

Photobiomodulation Laser Strategies in Periodontal Therapy

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Abstract Laser is considered basically effective for treating periodontal diseases because of its excellent physical properties namely ablation, hemostasis, bacterial killing and cell stimulation. The current laser application mainly used for the treatment of periodontitis is high-power laser ablation (HLLT). Laser ablation of diseased periodontal tissues using the HLLT is widely performed, partly expecting a simultaneous photo-bio-modulation effect (LLLT) in the surrounding tissues. In periodontal pocket therapy, laser can not only ablate the diseased tissues but also stimulate or activate the surrounding gingival and bone tissues, which would result in improved pocket healing and tissue regeneration. By elucidating the photo-bio-modulation effect in detail, this effect could be used more effectively and laser therapy would be more advantageous in non-surgical and surgical therapies of periodontitis as an adjunctive or alternative means to current mechanical treatment. As a future strategy of periodontal therapy, the photo-therapy using photo-bio-modulation/activation and photo-dynamic effects could be developed increasingly for prevention and control of periodontal diseases.

Keywords: Photo-bio-modulation, periodontal diseases, periodontitis, periodontal pocket, bone, Er:YAG laser.

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Introduction

The most common form of periodontal disease is a chronic, inflammatory and infectious disease, leading to episodic and progressive loss of periodontal tissues including gingival tissue, periodontal ligament and bone tissue. Recently, a variety of lasers have been used for a broad range of oral-facial conditions including periodontal therapy [1, 2]. The use of lasers is considered safe and effective for treating such inflammatory and infectious diseases as periodontitis. Lasers have numerous physical properties that can effect a broad range of biological responses that are suitable for treating a variety of periodontal conditions, such as ablation, hemostasis, microbial inhibition and destruction, cell stimulation, as well as modulation of metabolic activity.

High-power lasers were first used successfully as a variation of conventional approaches for soft tissue treatment such as gingivectomy and gingivoplasty in the clinic. Recently, for example, an Er:YAG laser was developed which can be used on both dental soft and hard tissues due to its low thermal side-effects. Consequently, the Er:YAG laser has been used to treat gingiva, tooth roots, and bone tissue, thus becoming one of the more promising laser units for periodontal treatment [1, 3].

Current Laser Strategy

The main laser application strategy currently used for the treatment of periodontal diseases is high-power laser ablation or high-level laser treatment (HLLT). Laser ablation of diseased tissues is widely performed, partly expecting a simultaneous photo-bio-modulation (PBM) effect (LLLT) in the surrounding tissues [7].

In periodontal pocket therapy, laser devices can not only ablate the diseased tissues and decontaminate and detoxify the pockets and root surfaces but also stimulate or activate the surrounding gingival and bone tissues. If properly used, this would result in improved pocket healing with soft and bone tissues regeneration by reduction of inflammatory condition and promotion of cell proliferation and differentiation (Fig. 1) [1].

Such additional PBM effects during HLLT would be not so strong but the effects are also another advantageous property of laser pocket treatment and would provide a great therapeutic benefit producing improved clinical outcomes. Some researchers and clinicians have recently recognized and realized those PBM effects in the laser pocket treatment to some extent and have been using lasers intentionally expecting those effects. Interestingly, they have experienced improved pocket healing and increased bone regeneration following laser treatment. However, clinical studies concerning the PBM effects in laser pocket treatment have not been clearly proposed and demonstrated so far. Although laser pocket treatment has been increasingly reported in the non-surgical or closed periodontal pocket therapy, most researchers have not sufficiently noticed and understood the PBM effects during laser pocket treatment and scientific publications showing positive results of PBM are delayed and still insufficient.