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Lasers a Boon or Myth in Periodontal and Implant Therapy: An Overview

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***Abstract*---**In the past 100 years there has been extensive development of the mechanical cutting devices used in dentistry. From the end of the 20th century until now, there has been a continuous upsurge in the development of laser-based dental devices based on photo-mechanical interactions. Basically, lasers have the potential advantages of bactericidal effect, detoxification effect, and removal of the epithelium lining and granulation tissue, which are desirable properties for the treatment of periodontal pockets. To use lasers safely in a clinic, the practitioner should have precise knowledge of the characteristics and effects of each laser system and their applications as well as a full understanding of the conventional treatment procedures.

***Keywords*---**lasers, implants, dentistry, periodontal, treatment.

Introduction

The word "laser" is an acronym for "light amplification by stimulated emission of radiation."1 It refers to a device that emits light that is spatially coherent and collimated; a laser beam can remain narrow over a long distance, and it can be tightly focused. When directed at tissues, different interactions result. The absorption, reflection, transmission, and scattering of the laser light vary depending on the wavelength of the laser and the characteristics of the tissue. In 1917 Einstein published ideas on stimulated emission of radiation. Maiman developed the first laser prototype in 1960 using a crystal of ruby as a medium that emitted a coherent radiation light, when stimulated by energy. The first dental lasers approved by the US Food and Drug Administration, namely the

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CO2, the Nd:YAG and the diode lasers, were accepted for use only for oral soft tissue procedures in periodontics.2

Classification of lasers

- Classification based on light spectrum5:

U.V. light	100nm-400nm	Not used in dentistry
Visible light	400-750nm	Most commonly used in dentistry (argon & diagnodent laser)
Infrared light	750-10000nm	Most dental lasers are in this spectrum

- Classification according to material used:

Gas	Liquid	Solid
Carbon dioxide	Not so far in clinical use	Diodes, Nd:YAG, Er:YAG, Er,Cr:YSGG

Laser - tissue interaction

Laser light has four types of interactions with the target tissue which depends on the optical properties of that tissue: Absorption, transmission of laser energy, reflection and scattering of the laser light [Fig.1].3, 4

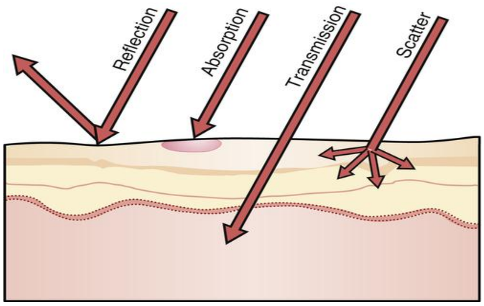

Figure 1. Laser tissue interaction.
Courtesy: pocketdentistry.com

Lasers versus conventional therapy
Soft tissue applications

Currently, lasers are generally accepted and widely used as a tool for soft tissue management. The major advantageous properties of lasers are relative ease of ablation of tissues together with effective hemostasis and bacterial killing. Gingivectomy, gingivoplasty and frenectomy are the most popular procedures carried out using lasers. Compared with the use of a conventional scalpel, lasers can cut, ablate and reshape the oral soft tissue more easily, with no or minimal bleeding and little pain as well as no or only a few sutures. Laser surgery occasionally requires no local anesthetic, or only topical anesthetic.6 Thermal effects on the teeth and surrounding tissues are still a concern when using deeply penetrating types of lasers.

The deeply penetrating lasers, such as the Nd:YAG and diode lasers, can be used to cut and reshape soft tissues. The surgical technique used with Nd:YAG or diode laser is similar to that of electrosurgery. Only the Nd:YAG laser is contraindicated for the management of peri-implant soft tissue because this laser interacts readily with titanium that is found in most implants .

