Clinical comparison of two laser wavelengths

In the treatment of periodontal disease

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_Abstract

The use of lasers in everyday dental practice has grown steadily in the past ten years. Both Neodymium YAG (Nd:YAG) lasers and Diode lasers are routinely used in dental offices around the world for a variety of soft tissue procedures. In most clinical circumstances, a laser can offer well-defined benefits to the practitioner and patient.

Over the years lasers have been used extensively for the treatment of periodontal disease, and numerous studies have been conducted with a wide variety of techniques and laser parameters, leading to outcomes which can be difficult to interpret. In this report, two of the more common wavelengths used in dentistry to treat periodontal disease, the 1,064 nm Nd:YAG laser crystal and the 808 nm diode, will be reviewed for their clinical advantages and disadvantages.

_Introduction

Both Nd:YAG lasers and Diode lasers produce light that is highly absorbed by pigment and hemoglobin, making them ideal for use with soft tissue procedures, especially when bleeding is a concern. One of the main differences between the two technologies is the way that the laser energy is pulsed. Diode lasers are continuous lasers whose energy is pulsed or shuttered by mechanical interruption of the energy stream, similar to what happens when the beam from a flashlight passes through the blades of a fan. The energy is "turned on" the whole time but shuttered by the blades of the fan, allowing for a slight relaxation of the tissue.

The Nd:YAG laser differs from the diode in that it can be micro pulsed electronically while reaching very high peak powers. The Nd:YAG laser energy has been compared to a lightning bolt in that the energy is delivered with high intensity (high peak power) and then dissipates quite rapidly. This difference in the approach to pulsing between the two laser technologies appears to be a key factor contributing to the long-term effectiveness of each treatment.

A review of the literature shows mixed support for the use of diode lasers in periodontal treatment. In 2008, Caruso and Nasti[1], found no statistical dif-

Fig. 1_Pre-op situation.
Fig. 2_After first pass with Nd:YAG.


Fig. 1


Fig. 2

ference between the control group and the diode laser treated group in regards to periopathogen reduction. Also in 2008, Ribiero[2] found that diode lasers in conjunction with scaling and root planing did not provide any clinical benefits in shallow-to-moderate pockets. However, in 2007 Kamma[3] found that diode laser therapy in conjunction with scaling and root planing seemed to show a reduction in clinical parameters such as bleeding on probing and pocket depth. Other various studies have shown a decrease in oral malodor and bleeding upon probing after diode therapy.

The Nd:YAG literature shows more conclusive but not complete support for definitive periodontal treatment. Kara[4] found a decrease in oral malodor following Nd:YAG laser therapy. Grassi[5] found that Nd:YAG was a therapeutic aid to scaling and root planning. Slot *et al.*[6] did a literature review of Nd:YAG laser-assisted periodontal therapy and suggested that further research was needed.

Other more recent studies using trademarked procedures such as WPT (Wavelength-optimized Periodontal Therapy)[7] further suggest that the use of a combination of Nd:YAG and Er:YAG lasers in periodontal therapy can be associated with cementum-mediated new connective tissue attachment and apparent periodontal regeneration of diseased root surfaces.

Based on over 15 years of clinical use of lasers in periodontal therapy, the author of this article has come to his own independent conclusions after performing the following treatment procedures and consistently noting the accompanying observations.

_Laser Treatment Methods

A diode-based laser treatment technique, used on more than 120 patients over a 7 year period, was performed as follows: a complete oral exam and full series of X-rays, full mouth periodontal probings, anesthesia of the entire quadrant, followed by scaling, root planing to remove all accretions on the root surface, and subsequent diode-laser irradiation of the periodontal pocket. The diode was set at 1 watt continuous power (808 nm) and the tip was initiated. After inserting the tip to the depth of the pocket for a few seconds, it was removed and all debris was wiped off. This was repeated until no other debris was present on the tip (usually two or three times). The patient was sent home with Doxycycline 100 mg, one per day for ten days and followed up with at one week, two week and thirty day intervals. The patient was instructed to follow a strict home care regimen and to return



Fig. 3_Selective removal of calculus with the Er:YAG laser.

every three months for a comprehensive prophylaxis.

