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# A Review On Use Of Lasers In Periodontics

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**Abstract**

Lasers have a huge role in periodontics and its application includes calculus removal (Er: YAG, Er, Cr: YSGG lasers); soft tissue excision, incision and ablation; decontamination of root and implant surfaces; biostimulation; bacterial reduction; and osseous surgery. Lasers have provided us with a potential alternative to simultaneously remove the diseased soft tissues, target the micro-organisms as well as stimulate wound healing. This papers reviews about the use of lasers in dental practice and periodontics, its advantages and disadvantages and the hazards involved in using lasers. This is an exciting field with many promising possibilities to be investigated and represents an area that may ultimately prove to be rich with utility in the context of Periodontics.

***Keywords: Laser, periodontics, bacterial reduction, pocket, implant therapy.***

## I. Introduction

The term laser is an acronym for the process of light getting amplified by stimulated emission of radiation. The laser device emits light which is spatially coherent and collimated. The beam emitted by the device can remain narrow and focussed over a long distance. When this beam is directed towards a tissue, several interactions occur through absorption, reflection, transmission and scattering of laser light. This also depends on the nature of the laser light, its wavelength and characteristics of the tissue.[1]Lasers have a variety of role in periodontics and its application includes calculus removal (Er: YAG, Er, Cr: YSGG lasers), excising soft tissues, incision and ablation, decontamination of tooth surfaces, specifically root and implant surface, biostimulation, reduction of colony forming units and in osseous surgery. Certain lasers (Er: YAG, Er, Cr: YSGG) are easily absorbed by hydroxyapatite crystals and hence used in osseous surgery. Other lasers like diode and Nd: YAG lasers are easily absorbed by haemoglobin and hence used when coagulation is mandated. In addition, they are also used for depigmentation.[2]This paper aims at revisiting concepts regarding dental laser and its application in periodontal practice, peri-implant surgery and various challenges encountered in dental practice.

## II. History

The history of laser dates back to 1900, when Max Plane gave the theory of light. Based on the quantum theory two fundamental radiation process were explained: Stimulated absorption and Spontaneous absorption. This lead to the newer concept of stimulated emission.[3] After about 40 years American physicist CharlesH. Townes introduced frequencies, and

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Microwave Amplification by stimulated Emission Of Radiation (MASER) in 1951. In 1957 an American physicist Gordon Gould gave the term LASER(Light Amplification by Stimulated Emission of Radiation). In 1960, H. Theodore Maiman operated the first laser- a solid-state ruby laser. In 1960, Sorokin and Steven invented solid state uranium laser and Ali Javan, and William R. Bennett, and Donald Herriott constructed the first gas laser, using helium and neon. In 1961, Neodymium laser was demonstrated by Johnson and Nassau. In 1962, Robert N.Hall demonstrated the first laser diode devices, made of gallium arsenide. In 1964,neodymium doped yttrium-aluminium-garnet laser, CO2 -Carbon dioxide laser and argon laser was developed by Geusic, Marcos, and Van and Hughes respectively.[4]

## III. Properties of laser[5]

### Monochromaticity

The light emitted from a laser is *monochromatic*, that is, it is of one wavelength in contrast to ordinary white light which is a combination of many different wavelengths.

### Directionality

Lasers emit light that is highly *directional.* Laser light is emitted as a relatively narrow beam in a specific direction. Ordinary light, such as coming from the sun, a light bulb, or a candle, is emitted in many directions away from the source.

### Coherence

The light from a laser is said to be *coherent,* which means the wavelengths of the laser light are in phase in space and time.

### Brightness

The *brightness* of laser sources is typically several orders of magnitude greater than that of the most powerful incoherent sources. This is due to the extreme directionality of a laser beam.

## IV. Mechanism of action

Laser consists of three principal parts: An energy source, an active lasing medium, and two or more mirrors that form an optical cavity or resonator. For amplification to occur, energy is supplied to the laser system by a pumping mechanism, such as, a flash-lamp strobe device, an electrical current, or an electrical coil. This energy is pumped into an active medium contained within an optical resonator which produces a spontaneous emission of photons. Subsequently, amplification by stimulated emission takes place as the photons are reflected back and forth through the medium by the highly reflective surfaces of the optical resonator, prior to their exit from the cavity via the output coupler.The light energy produced by a laser can have four different interactions with a target tissue: Reflection, Transmission, Scattering, and Absorption. When a laser is absorbed, it elevates the temperature and produces photochemical effects depending on the water content of the tissues. At a temperature of

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100°C, vaporization of the water within the tissue occurs, a process called *ablation*. At temperatures between 60°C and 100°C, proteins begin to denature, without vaporization of the underlying tissue. Conversely, when thetemperature crosses 200°C, the tissue is dehydrated and burned, resulting in an undesirable effect called *carbonization*.[6]

## V. Advantages and Disadvantages of Laser

The advantages of laser includes greater homeostasis, bactericidal effect, minimal wound contraction in incision, ablation and reshaping oral soft tissues easily when compared to a scalpel.[7] However a variety of disadvantages are observed including tissue destruction at bottom of the pocket, excessive ablation of root surface and gingival tissue, injury to hard and soft tissues. It is also necessary to follow precautions like use of glasses for protection, inadvertent irradiation, protect patients eyes, throat and oral tissue, reflection from shiny surfaces and adequate high speed vacuum to capture laser plume.[8]

## VI. Application of laser in periodontal practice

Different lasers penetrate to different tissue depths, depending on their wavelength and the type of tissue at which they are directed. For instance, when applied to soft tissues, Nd: YAG lasers (1064 nm) have a penetration depth of approximately 2–3 mm, compared to $CO_2$ lasers (10,600 nm), which affect the tissue only superficially (0.1–0.3 mm). In addition, $CO_2$ lasers have a high absorption from water.Lasers can be used in a focused beam (for excisions and incisions) and in an unfocused beam (for ablation and coagulation). Some evidence suggests that lasers used as an adjunct to scaling and root planing (SRP) may provide additional benefits.[2]

## VII. Laser in Diagnosis and prevention

Laser works on caries detection based on the principle of differential fluorescence between healthy and diseased tooth. It is also used in detection of calculus. Wavelength of 655nm can also be used for calculus detection. Calculus fluoresces (glow) differently than healthy tissue. A laser toothbrush is designed to provide an antibacterial effect in oral cavity using an irradiating laser beam of 630 nm low output semiconductor.

## VII. Laser in root conditioning

The use of $CO_2$ lasers to decontaminate root surfaces has been investigated, providing more information about the exact power settings and parameters required to avoid root damage. A defocused, pulsed $CO_2$ laser creates a smooth and clean root surfaces compared to a focused, continuous wave; the latter leads to melting and root surface damage.

## VIII. Laser in Bacterial reduction

A laser application that has been especially promoted in the past is for the reduction of bacteria in pockets, due to the high absorption of specific laser wavelengths by the chromophores. Initially, the use of an Nd: YAG laser was shown to reduce the load of *Porphyromonasgingivalis* and *Prevotellaintermedia.* Using a 980 nm-diode laser reducesperiodonto-pathogenic bacteria in patients with aggressive periodontitis. Also diode lasers prevents bacteremia, especially in immuno-compromised patients.[15-16]

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**IX. Laser in nonsurgical pocket therapy**

Laser in pocket therapy is a simple nonsurgical procedure to eliminate or, at least, reduce the number of viable bacteria in the gingival sulcus. In this procedure a diode laser is used with a thin optic fiber. If the calcified accretions on the root surface are not removed, the therapy is doomed to fail. Laser now are being used for this procedure. Not only does the laser remove the calculus on the root surface, but it also alters the cementum surface in such a way that it makes it favorable for fibroblast attachment. Photodynamic therapy or photochemotherapy uses a photoactive dye that is activated by exposure to light in the presence of oxygen with specific wavelength, forming free radical species that kill target microbes. Low-level laser therapy (LLLT) has shown to be effective in the treatment ofhyperemia and inflammation of the dental pulp by itsanti-inflammatory, analgesic and cellular effects. For the treatment of hypersensitivity, a 780nm diode laser at a power of 30m Wor Nd: YAG laser at low power can be used.[9]

**X. Laser in surgical procedure**

In LANAP (laser assisted new attachment procedure), the laser is used to remove the epithelial lining of the sulcus as well as junctional epithelium. It is also used in biopsy and excision of soft tissue pathologies as well as for soft tissue periodontal applications. The Nd: YAG was the first laser to be compared to the scalpel for treating periodontal pockets and controlling bacteremia and gingival bleeding.[13]

**XI. Laser in soft tissue application**

The most popular procedures such as crown lengthening, gingivectomy, gingivoplasty, and frenectomycan be carried out using a laser. Compared with the use of a conventional scalpel, lasers can cut, ablate and easily reshape the oral soft tissue, causes less bleeding and little pain with a few sutures. For the esthetic periodontal soft tissue management Er: YAG laser is very safe and useful.CO2, Nd: YAG, Diode, Er: YAG lasers are generally accepted as useful tools for this type of surgery.Gold and Vilaridi reported that Nd: YAG laser is safe for removal of the sulcular epithelium in periodontal pockets which has an added advantage of protecting the underlying connective tissue by causing necrosis or carbonization.[10,11]

**XII. Laser in osseous surgery**

The use of erbium lasers is becoming increasingly popular for bone surgery. Erbium lasersoffer more precision and better access than mechanical instruments. They reduce the risk of collateral damage, particularly when compared with rotary instruments that may become entangled with soft tissue. Lasers also improve the comfort to both patients and surgeons by markedly reducing noise and eliminating the grinding of the bone tissue.

**XIII. Laser in Implant therapy**

Use of laser in implant may have several advantages, including improved hemostasis, production of a fine cutting surface with less patient discomfort during the postoperative period, and favorable and rapid healing following abutment placement, thus permitting a

faster rehabilitative phase because of the ability of the laser to produce effective bone tissue ablation.[11]

## XIV. Hazards of Laser

Injury to eyescan occur either due to direct emission from the laser or reflection from a mirror. Laser induces damage to skin and other nontarget tissue which results in thermal interaction. Above the normal temperature it can produce cell destruction by denaturation of cellular enzymes and structural proteins. Inhalation of airborne biohazardous material,released by the application of laser chemicals like methane, benzene, formaldehyde present in the laser can be injurious if inhaled. Flammable gas, solid, liquids used within the clinical setting can be easily ignited if exposed to a laser beam. Electrical hazards are due to very high currents and high voltage required to use the present dental lasers. There can be electrical shock hazards, electrical fire or explosion hazards.[12]

## XV. Conclusion

Laser treatment is expected to serve as an adjunct to conventional mechanical periodontal treatment.The use of laser should be based on the proven benefits of hemostasis, a dry field, reduced surgical time and less post-operative swelling. So, laser is safe and efficient for periodontal bone surgery when used concomitantly with adequate irrigation.

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