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Laser – A Paradigm Approach in Periodontal Surgery - A Review Article

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***Abstract**: Lasers are used in various periodontal applications which include calculus removal, soft tissue excision, incision and ablation. Other uses incorporate implants; biostimulation; bacteria reduction lastely bone removal.This article deals with the implications of lasers in periodontal surgery*
***Keywords:** Laser, Implants, Periodontal surgery*

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I. Introduction

The word "laser" is an acronym for "light amplification by stimulated emission of radiation." It is a device that emits light that is coherent and collimated. Laser beam is narrow over a long distance, and can be focused.[1,2,3,4] When directed at tissues, different interactions result. The scattering of the laser light vary, depending on the wavelength of the laser.[3,4,5.6]

Hydroxyapatite absorb Lasers and it can be used for bone removal more efficiently. Diode and Nd: YAG lasers are more highly absorbed by hemoglobin and thus should be used when coagulation is desirable.[1,3,5,7] Lasers (diode and Nd: YAG lasers) used by Periodontics for removal of gingival pigmentation.[5,7,8,9]

Laser Effects on Tissue[3,6,10,11,12,13]

Optical properties of a tissue decide the interactions with Lasers. When radiant energy is absorbed by tissue, four basic types of interactions occur.

1. Photochemical interaction.
2. Photo thermal interaction
3. Photo mechanical interaction
4. Photo electrical interaction

Photo chemical interaction include[5,7,14]

Bio-stimulation, which describes the stimulatory effects of laser light on biochemical and molecular processes that normally occur in tissues such as healing and repair.

Photo thermal interactions include[11,14,15]

Photo ablation, or the removal of tissue by vaporization and superheating of tissue fluids, coagulation and hemostasis.

Photomechanical interaction include[16,17,18]

Photo-disruption or photo-disassociation, which is the breaking apart of structures by laser light.

Photoelectrical interactions include[7,19,20]

Photo plasmolysis which describes how tissue is removed through the formation of electrically charged ions and particles that exist in a semi-gasseous high energy state.

Applications in Dentistry[5,7,9,10,16,19,20,21,22]

I. Intra oral soft tissue surgery
a. Sulcular debridement
b. Laser – assisted uvulophlatoplasty
c. Treatment of pathologic condition.
d. Ablating, incising, excising, coagulating

II. Hard tissue application

a. Tooth bleaching
b. Cavity preparation
c. Caries removal, inhibition, detection
d. Surface modification

e. Calculus removal
f. Bone ablation and cartilage reshaping
g. Dentin desensitization
h. Analgesia

III.Dental Materials
1. Composite curing, bracket bonding
2. Alloy welding

IV. Endodontics
V. Other application
a. Laser diagnostic
b. Instrument sterilization
c. Holography
d. Bio-stimulation

Uses of Lasers In Periodontics[12,14,22,23,24]

Treatment of Dentine Hypersensitivity With Lasers:

Dentine hypersensitivity is characterized by short, sharp, pain arising from exposed dentine in response to stimuli typically thermal evaporative tactile, osmotic or chemical and which can not be ascribed to any other form of dental defect or pathology. The lasers used for the treatment of dentine hypersensitivity are divided into two groups:

- Low level lasers like He-Ne, GaAlAs, and
- Middle output lasers like Nd: YAG and CO lasers.[14,17,25,26]

The mechanism of laser effects on 2 dentine hypersensitivity is thought to be the laser induced occlusion or narrowing of dentinal tubules (Lan& Liu 1995), as well as direct nerve analgesia, via pulpal nerve system.[7,8,10,12,19,22,27] It has been hypothesized that the laser energy interferes with the sodium pump mechanism changes the cell membrane permeability and / or temporarily alters the endings of the sensory axons.[5,18,20,25]

Laser DeepithelizationFor Enhanced GTR:

Successful treatment of periodontal defects to obtain new attachment continues to represent a serious therapeutic challenge for predictable result in periodontics. Varied methods have been tried to slow down the growth of gingiva.[1,12,17,19,23,27] The CO laser creates an impact on the gingiva that it does not burn, rather an instantaneous vaporization of the intercellular fluid occurs and disintegration of the cell structure occurs. The laser wound on skin and gingiva causes a delay in reepithlization because of factors such as reduced inflammatory response and less wound contraction.[8,9,11,12,18,24,28]Rossman et al did a 28 day study on monkeys and evaluated the correlation of interproximal defects using CO treated 2 sites with control sites; the study indicated a greater amount of connective tissue rather then epithelial attachment.[6,22,27,29]

Depigmentation With Laser:

