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Lasers in Periodontics- A dilemma

M Mittal, R Mishra, P Sikri

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Abstract

With the development of the first laser by Mainam in 1960[1], over decades, the subject has grown by leaps and bounds in dentistry over the conventional therapies. However, despite a large number of studies, the application of lasers for the treatment of periodontitis remains controversial. Lasers used today are either a continuous, pulsed (gated) or running pulse waveform. E.g. CO_2, Nd:YAG, Ho:YAG, Er:YAG, Er,Cr:YSGG, Nd:YAP, GaAs(diode) and Argon. Two main factors that determine the extent of energy absorption is the wavelength of the light used and the optical properties of the tissue. Others include pigmentation, water content, mineral content, heat capacity and latent heat of transformation. Lasers tissue interactions include the physiologic and mechanical processes of heat conduction and dissipation, the degree of tissue inflammation and vascularity and the availability of progenitor cells to participate in the healing process. The present article is a literature review designed to assess the rationality of using lasers in periodontal therapy.

INTRODUCTION

With the development of the first laser by Mainam in 1960[1], over decades, the subject has grown by leaps and bounds in dentistry over the conventional therapies. However, despite a large number of studies, the application of lasers for the treatment of periodontitis remains controversial. Lasers used today are either a continuous, pulsed (gated) or running pulse waveform. E.g. CO_2, Nd:YAG, Ho:YAG, Er:YAG, Er,Cr:YSGG, Nd:YAP, GaAs(diode) and Argon. Two main factors that determine the extent of energy absorption is the wavelength of the light used and the optical properties of the tissue. Others include pigmentation, water content, mineral content, heat capacity and latent heat of transformation. Lasers tissue interactions include the physiologic and mechanical processes of heat conduction and dissipation, the degree of tissue inflammation and vascularity and the availability of progenitor cells to participate in the healing process. The present article is a literature review designed to assess the rationality of using lasers in periodontal therapy.

CLINICAL APPLICATIONS

ORAL SOFT TISSUE APPLICATIONS

Lasers have been used instead of the conventional scalpel for intraoral soft tissue procedures like frenectomy, gingivectomy and gingivoplasty, de-epethelization, removal of granulation tissue, second stage exposure of dental implants, lesion ablation, incisional and excisional biopsies of benign and malignant lesions, irradiation of apthous ulcers, coagulation of free gingival graft donor sites and gingival depigmentation. The several advantages ascribed to laser use include coagulation leading to better visualization, less pain, faster healing and less scarring. Better visualization due to coagulation is clinically obvious benefit. However, a comparison of wound healing following irradiation by the Nd:YAG and CO2 lasers indicates that CO2 laser–induced wounds in oral, oropharyngeal and laryngeal mucosa healed significantly faster than those created by the Nd:YAG laser, but both heal slower than the conventional scalpel-induced wound[2]. White et al[3] used CO2, Nd:YAG, Er:YAG, and two diode wavelengths (815 and 980 nm)was determined that high power (watts), long pulse duration, high repetition rates (hertz), and long interaction times (duration of target exposure) all increased the risk of detrimental outcomes.

ORAL HARD TISSUE APPLICATIONS

Exposure of bone to heat at or above 47 is reported to induce cellular damage leading to osseous resorption and temperature levels of 60 results in tissue necrosis[4]. The results except that of two wavelengths – Er:YAG and Er,Cr:YSGG have been detrimental. Two studies have compared healing of tibial osteotomy defects in rats created by rotary bur, CO2 (780 and 1,032 J/cm2) and Nd:YAG lasers (714 and 1,000 J/cm2). At all time intervals (0 to 63 days post-treatment), regardless of energy density or use of air/water surface coolant during irradiation, the osseous healing response was severely delayed[5,6]. Severe collateral damage has been accounted for delayed healing evident by the charring and melting of the treated surface, presence of inert bone fragments encapsulated by fibrous connective tissue , sequestra of bone and its fragments surrounded by multinucleated giant cells . When considering laser-mediated osteotomy or ostectomy, the Er,Cr:YSGG appears to be a popular laser with clinicians. Yet, even with this wavelength, there is a paucity of evidence in the literature to support its use on bone.

LASER- INDUCED ROOT SURFACE MODIFICATIONS

The CO_2, Nd:YAG, and also diode laser have been shown to induce cementum damage and have little applicability in subgingival therapy. The CO_2 and Nd:YAG lasers have yielded unsuitable results by charring and melting of root surface. Nd:YAG has produced mixed results when used with varying parameters[7,8,9]. Er:YAG proved to be an effective tool in calculus removal, root etching and creation of a biocompatible surface for cells or tissue reattachment with effective use of water spray surface coolant. In an in vitro study, Crespi et al[10] noted that use of the Er:YAG laser in a defocused non-contact mode effectively removed calculus with only minimal removal of cementum.

EFFECT OF LASERS ON BACTERIA AND CALCULUS

Lasers, as a group, have inconsistently demonstrated the ability to reduce microorganisms within a periodontal pocket. Mechanical root debridement still remains a priority to attain improvements in clinical attachment levels. Eberhard et al[11] compared mechanical scaling and root planning with laser assisted SRP in situ. Microbial samples were taken prior to and immediately after treatment for DNA probe analysis. Following tooth extraction, scanning electron microscopy using digitized planimetry was used to measure residual calculus. Results showed that only 68.4% of the root surface was calculus free in contrast to 94% after mechanical SRP while both treatments resulted in similar reductions

of pathogenic bacteria. An in vivo study compared SRP to SRP followed by irradiation with the Nd:YAG laser at a relatively high energy density of 124 J/cm2. Treated pockets were irradiated once per week for 3 weeks. Levels of Pg, Pi, and Aa were determined at 6 months post-treatment, and only levels of Pg were found to be significantly reduced compared to SRP.[12]

CONCLUSION

Given the same wavelength, dissimilar parameters yield different levels of energy density for varying periods of time and thereby different degrees of change in the target tissues.

Also, the same laser can be used at different wavelengths to yield different clinical outcomes. There are numerous studies, both in vivo and in vitro giving conflicting results; therefore there is a demand for more multicenter collaborative studies and clinical trials before attributing lasers any superiority over the conventional scalpel. In the present scenario, lasers have far drawn the attention regarding contemporary trends in periodontics but the cost, size and dearth of adequate evidence, currently delimits the flourished use of lasers in the specialty of Periodontics.

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Author Information

Manoj Mittal
MDS, Professor and head, Dept of Periodontics, Mauras College of Dentistry and Oral Research Institute

Rahul Mishra
MDS, Senior lecturer, Dept of Periodontics, Seema Dental College and Hospital

Poonam Sikri
MDS, Professor and Head, Dept of Periodontics, Seema Dental College and Hospital