

# The impact of laser application on periodontal and peri-implant wound healing

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In some patients gingivitis progresses to periodontitis, and this progression is mainly influenced by the individual's immune and inflammatory responses to the formation of microbial biofilm on teeth. Periodontitis is characterized by the destruction of the supporting structures of the teeth, including the periodontal ligament, bone and soft tissues, which in turn may ultimately cause tooth loss (36). Similarly, the host response to biofilm formation on implant surfaces includes a series of inflammatory reactions that are initially located in the mucosa but may subsequently progress and lead to a loss of supporting alveolar bone (103). The response of the soft tissues surrounding both teeth and implants to short periods and also to more long-standing periods of plaque accumulation has been analyzed in experimental animal studies (8, 22) as well as in human studies (53, 64). It was observed that the quantity and composition of developing bacterial biofilms was comparable on tooth and implant surfaces. Based on these findings, it may be suggested that early microbial colonization of titanium implants follows the same pattern as that on teeth (50). A cause-related therapy of either periodontal or peri-implant infections is aimed at resolving infection and inflammation and thereby arresting disease progression (9, 37). Ideally, therapy not only includes arresting periodontal disease but also regeneration of the tissues that have been lost as a result of the disease. In recent years, the use of laser radiation has been investigated as an alternative or adjunctive tool to conventional, mechanical and antiseptic procedures commonly employed in the treatment of periodontal and peri-implant diseases. Various beneficial characteristics, such as hemostatic effects, selective calculus ablation or bactericidal effects against periodontal pathogens, might lead to improved treatment outcomes (2–4, 27). The objec-

tive of the present review was to evaluate preclinical and clinical studies aimed at investigating the pattern of wound healing following treatment of either periodontal or peri-implant infections using laser wavelengths most commonly employed in dentistry.

## Laser characteristics

A laser is a device that emits light through a process called stimulated emission (21), featuring collimated (parallel) and coherent (temporally and spatially constant) electromagnetic radiation of a single wavelength. When it reaches biological tissues, the laser light can be reflected, scattered, absorbed, or transmitted to the surrounding tissues (Fig. 1). The emission wavelength mainly influences these modes of interaction in the target tissue and must therefore be selected with caution for any diagnostic or therapeutic interventions.

The wavelengths of the lasers most commonly used for the treatment of periodontal and peri-implant diseases, which include semiconductor diode lasers, solid-state lasers [-neodymium-doped: yttrium, aluminium and garnet (Nd:YAG); neodymium-doped: yttrium, aluminium and perovskite (Nd:YAP); erbium-doped: yttrium, aluminium and garnet (Er:YAG); and erbium, chromium-doped yttrium, scandium, gallium and garnet (Er,Cr:YSGG)] and gas lasers (CO<sub>2</sub>), range from 635 to 10,600 nm (4).

According to the cause-related concept of periodontal/peri-implant treatment, thorough removal of any bacterial deposits without causing major damage to the adjacent tissues may be required in order to effect healing at diseased sites.

For these specific therapeutic interventions, the emission wavelength will potentially interact with the following: