Lasers in periodontal therapy: the TwinLight® approach

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Fig. 1


Fig. 2

Fig. 1_Image of the anterior group before the initial periodontal therapy.

Fig. 2_Laser therapy starts with the de-epithelialisation of the external and internal side of the gum. In this case, an Er:YAG laser was used at 60–80 mJ, 20 Hz, with SP mode. The handpiece strokes the gum from side to side (water spray off).

_Introduction

The objectives of periodontal treatment are to remove all calcified concretions from the root surface[1] and inflamed tissues from the periodontium and to reduce the bacterial load inside the gingival pockets.

The periodontal pocket may be considered an open system where different bacterial species live in different layers and can exercise disruptive action. Aerobic and anaerobic bacteria colonise the radicular cement at different depths, in a very adherent and robust manner. It is very difficult to completely eradicate the biofilm with chemical, mechanical and physical devices; furthermore, it is difficult for dentists and dental hygienists to explore, clean and disinfect such a complex system because of the specific location and anatomy of the roots. Another problem of periodontal treatment is the maintenance of the patient's health conditions after the initial periodontal therapy, as microbiological studies have indicated that recolonisation of the periodontal pocket occurs between three and six months after healing.[2,3]

_Laser in non-surgical periodontics

In recent decades, laser has been used as a monotherapy or as an adjunctive treatment to conventional periodontal therapy. The international literature reports contradictory results on the efficacy of laser treatment, and a common consensus on the real advantages of different laser techniques has not been reached. Studies have reported that, when used as monotherapy, laser therapy has failed to reach all the goals of periodontal treatment completely. However, clinical outcomes of laser therapies have reported several advantages that encourage the use of the laser as an adjunct to conventional mechanical therapy in periodontics.[4] In addition to the outstanding reviews on this topic, which refer to studies ranging from 1990 up to 2008,[5,6] further investigations are required to consider the possible advantages derived from the use of newer technologies and techniques in recent years.

_Advantages and disadvantages of laser irradiation in periodontal therapy

Various advantages derived from the use of a laser, such as haemostatic effects, increased visualization of surgical sites, de-epithelialization of the gingival walls, selective calculus ablation, bactericidal effects against periodontopathic pathogens, reduced postoperative pain and high patient acceptance[7], might lead to improved treatment outcomes.[6,8-10]

Several laser wavelengths are commonly used in non-surgical periodontics:

- Near-infrared lasers include semiconductor diode lasers (wavelengths ranging from 810 to 1,064 nm) as well as Nd:YAG and Nd:YAP lasers (at 1,064 and 1,340 nm respectively). Near-infrared lasers are highly absorbed in pigmented tissues (haemoglobin and melanin). Reaching depths ranging from 1 to 4 mm as

Fig. 3_The Nd:YAG laser is used to decontaminate and to de-epithelialise the internal side of the pocket. The fiber works side by side and up and down.

Fig. 4_The Er:YAG laser is used again to refinish the root scaling and debriding, using different tips: X-pulse, Varian or PIPS. The handpiece strokes up and down the pocket (water spray on).

a function of optical diffusion, minimal absorption in water and reflection, near-infrared irradiation can help with subgingival curettage, de-epithelialisation and disinfection of the periodontal pockets with various degrees of success.[6,11-13]

- Shorter wavelengths, both visible and near infrared, are also used as activators of specific photosensitisers in the so-called Photo-Activated Disinfection (PAD).[14,15]
- Medium-infrared lasers (Er:YAG at 2,940 nm and Er,Cr:YSGG at 2,780 nm) are superficially absorbed in water within the hard and soft periodontal tissues; the micro-explosion of water molecules helps with calculus removal[3,16-20] and the removal of biofilm from the root surfaces. It must be also emphasized that the degree of treatment discomfort scored significantly lower for the Erbium laser when compared to other treatment modalities.[21]

On the other hand, several studies have reported thermal side effects, such as melting, cracking or carbonisation when Nd:YAG and diode lasers were used directly on root surfaces, as well as damage to periodontal hard tissues if irradiation parameters were not adequate.[22-25,19] Near-infrared lasers were also proven to be ineffective at removing mineralised deposits from the root surface[24,12,13,19] and different studies have also indicated that Er:YAG laser radiation may not have any beneficial adjunctive effect at the microbiological level when compared with conventional treatment procedures alone. All of these findings lead to further considerations.

_Discussion

According to the different effects of the two laser groups (near- and medium-infrared), a combination of different wavelengths could work as a more effective adjunct to conventional periodontal therapy (SRP). Each wavelength can perform its characteristic action, helping in the resolution or control of some aspect of the periodontal disease (bacterial load, inflamed tissue, tartar). The different wavelengths, energy settings, exposure time and operative modes, as used in different studies, may explain the varying results obtained for the resolution of periodontal disease. Also, considering the same wavelength, another point that must be explored is related to the different technologies available nowadays.