The technique used with the Nd:YAG laser on over 182 quandrants to date, was performed as follows: a complete oral exam (including all necessary X-rays) was followed by a complete full-mouth probing to determine the extent of disease (see sample patient photo in Fig. 1).

The next step was to anesthetize the entire quadrant, followed by adjustment of the occlusion to remove high spots. A Fotona AT Fidelis laser system that includes two wavelength sources in one unit: the Nd:YAG (1,064 nm) and the Er:YAG (2,940 nm) lasers, was used in all treatments. The Nd:YAG parameters were set as follows: 3.75 W at 20 Hz VSP. The fiber was inserted deep enough to remove inner epithelium to separate the tissue from the tooth and create access to the entire root surface (Fig. 2).

When performing WPT treatments, the Fotona AT Fidelis 2,940 nm Er:YAG laser was then used to selectively remove calculus (Fig 3). A piezo scaler of choice was finally applied to thoroughly debride the root surface of any hard tissue accretions. Following the debridement, the Nd:YAG laser was used again at a setting of 3.75 W and 20 Hz, in the longest pulse. The fiber was inserted to the depth of the pocket and removed slowly, creating a clot to seal the periodontal pocket (Fig. 4).

This so called "fibrin clot" facilitates healing and allows the patient to go home with no concern of bleeding (as long as it is not disturbed). Patients were placed on antibiotics and told not to brush the treated quadrants for 7 days (typically two quadrants are done at one visit).

_Results

Diode laser treatment, in conjunction with scaling and root planing, led to decreased bleeding, de-

Fig. 4_After second pass with Nd:YAG laser.
Fig. 5_Post-op.


Fig. 4


Fig. 5

creased malodor, and from a patient's perception, a better feeling in their mouth when compared with conventional periodontal treatments. With the Nd:YAG treatment, patients likewise healed uneventfully with little-to-no post-operative discomfort. Patients were followed up weekly for four weeks and all reported feeling much better post operatively.

The diode laser treatment provided very good short term results, but the disease relapsed in almost every case within 12 months, regardless of oral hygiene control.

The Nd:YAG laser treatment administered by the author produced more stable and longer-term control of the patients' periodontal disease. Reduction in bleeding, oral malodor, and mobility of teeth was carefully noted, and the results have proven to be long-term for all patients that followed the home care and recare instructions (Fig. 4).

_Discussion

Questions have arisen as to why the Nd:YAG laser may be better suited for the treatment of periodontal disease than the diode laser. Both kill bacteria and reduce inflammation, but a study by Harris may hold the answer. Harris[7] found that the difference in the therapeutic index between the Nd:YAG and diode indicates that the pulsed Nd:YAG has 16 times greater selectivity for the destruction of pigmented oral pathogens than the diode laser. Moreover, it destroyed these pathogens while leaving the surrounding tissue intact. This concept of "getting rid of the bad guys while leaving the good guys" makes the Nd:YAG laser a far superior tool for long-term stabilized treatment of periodontal disease.

From the perspective of this author, the concept of laser use in periodontal therapy makes perfect sense. After considerable analysis of the two most common laser wavelengths used for treating periodontal disease, the author has come to the following conclusions.

_Conclusion

The diode laser can be used to contain disease in mild to early-moderate stages of periodontal disease. Based on its ability to kill bacteria, the use of the diode laser in a 5 mm bleeding pocket would be acceptable as long as expected results are short-term, analogous to using common chemo-therapeutics in dentistry. The Nd:YAG, on the other hand, can be used for all cases, including moderate to severe stages of the disease when the goal is complete long-term treatment; with proper patient follow up, long-term resolution of the disease can be expected.

_References

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Editorial note: The whole list of references is available from the publisher.

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