

# The Diagnostic and Therapeutic Application of Laser Exclusively in the Periodontal Field

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## Abstract

When laser energy is used as a therapy modality for the prevention, treatment, and management of different types of periodontal disease, it emerged into a very exciting therapeutic tool bringing a huge success with it. Various types of lasers are available today in the modern technology world. Along with the types of lasers, also available the various options to choose the right wavelength according to the treatment modality. Not only is the laser used for root surface procedures, but also the soft tissue manipulation in the field of Periodontology. This makes periodontal treatment by dental laser a grand success as reported in a myriad of literature. The only mandatory condition applied to be applied is the sound knowledge of the clinician in choosing the right type of laser with the required wavelength for a particular periodontal procedure. No other field of dentistry still has seen so many marvelous transformations in the healing and success in the management of the soft tissue after a periodontal procedure. There is a huge application of the usage of Laser in the periodontal world exclusively, which is the goal of this review paper.

**Keywords:** Periodontics, lasers, laser uses.

## Introduction

One of the first CO<sub>2</sub> lasers used for oral soft tissue applications was introduced in 1987. The history of laser therapy as applied to the field of Periodontics begin in the early 1960 with the development of the argon, carbon dioxide (CO<sub>2</sub>), and neodymium: yttrium-aluminum-

garnet (Nd:YAG) lasers. The next major advance in the expansion of laser technology for soft tissue use was the introduction of a contact delivery system for the Nd: YAG laser in 1984. A simple handpiece through which the fiberoptic is threaded, and then passed through a disposable tip allows the energy to be focused at the tissue surface for cutting or ablation or in an unfocused position above the tissue for other uses. This system opens up the door to a wide variety of clinical applications. YAG lasers have been used for osseous surgical and decay removal procedures, whereas the other laser types do not lend themselves to hard tissue applications. Lasers today are becoming smaller and more portable and are being used for an ever-increasing variety of periodontal and soft tissue applications. However, along with the therapeutic property, the dental laser also has the diagnostic property.<sup>1-5</sup>

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**Classification of Lasers in Periodontics Based on Their Usage:**

1. **Therapeutic uses:** Non-surgical therapy and surgical therapy
2. **Diagnostic uses:** Detection of caries and dental calculus, measuring tooth mobility
3. **Prevention uses:** Antibacterial effect in the dentistry can be achieved through Laser toothbrush. It is achieved by using the low output semiconductor laser of almost 630 nm. Also, a low-level laser therapy toothbrush is been implicated in the treatment of dentin hypersensitivity.<sup>5</sup>
4. **Other application:** Instrument sterilization, Bio-stimulation

**Laser and its usage exclusively in the periodontal field:**

1. **Scaling:** The Er:YAG, CO<sub>2</sub> laser, and diode laser are highly absorbed in water which takes care of the temperature makes scaling easier exclusive of any carbonization. These lasers are also used for the bacterial reduction, often known as Laser Bacterial Reduction (LBR). With the thin fiber optics, these lasers are used for the sulcular debridement to make the gingival sulcus sterile free from the viable putative microorganisms and thus causes bacterial reduction.<sup>6</sup>
2. **Root planning:** The CO<sub>2</sub> laser is highly absorbed by water is used for root planning to achieve a clean smooth cemental surface for the proper periodontal ligament cells attachment.
3. **Sub Gingival Curettage:** The Nd:YAG and Er:YAG laser lasers are used for subgingival soft-tissue curettage These lasers are set at a particular wavelength suitable for it. CO<sub>2</sub> laser is efficiently used for the granulation tissue removal from the pocket during flap surgery along with the removal from the bony defects like craters. The advantage is these lasers can well differentiate between the healthy gingival and the infected granulation tissue, and thus does not sacrifice the healthy tissue. The patient comfort is maximum here as it is painless and within a much stipulated time.<sup>7</sup>
4. **Cauterisation of highly vascular lesions and hemangiomas:** The Argon laser is used here. It produces coagulation, vaporization, or both and helps in the cauterization of the highly vascular

lesions in the oral cavity. The bleeding is minimal and the post-operative healing is very comfortable for the patient. It prevents recurring of certain vascular lesions like pyogenic granuloma.<sup>4</sup>