Nonsurgical pocket therapy

- **Conventional root debridement**
  In periodontal pockets, the exposed root surfaces arecontaminated with an accumulation of plaque and calculus, as well as infiltration of bacterial endotoxins into the cementum. Complete removal of bacterial deposits and their toxins from the root surface within the periodontal pockets is not always achieved with only the use of conventional mechanical therapy. In addition, access to areas such as furcations and grooves is limited owing to the complicated root anatomy.7
- **Removal of subgingival calculus**
  The CO2 laser cannot be used for calculus removal because this laser readily causes melting and carbonization on the dental calculus. The Nd:YAG laser is also basically ineffective for calculus removal when a clinically suitable energy is employed. Unlike these lasers, the Er:YAG laser is capable of easily removing subgingival calculus without a major thermal change of the root surface in vitro. The level of calculus removal by this laser is similar to that of ultrasonic scaling, and the depth of cementum ablation has been reported generally to be 15–30 µm when the contact tip is applied obliquely to the root surface.
- **Root surface alterations**
  The CO2 laser readily carbonizes the root cementum, and cyan-derived toxic products, such as cyanamide and cyanate ions, have been clearly detected on the carbonized layer by chemical analysis using Fourier transform infrared spectroscopy. The residual char layer has been demonstrated to inhibit periodontal soft tissue attachment in vivo, and thus focused CO2 laser irradiation is contraindicated for root surface treatment. Regarding the Nd:YAG laser, surface pitting and crater formation with charring, carbonization, melting and crater production have been reported after irradiation in vivo, even when irradiation was performed parallel to the tooth surface. 7
- **Periodontal pocket treatment**
  One of the possible advantages of laser treatment of periodontal pockets is the debridement of the soft tissue wall. Conventional mechanical tools are not effective for the complete curettage of soft tissue. Gold & Vilardi reported the safe application of the Nd:YAG laser (1.25 and 1.75 W, 20 Hz) for removal of the pocket-lining epithelium in periodontal pockets without causing necrosis or carbonization of the underlying connective tissue in vivo.8 Recently, use of an Nd:YAG laser in a laser-assisted new attachment procedure (LANAP) has been advocated to remove the diseased soft tissue on the inner gingival surface of periodontal pockets (Food and Drug

Administration 510 k clearance K030290). Furthermore, in an animal study the Er:YAG laser also seems to induce new cementum formation after pocket irradiation.9

Laser applications in implant dentistry

Various lasers have been applied in the field of implant dentistry for uncovering the submerged implant (second-stage) prior to placement of the healing abutment. Use of lasers in these procedures may have several advantages, including improved hemostasis, production of a fine cutting surface with less patient discomfort during the postoperative period, and favorable and rapid healing following abutment placement, thus permitting a faster rehabilitative phase.10 Furthermore, because of the ability of the laser to produce effective bone tissue ablation, some researchers have suggested using the Er:YAG laser to prepare fixture holes in the bone tissue in order to achieve faster osseointegration of the placed implants and to produce less tissue damage in comparison to conventional bur drilling. Although these studies demonstrated uneventful wound healing of the laser-prepared fixture holes and effective osseointegration, the results are still controversial and there was no consensus regarding the superiority of the application of lasers.

Many clinicians want to know if lasers can be used to treat peri-implantitis, but it is impossible today to investigate this question using randomized clinical trials due to the lack of comparable test and control sites. However, there are applications for lasers in implant dentistry, including for second stage surgery, removal of peri-implant soft tissues, and decontamination of failing implants. Serious concerns about the implant overheating followed by melting of the implant surface have been raised, along with concerns about a lack of reosseointegration following treatment of peri-implantitis with lasers. Recent systematic reviews have focused on the latter question and provided more information about how implants can restabilize following implant surface laser decontamination. Recent systematic reviews have shown that there is limited information available about laser assisted decontamination of implant surfaces, with high heterogeneity of results and a low number of included studies. However, although information is limited about the clinical application of CO_2 (10.6 µm) laser in the surgical treatment of peri-implantitis, its use appears promising.11

Conclusion

Traditional mechanical therapy has various drawbacks in techniques and effects, and lasers have been introduced as an adjunctive or substitute tool for mechanical treatment. The huge financial cost of a laser unit is a significant barrier for laser utilization by periodontal practitioners. As knowledge of the nature of laser light evolves, lasers will be used more effectively in the treatment of periodontal diseases. Lasers have a place in the future of dentistry and may become as standard in dental practice as they are in medicine.

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