LASER TECHNOLOGY TO MANAGE PERIODONTAL DISEASE: A VALID CONCEPT?

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SORT SCORE			
A	**B**	C	NA

SORT, Strength of Recommendation Taxonomy

LEVEL OF EVIDENCE		
1	**2**	3

See page A8 for complete details regarding SORT and LEVEL OF EVIDENCE grading system

ABSTRACT

Present day dental lasers can create oral environments conducive for periodontal repair.

Background and Purpose

With the bacterial etiology of periodontitis and the resulting host inflammatory reaction, clinicians continue to search for therapeutic modalities to assist in the non-surgical management of periodontal disease. Traditional chairside therapies consist of mechanical debridement with manual and/or ultrasonic instrumentation with the objective of removing calculus, biofilm, and endotoxin from tooth root surfaces. Decreasing the microbial stimuli and associated end products decreases the inflammatory reaction and allows the host an opportunity to regenerate tissue through wound healing. The purpose of this article is to examine whether dental lasers, which have been in use for the past 3 decades, may augment traditional non-surgical periodontal therapy.

Methods

Review of research publications related to lasers and non-surgical periodontics with attention focused on systematic studies.

Conclusions

Studies utilizing laser technology may demonstrate positive effects on 1) selectively decreasing the biofilm environment, 2) removing calculus deposits and neutralizing endotoxin, 3) removing sulcular epithelium to assist in reattachment and decreased pocket depth, and 4) biostimulation for enhanced wound healing. Comparisons of studies to determine the difference between lasers and their respective effects on the periodontium are difficult to assess due to a wide variation of laser protocols.

Key words: periodontitis, periodontal disease, laser, bio-stimulation, non-surgical periodontal debridement, diode laser, dental hygiene

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J Evid Base Dent Pract 2014;14S: [154-159]

1532-3382/$36.00

http://dx.doi.org/10.1016/j.jebdp.2014.03.010

INTRODUCTION

The primary objective of periodontal therapy is to maintain the dentition in comfort, function and esthetics. The focus of this management is centered on controlling both bacterial etiology and the host defense system through host modulation. Therapy is generally divided into two categories: 1) surgical and 2) nonsurgical periodontal therapy. The objective of nonsurgical therapy includes plaque biofilm control, supra- and subgingival scaling, root planing, and the adjunctive use of chemical agents. Scaling is defined as instrumentation of the crown and root surfaces of the teeth to remove plaque, calculus, and stains from these surfaces. Root planing is a treatment procedure designed to remove cementum or surface dentin that is rough, impregnated with calculus, or contaminated with toxins or

microorganisms. An additional procedure called curettage has been also included in nonsurgical periodontal therapy and it includes the process of debriding the soft tissue wall of a periodontal pocket.

The objective of this paper is to introduce the role of lasers in accomplishing the objectives of nonsurgical periodontal management as related to both the stated goals of procedures within the management process and to investigate additional modalities such as biostimulation.

LASER FUNDAMENTALS

Laser was introduced into dentistry in the 1980's, with significant attention for the past three decades (see **Figure 1**). Dental lasers are divided into several categories dependent on wavelength with most for dental use being in the range of 500 nm to 10,000 nm. Several media exist to generate the energy from semi conductors to crystals and each creates a particular wavelength with a particular affinity for a respective target (chromophore) based on absorption coefficients and depth of penetration (see **Figure 2**). A chromophore is the part of a molecule responsible for its color and attracts a particular wavelength. The chromophores found in the oral tissue are melanin, hemoglobin, oxyhemoglobin and water.