5. **“Laser pocket thermolysis”:** Argon laser is been utilized to keep the line of control of the putative pathogenic microflora like Prevotella and Porphyomonas in adjunct with SRP. It is done with the insertion of the tip and the tip is stimulated circumferentially till the base of the pocket, thus infection arising pathogens get carbonized with rapid healing.<sup>4</sup>
6. **Gingivectomy:** The Co<sub>2</sub> laser is been used as it is very much effective in removing masses of soft tissue by ablation, as in phenytoin induced hyperplasia and gingival hypertrophy resulting from other inflammatory stimuli. It results in a dry neat bloodless site as the blood vessels get coagulated easily and chances of bacterial risk also lessen to a great extent. Healing is fast and comfortable for the patient.<sup>6</sup>
7. **Enhance Guided tissue Regeneration:** The Er:YAG, Nd: YAG laser and CO<sub>2</sub> laser are used to reduced inflammatory response, thermal necrosis, and a firm scar of the wound margin and less wound contraction which causes a delay in re-epithelialization. Thus the epithelialization growth is stopped and the periodontal cells are guided to grow and occupy the place for tissue regeneration.<sup>1</sup>
8. **Frenectomies:** The Co<sub>2</sub> and Nd: YAG laser both can be used here. When frenectomy is performed via laser ablation, neither sutures nor surgical packing is necessary as the surgical site heals by secondary intention. The laser frenectomy reduces frenal strain and encourages the health of the gingiva.
9. **Biopsy:** The Co<sub>2</sub> laser is used only for the laser excisional biopsy to avoid electrofulguration. As its penetration is poor, hence it is fit to use for the close to crucial anatomical structures.<sup>1</sup>
10. **Anesthetic effect:** The pulse duration of the Nd:YAG laser is 150µs which is apparently below the level of the neuronal action potential, thus the anesthetic effect is achieved in the indicated diagnosis area.<sup>3</sup>
11. **Esthetic gingival procedures:** The Er: YAG laser is used mostly for this type of treatment. Crown lengthening, to treat gummy smile as it precisely ablates the soft tissues and also wound healing is

fast. Dr. Eshom (2002) popularized a procedure “closed-flap” crown lengthening to trim and shape bone tissue to accomplish biologic width without involving a soft tissue flap.<sup>7,10</sup>

**12. Exposure of unerupted and partially erupted teeth:**

The Nd:YAG laser is used to ablate the soft tissues around the unerupted or partially erupted tooth for the orthodontic treatment. To place an orthodontic bracket to pull the unerupted tooth, tissue removal minimally and conservatively is mandatory to access the unerupted tooth. This laser is advantageous in creating a very conservative way of tissue removal, and also the bloodless surgical field is achieved.<sup>8</sup>

**13. Ablation of the hard tissues:**

The Argon laser can be utilized as a smooth laser knife, for cases like Coronoplasty, Enameloplasty.<sup>6</sup>

**14. Hypersensitivity:**

Dentin hypersensitivity can be treated successfully with the help of the lasers which are of two different categories like: Low-level lasers like GaAlAs diode laser acts at the nerve level, thus eliminating sensitivity, and middle-level lasers like Nd: YAG and CO<sub>2</sub> lasers desensitize causing contraction and occlusion of the dentinal tubules.<sup>9</sup>

**15. Laser-Assisted New Attachment Procedure (LANAP):**

LANAP, which ingrain free-running pulsed Nd:YAG laser, enhances the intangible aim of renewal of attachment apparatus giving rise to a true regeneration. LANAP is a carefully intended management procedure which not only aims at bactericidal and detoxification effect but also aims to reduce the source of the infection.<sup>1</sup>

**16. Laser root conditioning or root etching:**

The CO<sub>2</sub>, Nd:YAG, Er:YAG, Diode laser are used here. CO<sub>2</sub> lasers are a popularized system to achieve root conditioning with a superior fibroblastic movement, cellular abundance, and larger fibroblast connection and possess a superior caliber for the removal of smear layers.<sup>1</sup>

**17. Depigmentation:**

The Er:YAG laser is applied for the elimination of nonstandard gingival mark, like metal tattoos. When the oral tissue was seen to be filled with melanin pigmentation, it readily absorbs the blue-green visible light of the argon laser yielding a thermal effect from the conversion of the energy and thus causing ablation of the melanin pigments.<sup>10</sup>

**18. Osseous surgery:** Er:YAG laser is used for the removal of exostosis accompanied with the saline spray, collateral damage risk is minimized which is seen maximum with the Rotary instruments as they get entangled with the soft tissues during the resection procedure. Also it is preferred by the patient for the comfort, as less noise emitted while bone tissue grinding.<sup>6</sup>

