ISSN No:-2456-2165

Advances in Laser Technology and Cold Lasers in Periodontal Therapy: A Review

[1.] Dr. Uma Sudhakar, Prof & HOD,
Department of Periodontics,
Thai Moogambigai Dental College and Hospital,
Chennai, India.

[2.] Dr. Lalitha T Arunachalam, Professor,
Department of Periodontics,
Thai Moogambigai Dental College and Hospital,
Chennai, India.

[3.] Dr. Akshara Jadhav, Junior Resident,
Department of Periodontics,
Thai Moogambigai Dental College and Hospital,
Chennai, India.

[4.] Dr. Lalith Kumar, Junior Resident,
Department of Periodontics,
Thai Moogambigai Dental College and Hospital,
Chennai, India.

[5.] Dr. Shiba Zain, Junior Resident,
Department of Periodontics,
Thai Moogambigai Dental College and Hospital,
Chennai, India.

Abstract:- After the introduction of lasers in the 1960s, lasers have redefined dentistry. As a result of the use of lasers in the field of dentistry, a variety of great experiences have occurred and experienced by clinicians and patients. It was discovered that laser therapy had the potential to enhance wound healing and reduce pain, inflammation, and swelling. Laser can not only be used for surgeries but can also be used as an alternative to scaling and root planing. From pediatric and operative dentistry and periodontics, prosthetics and cosmetics and implantology, lasers have had a big effect on the delivery of dental treatment within the 21st century and will continue to do so as technology continues to advance and develop. This article explains about low-level laser technology, its use in all areas of dentistry and the advances, so that it can be used in the delivery of superior dental treatment.

Keywords:- *Cold Lasers, Periodontal Therapy.*

I. INTRODUCTION:

The word laser stands for Light Amplification by Stimulated Emission of Radiation.[1] For over past 25 years lasers, have been put into practice in dentistry. It was first applied to dental tissue by Goldman et al and Stern and Sognnaes.[2] The clinicians and the patients are both benefited by using lasers in their practice. Lasers are devices that transforms light of various frequencies into a chromatic radiation in the visible, infrared and ultraviolet regions and those waves produces immense heat and power in a localized area.[1] Laser beam are delivered in two different ways either by a flexible hollow waveguide or by glass fiber optic cable. Laser energies are photothermal thus when they are targeted at a tissue, they cause changes in temperature and water content.[5] Hand scaling and curettes are time consuming procedures and causes tiredness and power scalers are inconvenient because of their noise and vibration. There is also risk of microorganisms becoming resistant to systemic and topical antibiotics.[4] The smear layer consists of bacteria, bacterial endo-toxins and thus the primary goal of periodontal therapy is to curb the periodontal infection by scrapping off supra and sub-gingival biofilms and also the contaminated root cementum by root planing and curettage.[3] Thus lasers are helpful in periodontal therapy as it has good tissue ablation with strong bactericidal effects.[4] In addition, low level laser therapy at lower wavelengths aid in wound healing, reducing pain and can be used as an adjunct to many periodontal conditions and procedures. Hence the main aim of this paper is to discuss about cold lasers and its application in periodontal therapy.

II. CLASSIFICATION

Lasers are classified according to its spectrum of light, state of gain medium, hardness and output energy which is summarized in Table 1.

Based on spectrum of light	
UV light (100-400nm)	Not used in Dentistry
Visible light (400-750nm)	Most commonly used in Dentistry (Argon &Diagnodent Laser)
Infrared light (750- 10,000nm)	Most Dental Lasers are in this spectrum
Based on gain medium	
Solid state Example:	Nd:YAG, Er:YAG, Er:Cr:YSGG
Gas Example:	He, Ne, Ar, CO_2
Excimer Example:	ArF, KrCl
Diode Example:	GaAlAs
Based on hardness	
Soft lasers Example:	He:Ne, Ga:As
Hard lasers Example:	Ar, CO_2, Nd:YAG, Er:Cr:YSGG
Based on output energy:	
Low output, soft or therapeutic Example:	Diode lasers
High output, hard or surgical Example:	CO_2,Nd:YAG,Er:YAG