Gingival and cutaneous melanin pigmentation is often a source of an aesthetic problem. The intensity and extent of pigmentation varies widely among individuals. Various methods suitable for the removal of pigmentation from the gingiva have been described. Among them are cryotherapy, gingivectomy and argon laser irradiation. In addition several lasers are used for ablation of cutaneous pigmented lesions and oral lesions, among them are ruby, dyed pulsed, Nd:YAG, CO and eximer laser.[5,7,19,20,24,29,30]

Laser applications in implant dentistry

The use of lasers in implant dentistry has been discussed extensively. Clinicians want to know if lasers can be used for the treatment of peri-implantitis, but it is impossible today to investigate this question using randomized clinical trials due to the lack of comparable test and control sites.[10,11,21,24,27] However, there are applications for lasers in implant dentistry, including for second stage surgery removal of peri-implant soft tissues, and decontamination of failing implants. Serious concerns about the implant overheating followed by melting of the implant surface have been raised,along with concerns about a lack of re-osseointegration following treatment of peri-implantitis with lasers.[10,12,14,23,31]Recent systematic reviews have focused on the latter question and provided more information about how implants can re-stabilize following implant surface laser decontamination. Deppe*et al*. showed that CO_2 laser decontamination of the surface of implants placed in dogs allowed new bone to grow and be in contact with the implant surface (re-osseointegration). *In vitro* studies of osteoblasts have confirmed these effects for CO_2 and Er, Cr: YSGG lasers.[11,14,17,32]Previous clinical case series were able to demonstrate new bone fill and long-term success of failing implants that were decontaminated with a CO_2 laser.

The main advantage of using CO_2 laser irradiation on implant surfaces is that this wavelength does not pose the risk of overheating, unlike other wavelengths, such as that of diode, Nd: YAG, and Er: YAG lasers.[10,11,15,19,21,26,28,33] A significant increase of the implant surface temperature has been demonstrated when irradiating implant surfaces with a diode laser *in vitro* for more than 10 s. It is possible that authors have presented unsuccessful and nonpredictable clinical results from their studies because of overheating resulting from inconsistent power settings.[12,18,25,27,28,31,33] Recent systematic reviews have shown that there is limited information available about laser-assisted decontamination of implant surfaces, with high heterogeneity of results and a low number of included studies. However, although information is limited about the clinical application of CO_2 (10.6 µm) lasers in the surgical treatment of peri-implantitis, its use appearspromising.[6,11,13,14,28,31]

Further clinical trials and multicenter studies should be performed to improve the effects of laser treatment of periodontal and peri-implant diseases and to develop standardized protocols so that lasersmay be used in a predictable way in daily practice.

Advantages of using lasers in the periodontal therapy include

1. Less pain
2. Less need for anesthetics (an advantage for medically compromised patients)
3. No risk of bacteremia
4. Excellent wound healing; no scar tissue formation
5. Bleeding control (dependent on the wavelength and power settings);
6. Usually no need for sutures
7. Use of fewer instruments and materials and no need for autoclaving (economic advantages)
8. Ability to remove both hard and soft tissues
9. Lasers can be used in combination with scalpels (however, the laser is a tool and not a panacea).

Disadvantages of using lasers in periodontal therapy include

1. Relatively high cost of the devices
2. A need for additional education (especially in basic physics)
3. Every wavelength has different properties
4. The need for implementation of safety measures (i.e. goggle use)

Future Developments

There is a great potential for laser systems to be developed further to include additional features and functions. The Alexandrite laser is a solid-state laser, which could remove dental calculus selectively. Mechanism of selective ablation has not been clarified yet. The development of this laser for clinical use is widely expected due to its excellent ability for selective calculus removal from the tooth structure.[14,17,19,23,27,29,32,33]

II. Conclusion

Alternative or adjunctive to conventional mechanical periodontal treatment. Currently, among the different types of lasers available, Er:YAG and Er,Cr:YSGG laser possess characteristics suitable for dental treatment, due to its dual ability to ablate soft and hard tissues with minimal damage.[2,7,28,34] In addition, its bactericidal effect with elimination of lipopolysaccharide, ability to remove bacterial plaque and calculus, irradiation effect limited to an ultra-thin layer of tissue, faster bone and softtissue repair, make it a promising tool for periodontal treatment including scaling and root surface debridement. Finally, in order to have a successful periodontal treatment in long term, patients need to be motivated. It is not so much the technology but the motivation and psychology that matter when it comes to practice of oral hygiene before, during and after the periodontal treatment to maintain a good and stable periodontal condition.[9,11,13,17,33,36]

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