**19. As an analgesic and anti-inflammatory agent:**

The “ LLLT” or the “Low-Level Laser Therapy”/ Therapeutic Lasers/Low-Intensity Level Laser are the other names whereas the therapy has been referred to as “Biostimulation” and “Biomodulation”. These lasers are usually minor, very reasonable and function in the milliwatts ranging from 01-500 MW. The pain signals get blocked by the laser and thereby the sensitivity of the nerve comes down and also the pain perception is decreased significantly.<sup>10,12</sup>

**20. Accelerated tissue repair and cell growth:**

The Nd:YAG laser generates photon that gets deeply penetrated inside the tissue and thereby its stimulation efficiency stimulates the cell center for energy production. This energy created helps the cell nicely to absorb the beneficial nutrients and also guides the cells to let go of the unwanted waste in a little time.<sup>12</sup>

**21. Laser in Implants:**

**A. Laser in ablating the soft tissues around the implant:**

The Nd:YAG laser is used to ablate the soft tissues lying around the implant in the second stage for the implant fixture exposure. This laser has got the feature of carbonized tip for the absorption of the laser light radiation turning into thermal energy, which prevents penetration into the tissue deeply. If there is an adequate zone of attached gingiva around the implant and no trephining of bone is necessary, ablation of the overlying soft tissue around the implant can be achieved with little or no bleeding. The lack of hemorrhage, with the resulting clear field, and minimal tissue rebound often allow for the abutment placement and temporization in the same visit. Gingival troughing with the pulsed Nd:YAG laser is a convenient, painless method of preparing for accurate impressions and is an excellent substitute for retraction cord. There is no blood in the field, and lased circumferential tissues heal quickly and painlessly.<sup>7</sup>

**B. Laser in Implant Maintenance:**

The implication

of the Nd:YAG laser resulted in surface melting, loss of porosity, and other alteration including physical changes in the crystalline structure of the hydroxylapatite coating (Block et al 1992). So the usage of Nd:YAG is contraindicated in these cases. It has been shown that the CO<sub>2</sub> laser can be used for the second stage uncovering procedures in endosseous implants, sculpting tissue around the existing implant, control of mucosal abnormalities, and control of implant soft tissue complications. The CO<sub>2</sub> laser is ideal because its energy is rapidly absorbed by the high water content of mucosa so that the depth of tissue necrosis or vaporization is minute (only 100 – 200 microns). The potential harmful thermal energy is dissipated rapidly and does not reach the metal surface of the implant.<sup>2</sup>

**C. Treatment of Peri-Implantitis:** Every laser available in the market cannot be applied for the implant maintenance, exposing submerged implants, or for the treatment of peri-implantitis. Nd:YAG laser is never appropriate for implant treatment, because it simply ablates the implant surface made of titanium irrespective of yielded energy. On the other hand, a diode laser is preferred here, as it does not intermingle with the titanium surface of the implant.<sup>6</sup>

**D. The LAPIP Protocol:** This is coined by McCarthy as “Laser-Assisted Peri-Implantitis Procedure” as a modification of LANAP which could be applied in contaminated implants. Laser, takes off inflamed pocket tissue, dislocate the biofilms, and purify the root/implant plane. Drop off in inflammation and a laser-induced hemostasis added disinfected the tissue outpouring a tough blood clot to lock the method.<sup>1</sup>

**Waterlase System:** Waterlase-™ uses hydrokinetic technology, laser-energized water to cut or ablate soft and hard tissues. Laser-powered hydrokinetic system (LPHKS) uses an Er, Cr: YSGG crystal. With this particular wavelength less hemostasis is seen and anesthesia is not typically required. This not only increases patient comfort and acceptance, but also allows performing the procedure in the entire mouth in one sitting. Post-operative discomfort is also minimized. Using the Waterlase, one can carry out all of the subsequent procedures-Frenectomy and frenotomy, gingivectomy, gingivoplasty, curettage, vestibulopathy, operculectomy, gingival troughing for crown impressions, soft tissue crown lengthening,

expose unerupted teeth (hard and soft tissue impactions); flap surgery, full-thickness flap; partial-thickness flap, degranulating bone, osseous surgery as osteoplasty and osseous recontouring; osteotomy; osseous crown lengthening; removal of diseased granulation tissue from the bony defects; laser soft tissue curettage of the post-extraction tooth sockets and the periapical area during apical surgery and perforating the bone to access the blood supply.<sup>6</sup>

## Conclusion

The regular usage of the laser has become very beneficial and comfortable for both the surgeon as well as for the patient. It seems to be a very flourishing and promising field in the future with the advancement of science and technology. It aids in a much easier way than the conventional treatment protocols in dentistry. There is a great hope of usage of laser in both medical as well as in the dental field ahead of time.

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