Table 1:- CLASSIFICATION OF LASERS[6]

III. MECHANISM OF ACTION OF LASERS:

Lasers is an electromagnetic wave generator, a monochromatic light of man-made single photon wavelength.[1,2,10] There are three characteristic features of lasers, they are: collimation, coherency and efficiency.Sir Max Plank and Niels Bohr proposed spontaneous emission based on quantum theory of physics.It defined as the process by which a light source, such as an atom, molecule, nanocrystal, or nucleus in an excited state undergoes a transition to the ground state and emits a photon.[2] The effect of lasers on tissue depends on their wavelength and also on tissue chromophore such as pigmentation, water content, mineral content. [1,6] The targeted tissues either reflects, scatters, transmits or absorbs these laser beam energies. The main principal laser tissue interaction is photo-thermal, photo-chemical and bio-stimulatory effect.[6] Lasers can help in superheating of tissue fluids, removal of tissue by vaporization, coagulation and hemostasis through its photo-thermal interaction.[10] Lasers also have disinfectant property through its photo-chemical interaction. They can also help in pain relief, faster wound healing and anti-inflammatory action through its bio-stimulatory effect.[6]

IV. COLD LASERS

Cold laser's also known as 'Soft Laser Therapy' or 'Low-level laser treatment' was introduced by Mester and his colleagues is an infrared light of cold energy which are emitted as a wavelength having low absorption power in water and known to stimulate cellular activity.Been for more than three decades in the health system, it utilizes diode and has been used for various purposes including for soft tissue surgeries, healing of tissues, reduction of inflammation, edema and pain.[7,8] Application of soft laser therapy in soft tissue surgeries include troughing of the gingiva while taking impression, gingivectomy, gingivoplasty, frenectomy, and biopsies of the soft tissues.[9] It penetrates about 3mm-5mm into the hard and soft tissues and also facilitates motility of keratinocyte and fibroblast, angiogenesis, keratinocyte motility and synthesis of collagen.[7,10] They do not cause elevation of the temperature rather produces effects from photo bio stimulation effect within the tissue. Laser enhanced bio stimulation effect has been reported to induce intracellular metabolic changes resulting further in faster cell division , migration of fibroblasts, proliferation rate and rapid production of matrix.[11] A study conducted by Lui *et al* reported that a combined study of LLLT and photodynamic effect is shown to be beneficial to nonsurgical treatment of chronic periodontitis as an adjunct on a short term basis.[10] The currently employed soft tissue lasers in clinicals include:

- Gallium-arsenide (Ga-As)
- Helium-Neon (He-N)[8]
- Diode

The dosage range of LLLT ranges between 1.5-3 J/cm^2 which modulates the activity of cell interaction with an implant therefore promoting tissue healing and ultimately implant success.[10] Among the various advantages laid down on the application of LLLT the foremost includes superiority of LLLT over conventional scalpel surgery followed by patient acceptance and does not cut or ablate the tissues.[9,11] It is regarded as one of most progressive, contemporary, conservative and less painful method than surgery further promoting faster wound healing and less scar tissue than those produced from scalpel surgery.[9]

V. APPLICATION OF COLD LASERS

Major indication for application of cold lasers include for soft tissue surgery and management. Generally, CO2, Nd-YAG, diode, Er: YAG lasers are accepted for this surgery.[12] Following procedures have been listed which use Low level laser therapy in periodontology:

1. Surgical pocket therapy
2. Frenectomy
3. Gingivectomy
4. Soft tissue grafting

5. De-Pigmentation
6. Desensitization
7. Removal of granulation tissue
8. Osseous recontouring
9. Crown lengthening
10. Surgery-implants
11. Peri-Implantitis
12. Operculectomy

