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REVIEW ARTICLE

The role of lasers in the treatment of peri-implant diseases: A review

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KEYWORDS

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Review

Abstract We reviewed the indexed literature regarding the efficacy of laser therapy in the treatment of peri-implantitis (PI). Databases were searched using combinations of the following keywords: peri-implantitis, bone loss, photodynamic therapy, laser, and light-activated disinfection. Titles and abstracts of publications from these search results were screened to determine which studies fulfilled the eligibility criteria. Full texts of relevant studies were read and independently assessed against the eligibility criteria. The resulting 28 studies described the role of lasers in the treatment of PI. The erbium:yttrium–aluminum-garnet laser can be used to sterilize implant surfaces without damaging them. Likewise, the carbon dioxide laser can disinfect implant surfaces and enhance the bone-to-implant contact around previously infected sites. Photodynamic therapy exhibits high target specificity and can destroy pathogens associated with the etiology of PI. Laser therapy can significantly reduce levels of clinical markers of peri-implant tissue inflammation (i.e., bleeding upon probing and clinical attachment loss) without jeopardizing the integrity of the implant or alveolar bone. In conclusion, laser therapy as an adjunct to conventional mechanical debridement therapy can be used effectively for the treatment of PI.

Contents

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1. Introduction

Peri-implantitis (PI) is a disease of the tissues surrounding dental implants. Roos-Jansåker et al. (2006a,b) defined PI as an inflammatory condition in which implants with varying degrees of bone loss are accompanied by a probing pocket depth (PPD) of at least 4 mm, bleeding on probing (BOP), and purulent discharge upon probing. PI occurs in 10% of implants and in 20% of patients within 5–10 years after implantation (Mombelli et al., 2012). However, the reported prevalence of PI is variable (Mombelli et al., 2012; Schuldt Filho et al., 2014; Costa et al., 2012). Risk factors associated with the etiology of PI include poor oral hygiene or plaque control (Javed et al., 2009), previous history of periodontal disease (Javed et al., 2009), stagnation of residual cement in or around the gingivae after implant prosthesis cementation (Pette et al., 2013), occlusal overloading (Naert et al., 2012; Tawil, 2008), smoking (Galindo-Moreno et al., 2014), and systemic diseases, such as poorly controlled diabetes (Javed and Romanos, 2009), osteoporosis (Chen et al., 2013), and human immunodeficiency virus infection (Hwang and Wang, 2007).

Ideally, treatment of PI should focus on infection control, detoxification of implant surfaces, regeneration of lost tissues, and plaque control regimes via mechanical debridement with or without raising a surgical flap (Bautista and Huynh-Ba, 2013; Schou et al., 2004). New innovative therapeutic regimes, such as laser-supported and photodynamic therapy (PDT), have emerged as useful treatments for periodontitis and PI (Qadri et al., 2011, 2010; Vohra et al., 2014; Javed et al., 2013; Javed and Romanos, 2013; Leja et al., 2013; Romanos et al., 2009, 2013; Romanos and Weitz, 2012). Romanos and Nentwig (2008) investigated the efficacy of a carbon dioxide (CO_2) laser in the decontamination of failing implants. After a mean follow-up of 27 months, virtually complete bone regeneration occurred in the peri-implant defects. In a preclinical study in dogs, Nevins et al. (2014) assessed the efficacy of an erbium:yttrium–aluminum-garnet (Er:YAG) laser in reestablishing bone-to-implant contact around sites with PI. After 3 months of treatment, the animals were killed, and the jaw segments were resected and prepared for histologic assessment. Only animals treated with the Er:YAG laser demonstrated elimination of the inflammatory tissue and complete osseointegration with the implant surface (Nevins et al., 2014).

Laser dentistry has revolutionized modern clinical dental practice and research (Javed and Romanos, 2013). The aim of the present study was to provide a comprehensive review of literature concerning the efficacy of laser therapy in the treatment of PI.

2. Materials and methods

To determine which published studies were pertinent to laser therapy of PI, we established a set of eligibility criteria for inclusion in our study. The following eligibility criteria were imposed: (1) original articles; (2) experimental human studies; (3) experimental animal studies; (4) articles published only in English-language; and (6) full-text articles (Randomized and Controlled Clinical Trials). PubMed/Medline (National Library of Medicine, Bethesda, Maryland), EMBASE, Scopus, ISI Web of Knowledge and Google Scholar databases were searched for publications published between 1991 through August 2015, using different combinations of the following keywords: peri-implantitis, bone loss, photodynamic therapy, laser, and light-activated disinfection. Titles and abstracts of these studies were screened against the eligibility criteria (Fig. 1). Full texts of the remaining relevant studies were read and assessed against the eligibility criteria. During this search, potentially relevant articles that were cited within our primary library were also evaluated.

3. Results and discussion

Our initial search of the indexed literature yielded 171 unique publications (Fig. 1). After scanning the titles and abstracts, we excluded 25 publications that did not meet our eligibility criteria. We read the remaining 146 articles in full and eliminated 118 articles (including 11 reviews) that did not meet our criteria. The remaining 28 publications were included in our systematic review.

3.1. Disinfection of dental implant surfaces with the Er:YAG laser

Implant surface characteristics (e.g., surface roughness) play an important role in the osseointegration and long-term survival of dental implants (Javed et al., 2011). The Er:YAG laser has a high absorbability in water. This laser is capable of removing the microbe-infiltrated oxide layer from the surface of dental implants without compromising the implant surface characteristics or surrounding alveolar bone (Yamamoto and Tanabe, 2013; Takasaki et al., 2007).

In their study on dogs, Nevins et al. (2014) investigated the ability of the Er:YAG laser to treat PI by removing the contaminated titanium oxide layer from implant surfaces. After 3 months of follow-up, animals were examined clinically to assess the severity of peri-implant soft tissue inflammation. Afterward, the animals were killed, and their jaw segments (containing the implants and surrounding tissues) were assessed histologically. Minimal gingival inflammation was observed in the clinical examination. The histologic results showed bone formation with sufficiently enhanced bone-to-implant contact (Nevins et al., 2014). Yamamoto and Tanabe (2013) also reported that the Er:YAG laser is effective in stripping the titanium oxide layer from implant surfaces without damaging the implant surface or bone.