERIODONTAL POCKETS WITH REGARDS TO ITS BACTERICIDAL ABILITIES AND THE IMPROVEMENT OF PERIODONTAL CONDITION-AN ORIGINAL RESEARCH

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ABSTRACT

Aim

The purpose of our study was to assess the bactericidal ability and in turn improving the condition of periodontal pockets with the help of Diode laser therapy.

Methodology

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 H2O2. Each appointment also included a hygienic checkup. 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 semi-quantitatively.

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.

**Keywords** root; scaling; microbiology, laser.

**INTRODUCTION**

For many intraoral soft-tissue surgical procedures the laser has become a desirable and dependable alternative to traditional scalpel surgery. The dental literature contains many case reports and uncontrolled case studies that report on the use of various laser wavelengths, predominantly diode, CO2, Nd:YAG, Er:YAG, and Er, Cr:YSGG, for various intraoral soft-tissue procedures, such as frenectomy, gingivectomy and gingivoplasty, de-epithelization of reflected periodontal flaps, second stage exposure of dental implants, lesion ablation, incisional and excisional biopsies, irradiation of aphthous ulcers, removal of gingival pigmentation, and soft-tissue crown lengthening.1,2 Lasers easily ablate and reshape oral soft tissues. In addition, lasers increase hemostasis through heat-induced coagulation and occlusion of arterioles, venules, and capillaries. The resulting hemostasis allows for a clear and fully visible surgical field. Because of the intense heat, lasers also have the advantage of a bactericidal effect at the target site. A few studies have reported that laser surgery, compared with traditional scalpel surgery, is less painful, features less swelling, and heals faster with less wound contraction.3,4 However, there are conflicting opinions on pain and speed of wound healing. Several papers comparing lasers with traditional scalpel wounding have reported either an equivalent effect or that laser surgery is accompanied by more pain and slower healing.5–9 The bactericidal mechanism is hypothesized to be associated with laser energy which is selectively absorbed by dark pigments (photodynamic therapy on the dark pigment), such as melanin and haemoglobin.10 In inflamed periodontal pockets, the increased blood supply due to erythema and inflammation causes the laser light to be absorbed by the haemoglobin, which is elevated in the inflamed pockets. Chromophores (associated with periodontal inflammation) will result in greater absorption of laser energy in the inflamed tissue compared to healthy tissue.11 Nd:YAG lasers have been reported to induce undesirable changes on root surfaces, such as charring and melting.12 To prevent severe thermal damage to dental pulp and root surfaces, narrow setting parameters are recommended (1.5–3 W (60–150 mJ/pulse at 10–20 Hz). This limits the clinical application of Nd:YAG lasers and accounts for the controversial reports and overall limited clinical evidence regarding the actual efficacy in periodontology.13 Moritz et al reported that diode laser therapy, in combination with scaling, supports healing of periodontal pockets by eliminating bacteria.14 Red spectrum laser light used under specific conditions can accelerate wound healing. It has been reported that laser-enhanced biostimulation produces metabolic changes within the host cells, which results in faster cell division, rapid matrix production, and cell movement.15 One additional feature of laser application is its ability to de-epithelialize the periodontal pocket. The carbon dioxide laser has been shown to eliminate sulcular and gingival (external) epithelium without disturbing the underlying connective tissue. Few controlled studies have enrolled adequate numbers of human subjects and evaluated the beneficial effects of helium-neon laser biostimulation for treatment of periodontal disease.16–18

**AIM OF THE PRESENT STUDY**
The purpose of our study was to assess the bactericidal ability and in turn improving the condition of periodontal pockets with the help of Diode laser therapy.

**METHODOLOGY**

The patients were randomly subdivided into two groups. Thirty-seven patients were assigned to the group that underwent laser treatment; however, three of them could not be considered in the final evaluation because of inadequate oral hygiene. Thirteen patients were used as controls, one patient dropped out due to illness. The criterion for inclusion in this study was that at least one periodontal pocket with a depth of at least 4 mm had to be present in each of the four quadrants. All patients were completely dentate. When wisdom teeth were present, they were included in the treatment but excluded from the evaluation. Measurements of the periodontal indices were carried out. The papillary bleeding index (PBI) and the plaque index according to Quigley and Hein were assessed and the depth of all periodontal pockets were measured using a special periodontal probe (Ash Parodontic 25G). All measurements were carried out by the same examiner. To create comparable conditions, the patients were asked to brush their teeth twice daily after meals and were instructed in proper oral hygiene. Furthermore, all patients underwent scaling at the first appointment. They were recalled 1 week later for microbiologic sampling. One sample per patient was obtained from the deepest approximal periodontal pocket. All periodontal pockets of all patients of this group were lased at an output power of 2.5 W, a pulse duration of 10 ms, and a frequency of 50 Hz. The duration of lasering depended on the depth of the respective periodontal pocket. The control group underwent rinsing with H2O2 at the second appointment, following the microbiologic examination. At the third appointment after two weeks, the patients of both groups underwent another microbiologic examination, the procedure used being the same as above. At the fourth appointment after 2 months, both groups again underwent an evaluation of the hygienic index. The patients of the lasered group again underwent lasering of all teeth. The fifth appointment after 4 months comprised the same treatment and examination procedures as the fourth appointment. At the last recall appointment after 6 months, microbiologic samples were again obtained from the same periodontal pockets as before using the same procedure.