_Twin wavelengths approach (Figs. 1–7)

The latest technologies allow the use of new laser tips, settings and operating modes that are required to achieve a level of results that cannot be obtained otherwise. VSP (Variable Square Pulse) technology is a patented solution for generating square laser pulses for more controlled energy absorption (LightWalker AT, 1,064 nm & 2,940 nm; Fotona-Ljubljana). This technology minimizes unnecessary laser energy absorption into the tissues and helps to ensure ultimate performance and patient comfort during laser treatments. The pulse duration can be adjusted in the following increments: 50 µs (SSP mode), 100 µs (MSP mode), 300 µs (SP mode), 700 µs (LP mode) and 1,000 µs (VLP mode), depending on the procedure, thereby avoiding or limiting the thermal side effects.

When Er:YAG is used at very short pulse durations (SSP and MSP modes), photomechanical and photoacoustic phenomena can be initiated inside the pocket,

TwinLight® and WPT™ parameters	
1st step:	De-epithelialisation and decontamination Nd:YAG handpiece stroke side to side MSP – 20 Hz – 100-125 mJ – 2.0-2.5 W
2nd step*:	Calculus removal (debriding refinishing) Er:YAG Varian tip, 600 micron, handpiece stroke up and down SSP – 50 Hz – 30 mJ – 1.5 W
3rd step*:	Decontamination (Biofilm removal: PIPS™) Er:YAG PIPS TIP, 400-600 micron; surface mode SSP – 40 Hz – 20 mJ – 0.8 W
4th step:	Clot formation Nd:YAG activate laser on out stroke only VLP – 20 Hz – 175-200 mJ – 3.5-4.0 W

*Steps 2 and 3 may be performed at the same time with the same tip, changing the setting.

Fig. 5

Fig. 6

Fig. 5_Immediately post-operatory image.

Fig. 6_Image of two weeks postoperative control showing healing in progress.

improving the biofilm removal from the root surface and also minimizing unwanted thermal side effects in the periodontal tissues. This method has already been found effective in endodontics for biofilm and debris removal using the PIPS® technique.[26-28] At low energy and a high repetition rate (SSP, 30–40 mJ, 40–50 Hz), the Er:YAG laser is useful for effective debris removal from the bottom of the pockets, deeply in the furcations of molars and premolars, where curettes scarcely work. This procedure helps in promoting periodontal healing, improving some periodontal indices (PI and BOP). Longer pulse duration (SP, 60–80 mJ) can be used for a superficial de-epithelialization of the buccal and gingival side of the gum, thus delaying the migration of epithelial cells into the pocket: this procedure can promote a gain in the clinical attachment level (CAL), reducing the PD. Also the Nd:YAG laser can de-epithelialize the gingival walls. Studies demonstrated that the deep penetration of the Nd:YAG laser, at 3 W, is effective in reducing bacterial populations.[29] Accordingly, the use of modern Nd:YAG technology at short pulse duration (MSP mode – 100 µs, 100 mJ, 20 Hz, 360 micron fiber) can help to reduce the bacterial load in the gingival pockets and to de-epithelialize the gingival walls, at only 2 W, thus limiting unwanted thermal side effects. This procedure is useful to improve the periodontal indices (BOP and PD). When a thermal effect is required for the formation of a clot, superficially in the pocket, a longer pulse duration (LP mode – 650 µs, 175–200 mJ, 20 Hz) is also available. The fibrin clot temporarily prevents bacterial re-colonisation, while de-epithelialization allows for a faster attachment of connective tissue, together improving the periodontal healing. Repeating the decontamination phase every three months seems to control the recolonisation of the gingival pockets, promoting long-term healing. Two different protocols utilise the dual 1,064 nm and 2,940 nm wavelengths for non-surgical periodontal therapy (TwinLight® and WPT™) with slight differences in laser settings and tips, however, both are used for the same applications (see Table 1).

Fig. 7_From left to right, different tips for the TwinLight® procedure: Chisel, PIPS 600/9, X-pulse 400/14, Varian 500/14.

Fig. 7

_Conclusion

With the limited available information on different laser therapies provided in the literature, it is possible to conclude that the combined application of modern Nd:YAG and Er:YAG laser technology, as an adjunct to ultrasonic debridement in a non-surgical approach to periodontal disease, is a useful procedure to improve short-term healing without adverse effects on dental and periodontal tissues. Regular patient recall is required to maintain long-term healing._

Editorial note: A list of references is available from the author.

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