For the oral cavity, the target tissue for lasers is soft tissue is gingival epithelium and/or hard tissue containing apatite crystals in teeth and osseous structures. The interaction of the different wavelengths on targets can be photo thermal, photochemical, photomechanical and photo acoustic effects (see **Figure 3**). Since some laser media such as the diode are attracted to pigment they may be used for hemostasis and as an antimicrobial effect.[1]

MICROBIOLOGIC EFFECTS

A laser with its ability for irradiation will have an antimicrobial effect and thus the potential as an addition to traditional periodontal nonsurgical therapy.[2] All lasers have some photo thermal effect and most periodontal pathogens are eliminated above 50 °C.[1]

Nd:YAG and diode lasers are absorbed by bacteria, especially those with pigmentation, and therefore reduce re-colonization.[3] Predominate periodontal pathogens are gram negative anaerobic bacteria and include those that are considered to be black pigmented. The reduction in bacterial activity has a significant effect by decreasing the primary etiology of periodontal pathology, and can also impact wound healing with possible alleviation of patient discomfort.[4] Nd:YAG lasers have a bactericidal effects against gram negative anaerobes including black pigmented *Bacteroides* and it has been shown that the Nd:YAG can selectively kill pigmented pathogens without disturbing surrounding tissues.[5] Considerations for laser impact on black pigmented organisms are that these

Figure 1. LASER is an acronym for Laser Amplification of Stimulated Emission by Radiation.

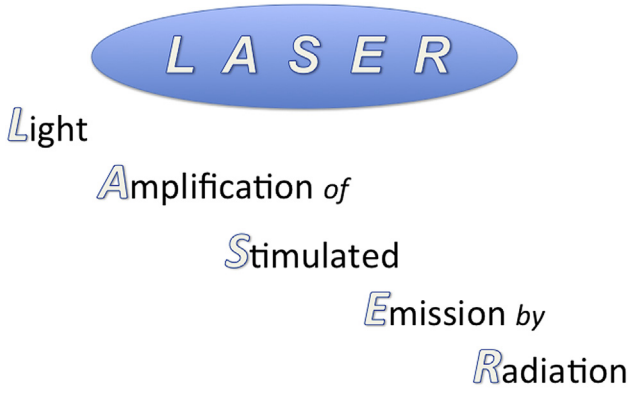
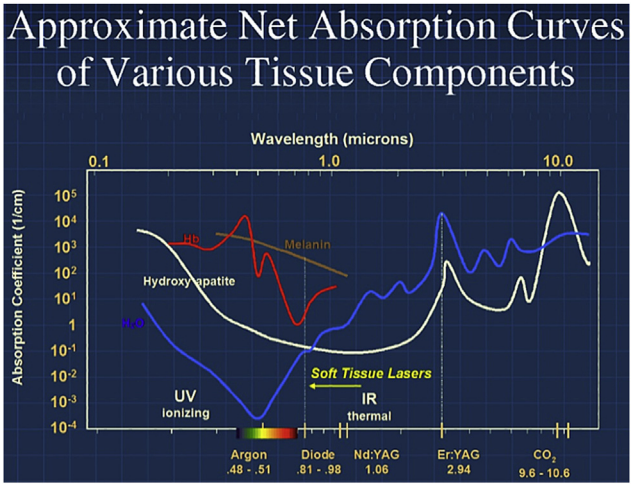


Figure 2. Laser wavelengths have an affinity/attraction to targets based on absorption curves.



organisms are only pigmented when placed on blood cultures, while several other periodontal pathogens are not pigmented. Since diode lasers have an affinity for pigment they therefore can have a significant bactericidal effect when used in the sulcus (see **Figure 4**). This effect has also been seen when the diode was used with scaling and root planing with aggressive periodontitis when *P. gingivalis* and *T. denticola* were reduced more in the SRP with diode laser treatment than SRP or laser treatment alone.[6] The erbium lasers also demonstrate some antimicrobial activity in endodontic procedures; this effect is not due to an attraction to bacterial pigment but more likely from a photo acoustic activity.[7] Studies have compared periodontal treatment with Er:YAG versus scaling and root planing. The Er:YAG treatment resulted in greater gains in clinical attachment levels with the most significant difference in increased pocket depths. No differences were detected in the microbiological analysis of the study.[8]

Photodynamic therapy (PDT) may have potential as an adjunct to periodontal debridement. Whether using a 'cold'