**RESULTS**

The long-term bactericidal effect of the diode laser on Actinobacillus actinomycetemcomitans (AAC) is of interest as well. Bacterial reduction of AAC was achieved in 73.5% of the lasered patients; the remaining 26.5% had not been contaminated with this bacterium from the start. In contrast, 33.3% of the controls showed bacterial reduction, 16.7% consistent values, and 8.3% an increase in bacteria. More than 41% of the controls had not shown contamination with AAC from the start. A reduction in Prevotella intermedia (Pi) was achieved in 85.3% of the lasered patients and 58.35% of the controls. The papillary bleeding index (PBI) values improved in 96.9% of the lasered patients and remained the same in 3.1%. PBI improved in 66.7% of the controls and remained consistent in 33.3%. The number of periodontal pockets depth decreased in comparison to the initial value was markedly greater in the lasered group than in the control group. The control group, on the other hand, showed more periodontal pockets with an increased pocket depth than did the lased group. In the lasered group, the mean periodontal pocket depth decreased from 3.9 mm to 2.6 mm, especially in the molar region. In the control group, the mean initial periodontal pocket depth in the molar region was around 3 mm and decreased to 2.6 mm after 6 months. (Table 1)

**DISCUSSION**
The effect of laser irradiation on certain tissues depends on both the wavelength of the laser and the absorbing capacity of the lased tissue. A study by Gold et al. demonstrated that the application of the Nd:YAG laser for curettage of the pocket epithelium does not cause damage to the underlying tissue layers.\textsuperscript{19,20} Histologic sections revealed complete removal of the pocket epithelium without necrosis and carbonization of the connective tissue structures in 83\% of the cases. A theoretical paper by Rastegar et al. comparing the application of a high-power diode laser (810 nm) and a Nd:YAG laser (1,064 nm) for tissue coagulation showed that both lasers had similar effects. However, the heat building up at a depth of 0.2 cm in the prostatic tissue of a dog during irradiation with a diode laser was almost 1.5 times that caused by the Nd:YAG laser. This means that the diode laser radiation was absorbed mainly by the superficial prostatic layers. Rastegar et al. examined the absorption of laser radiation by oxygenated and deoxygenated blood and found an absorption of 4.5 cm\(^{-1}\) and a penetration of 2.2 mm in both. A comparison of the absorption values of other tissues examined in that study (liver, heart, prostate) revealed that the greatest absorption occurs in oxygenated and deoxygenated blood. It can thus be concluded that tissue that is very well supplied with blood too shows a high absorbing capacity.\textsuperscript{21} Morlock et al. observed melted and re-solidified porous globules consisting of root mineral substance at the root surface following Nd:YAG laser treatment.\textsuperscript{21} The impressions in the root cementum had a mean depth of 20–30 mm. Infrared spectroscopic examinations carried out by Spencer et al.\textsuperscript{22} revealed a decrease in the protein/mineral ratio of the root surface following Nd:YAG laser treatment. Cobb et al. reported a significant reduction in periodontopathic bacteria.\textsuperscript{23} However, the cementum surface was damaged by the high energy levels of 1.75 W and higher in vivo. As far as bacterial reduction in periodontal pockets is concerned, the diode laser is expected to have a disinfecting thermal effect on bacteria that is basically limited to the root surface. The thermal effect of the laser beam is based on the absorption of radiation by tissue and subsequent transformation of laser energy into heat. Tissue absorbs a certain amount of laser radiation per volume and transforms it into a certain amount of energy, depending on the exposure time used. The amount of energy absorbed depends on the type of tissue irradiated and the wavelength of the laser. Because the effects of laser treatment on periodontal tissue basically depend on the wavelength, pulse energy, frequency, and spot size used, we consider the diode laser an interesting alternative to conventional IR lasers in periodontal treatment. Furthermore, lasing is a treatment modality that is finding very good acceptance with patients because it involves minimal pain.

**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.

**REFERENCES**


**TABLES**

**Table 1- Comparison Between Initial and Final Findings**

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<th>Lased group</th>
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*TC, Total bacterial count; AAC, Actinobacillus actinomyctemcomitans; Pi, Prevotella intermedia*