Cold lasers have also been used in the treatment of hypersensitivity providing anti-inflammatory, analgesic, and cellular effect. A 780nm diode laser Is used at a power of 30m W, or Nd: YAG laser at low power can also be put in application.[16] Cold Lasers therapy is applied in esthetic gingival procedures such as recontouring or reshaping of gingival crown lengthening. Er: YAG laser are used in aesthetic contouring of gingival procedures. Ablation of soft tissue by lasers provides fine contact and promotes faster healing of the wound proving one of the finest advantages of cold laser therapy application.[12] It has been used in the management of pain for the treatment of gingivectomies and other surgical procedures.[17] Application of Erbium Laser in crown lengthening of the anterior has brought a new approach towards smile design.[8] Another application of soft tissue laser therapy includes the treatment of periodontal pocket treatment using Nd: YAG which is reported safe for removal of the sulcular epithelium in the pockets. An advantageous factor of LLLT in this treatment includes protection of the underlying connective tissue by causing necrosis or carbonization.[12] Therefore LLLT has provided various beneficial assets in terms of application to periodontics which include effective treatment against chronic and acute injury, reduction of pain and inflammation and as a best alternative option to any allergy or harsh medications.[17]

VI. RECENT ADVANCEMENTS IN LASERS

Dental laser technology can be used to produce hard and soft tissue laser energy. Lasers are now the future of dentistry, making it even easier to eliminate decay. There are different type of techniques, protocols and tactics has been introduced that exceeds conventional methods of treatment. Patients are looking forward to greater convenience and precision in the treatment offered by laser technology.

A. PeriowaveTM

PeriowaveTM is a photodynamic disinfection system that uses non-toxic dye (photosensitizer) in terms of low-intensity lasers. A small amount of blue-colored photosensitizer solution is applied topically to the gums at the site where it binds to microbes and toxins associated with gingival or periodontal disease followed by a low-intensity laser guided to the region treated with the drug resulting in phototoxic reactions killing bacteria below the gingival line. The treatment requires only 60 seconds making it quick and painless.[1]

B. Periodontal Waterlase MD™

Target Applications of Periodontal Waterlase MD™ are restorative and multi-disciplinary dentistry procedures, cosmetic procedures, oral surgery, endo disinfection, implants and periodontal treatment. It utilizes Er,Cr:YSGG minimally invasive surgical periodontal laser therapy that shows improvements in bleeding on probing, probing depth, and tends to be beneficial in comparison to scaling and root planning due to more effective degree of attachment restoration.[1]

C. Waterlase C100

Target Applications of Waterlase C100 are restorative procedures, extraction and early periodontal treatment.[1]

D. Lanap

Regeneration refers to the formation of new bone, cementum, and periodontal ligament. However, it was discovered that laser-assisted new attachment procedure (LANAP) could help in the regeneration of the affected periodontal tissues and new connective tissue attachment mediated by cementum could be seen. As findings are based on a recent study that confirmed replacement of diseased tissues of root with new cementum, bone, and periodontal ligament, reflects periodontal regeneration. Many researchers believed that LANAP performed with Nd:YAG laser (PerioLase MVP-7) promotes periodontal regeneration and also causes minimal bleeding, edema, and postoperative uneasiness.[17]

E. Lapip

McCarthy introduced the concept of LAPIP, “Laser-Assisted Peri-Implantitis Procedure” as a modification of LANAP as it can be used in diseased implants. LAPIP helps in bringing back the diseased structure to healthy states, promotes bone and tissue regeneration, and the most commendable feature is that the procedure can be performed on implant without damaging it. Since no flap is reflected, it even leaves chances for other therapies in the future. The LAPIP protocol recommends the PerioLase MVP-7, a Nd:YAG “free-running” pulsed laser, to treat periimplantitis. However, researchers claim that both soft tissue lasers (Nd:YAG, diode, CO2),and hard tissue lasers, can cause harmful effect on implant surfaces, such as sudden rise in temperature as it can compromise bone vitality.[17]

