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Diode Lasers in Non Surgical Periodontal Treatment

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Abstract: ***One of the most widely studied areas in recent years with regard to periodontal treatment is the clinical application of lasers. To date, however, there is insufficient evidence to show significant improvement in clinical parameters when using lasers compared to conventional mechanical therapy – scaling and root planing (SRP)***

Keywords: diode lasers, periodontal therapy

1. Introduction

One of the most widely studied areas in recent years with regard to periodontal treatment is the clinical application of lasers. To date, however, there is insufficient evidence to show significant improvement in clinical parameters when using lasers compared to conventional mechanical therapy – scaling and root planing (SRP).

One of the most common applications of lasers in periodontology is the non-surgical treatment of chronic periodontitis. Lasers are used as monotherapy or in addition to SRP. The suspected benefits include subgingival curettage, minimally invasive access for debridement, and detoxification and destruction of subgingival parodontal pathogens. [1-6]

The diode laser uses a semiconductor with an electric pump to produce a laser beam with wavelengths in the range of 655 to 980 nm. The wavelength is most absorbed by pigmented tissues, making this laser the most suitable for application to soft tissues.

The active media of diode lasers are solid semiconductors of aluminum, gallium, arsenide, and sometimes indium, which produces laser wavelengths ranging from about 810 nm to 980 nm. All wavelengths of diode lasers are mainly absorbed by tissue pigments (melanin) and hemoglobin. On the other hand, they are not well absorbed by hydroxyapatite and water present in the enamel. Some of the procedures that can be done include aesthetic recontouring of the gingiva, clinical crown lengthening, removal of inflamed and hypertrophic tissues, frenectomies and photostimulation of aphthous and herpetic lesions.[7]. They are suitable for surgical manipulation in highly vascularized tissues, leading to coagulation and minimal bleeding in the gingiva [8]

Diode lasers in periodontology

In vitro studies have tested the efficacy of diode lasers in periodontal debridement using several models: 665-nm AlGeAs (aluminium–germanium–arsenide) [9], 810 nm GaAlAs (gallium-aluminum-arsenide) laser [9, 10], 655 nm GaAlAs laser [11] and a 980 nm diode laser [12]. In all these studies there was a minimal increase in temperature of 5 ° C above the accepted limits. The bactericidal effect of these lasers depends on the type of bacteria, the wavelength and the dose [11]. In vitro removal of calculus with diodea laser appears to be consistent and comparable to manual SRP. [9-12]

In in vivo studies with diode laser, large amounts of calculus have been detected after treatment and significant structural damage to the root surface [11]. Yilmaz et al. [13] used the GaAlAs laser in a randomized controlled trial and did not find any beneficial effects compared to SRP alone.

In our study using the Elexxion claros diode laser, 50 Watt with fiber tip 300 µm, the settings of the laser device in the program "Germ reduction in pockets" - pulse output 1.0 W; pulse freq. CW; pulse duration CW; avg. power 1 W for 15 seconds there was no statistically significant improvement in the clinical parameters tested compared to SRP alone.[14]

A study of Assaf et al. [15] uses a diode laser in combination with ultrasound scaling to treat gingivitis. They showed a significantly lower incidence of bacteraemia in the diode laser + ultrasound group (36%), compared to the ultrasound group (68%). They offer diode lasers to be used to prevent bacteraemia, especially in immune compromised patients.

The use of a 980 nm diode laser to reduce parodontopathogens in patients with aggressive periodontitis has been investigated. Kamma et al. [16] confirm that it is possible to reduce the total bacterial count in periodontal pockets without using systemic antibiotic therapy.

A study of Romanos and Brink [17] with 10 patients in a randomized protocol uses SRP + diode laser 980 nm, SRP + Nd: YAG laser and SRP with photodynamic therapy (PDT). The results show that the PDT group is able to significantly reduce bacteria in the periodontal pockets and provide predictable clinical outcomes for 3 months. In contrast, the use of a Nd: YAG laser is not very useful and shows a result similar to the control (SRP) group.

Two studies with close experimental designs and diametrically opposed results show how different laser wavelengths can have an effect on cells in vitro. In the first study GaAs and GaAlAs diode lasers were used at parameters ranging from 0.95 to 6.32 J / cm2 and the effect of laser irradiation on the synthesis of prostaglandin-E2 (PGE2) and cyclooxygenase-1 and 2 (COX-1 and COX-2) gene expression by gingival fibroblasts [18]. The authors report that exposure to GaAs and GaAlAs diode lasers significantly inhibits the production of PGE2 in a dose-dependent manner, which in turn leads to a decrease in COX-2 and mRNA levels.

Other in vitro studies reported a lack of positive effect on the attachment of periodontal cells to the root surface after

GaAlAs diode laser irradiation at 1 W for 20 seconds [11] or harmful ultrastructural changes that could disrupt collagen synthesis [19]. Despite these data, Kreisler et al. [20] reported that low energy iradiation with a GaAlAs diode laser (10 MW for 75, 150 and 300 seconds) had a stimulating effect on the proliferation of periodontal fibroblasts in vitro. In view of the findings of these studies, it can be concluded that different levels of power and exposure time lead to different results.

Another example of the importance of parameter selection was reported by Kreisler et al. [21] after in vitro iradiation of root surfaces with a GaAlAs diode laser. The study showed little to no root damage at power ≤ 1W and different rate of carbonization and thermal cracks at 1.5, 2.0 and 2.5 W.

2. Conclusion

The role of laser therapy in the non-surgical treatment of periodontitis remains controversial and further evidence are needed.

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