VII. CONCLUSION

As there is reduced risk and patient comfort and pain free experience, there is a wide demand for this technology to be used in dental clinics. Laser treatment is used as an adjunct to periodontal therapy. Currently, between the various types of lasers available, Er: YAG and Er, Cr: YSGG laser have features ideal for dental treatment due to their dual ability to work with soft and hard tissues with minimal damage and diode lasers used exclusively for soft tissue procedures. Given the potential benefits, low-cost features of LLLT, the usage of LLLT applications is bright. Efforts should be made towards the investigation, and effective dosimetry required for therapeutic laser effects

with an aim to modify treatment protocols. It is useful for the patient and dentist to research LLLT which is an undiscovered resource in the dental industry.

REFERENCES

[1]. Krishna V, Rai NP, Sharma A, Kumar P. Advancements in lasers: a revolutionary tool in periodontics.
[2]. Narang S, Maytreyee R, Singh N, Khare K, Jain P. Clinical Application of Soft Tissue Lasers in Periodontics. J Orofac Res 2015;5(3):94-98.
[3]. Katuri KK, Bollepalli AC, Sunkireddy HKR, Chilakalapudi HCB, Kurapati S, Vinnakota NR. Clinical effectiveness of laser assisted new attachment procedure as an adjunct to non-surgical periodontal treatment: A randomized clinical study. J Int Oral Health 2015;7(11):57-62.
[4]. Aoki A, Sasaki KM, Watanabe H, Ishikawa I. Lasers in nonsurgical periodontal therapy. Periodontology 2000. 2004 Oct 1;36(1):59-97.
[5]. Seyyedi SA, Khashabi E, Falaki F. Laser application in periodontics: J Lasers Med Sci 2012; 3(1):26-32
[6]. Thomas, G V et al. Laser - An Innovative Tool in Periodontal Therapy - A Review Paper. Annals of Dentistry University of Malaya**,** [S.l.], v. 21, n. 2, p. 1-7, dec. 2014. ISSN 2462-2060.
[7]. Sobouti F, Khatami M, Heydari M, Barati M. The Role of Low-Level Laser in Periodontal Surgeries. J Lasers Med Sci 2015;6(2):45-50
[8]. Dang AB, Rallan NS. Role of lasers in periodontology: A Review. Annals of Dental Speciality. 2013 Jul 1;1(1):8-12.
[9]. Matthews DC. Seeing the Light-The Truth about Soft Tissue Lasers and Nonsurgical Periodontal Therapy. Journal of the Canadian Dental Association. 2010 Apr 1;76(2).
[10]. Khurana D, Sharnamma B, Rathore PK, Tyagi P. Photodynamic Therapy-A Ray towards Periodontics. IOSR Journal of Dental and Medical Sciences. 2014;13(3):64-71.
[11]. Shah NK, Rai JJ, Dave DH, Patel JK. Deploying diode laser in periodontics: An evidence-based review. Adv Hum Biol 2018;8:64-9
[12]. Patila T, Zade RM, Amirisetty R, Gopinath V. Laser in Periodontics - A Review of Literature. Int J Oral Health Med Res 2016;2(5):140-143.
[13]. Bouhout Y, Gonçalves RB. Laser assisted periodontics: A review of the literature. World Journal of Stomatology. 2015 Nov 20;4(4):129-36.
[14]. Lee DH. Application of laser in periodontics: A new approach in periodontal treatment. Dental Bulletin. 2007 Oct 12;12(10):23-5.
[15]. Padmanabhan P. Lasers and its Application in Periodontology: A Review. Indian Journal of Public Health Research and Development. 2019 Nov1;10(11).
[16]. Brindha; DEVI, Renuka. Low-level Laser Therapy in Periodontics: A Review Article. Journal of Academy of Dental Education,[S.I],p. 12-16, feb. 2019. ISSN 2348-2621.
[17]. Jha A, Gupta V, Adinarayan R. LANAP, Periodontics and Beyond: A Review. J Lasers MedSci. 2018;9(2):76-81. doi:10.15171/jlms.2018.16