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Research Article

LASERS IN PERIODONTICS – AN UPCOMING BOOM

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A B S T R A C T

Dental lasers have been commercially available for several decades. Laser are an exciting technology, widely used in medicine, kind to tissue and excellent for healing. 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. A laser generates a precise beam light concentrated with energy. Every laser technology is engineered to perform specific special functions without changing or damaging the surrounding tissues.

INTRODUCTION

The use of lasers (acronym of the words "Light Amplification by Stimulated Emission of Radiation") in dentistry has recently received much attention, in both clinical practice and research; their unique properties produce favourable clinical results in some cases and encourage patient acceptance.[1] Laser is one of the most entrancing technologies in dental practice since 1960. Lasers were introduced in dentistry and changed the different treatment options in this field as an alternative to cutting devices by use of either scalpels or rotary instruments, However, rotary instruments are considerable progress in comparison to mechanical cutting, there are disadvantages of noise and vibration produced by the mechanical action of the air rotor or ultrasonic scalers in periodontics. Laser has now become an instrument of choice for better treatment outcome and patient acceptance.[2]

History

Different Evidences suggests its use in initial periodontal therapy, endodontic therapy, surgery, and most recently, its use in implant therapy. Evolving from different eras there has been a continuous expansion in the development of laser-based dental devices.

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In Periodontics, pathogenesis of periodontal disease and the methods of treatments have undergone drastic changes from the past 30 years. The current model for periodontal disease includes microbial components, host inflammatory responses, and host risk factors that contribute to the advancement of this disease and causes damage to the soft tissues and bones supporting the teeth and affects up to 50% of adults. Since lasers were introduced for the treatment of oral diseases, there has been considerable advancement in technology. As a result, numerous laser systems are currently available for oral use. Neodymium: Yttrium-Aluminum:Garnet (Nd:YAG), carbon dioxide (CO(2)) laser and the semiconductor Diode lasers have already been approved by the US Food and Drug Administration for soft tissue treatment in oral cavity.[3]

Mechanism of Action

With introduction of LASERS in dentistry and Periodontics practitioner should be well aware of mechanism of action how LASERS works, their types and action on different soft and hard tissues. As it is stated LASERS are the light energy that can induce energy transition in atoms, causing the atoms to move from their current state (EO) to the excited state / activated stage by the absorption of a quantum of energy which is "stimulated absorption." Because the lowest energy state is the most stable, the excited atom tends to return to normal by spontaneously emitting a quantum of energy called "spontaneous emission." This conversion to low energy state

can be achieved by stimulating the activated medium further by a quantum of light at the same transition frequency. This is called "stimulated emission." During this process, it releases a photon of the same size as of the released atom, which hits against the adjacent activated atom setting off a chain reaction of releasing photons. Laser light is distinctive in that it is monochromatic, unidirectional and coherent and can be delivered onto target tissue as a continuous wave, gated-pulse mode, or free running pulse mode. All laser devices have a laser medium, which can be a solid, liquid, or gas, An optical cavity or laser tube having two mirrors, one fully reflective and the other one partially transmissive, which are located at either end of the optical cavity and An external mechanical, chemical, or optical power source which excites or "pumps" the atoms in the laser medium to higher energy levels. Laser delivery systems includes Articulated arms (with mirrors at joints) – for UV, visible, and infrared lasers, Hollow waveguides (flexible tube with reflecting internal surfaces) – for middle and far infrared lasers and Fiber optics – for visible and near infrared lasers. The action of lasers on dental hard and soft tissue as well as bacteria depends on the absorption of laser by tissue chromphore (water, apatite minerals, and various pigmented substances) within the target tissue. Laser interaction mechanism is wavelength-dependent and wavelength-independent mechanisms And as Photothermal interaction occurs with high-powered lasers, when used to vaporize or coagulate tissue through absorption, photomechanicalas disruption of tissue due to shock wave formation and cavitations, photodynamic therapy, Biostimulation, Photoablation therapy and Photochemical effects by using light sensitive substances to treat conditions such as cancer.[2]

Lasers in Periodontics and Implantology In Phase i Therapy

Soft tissue lasers are used in bacterial reduction and coagulation. And in a periodontally involved sulcus that has dark inflamed tissue and pigmented bacteria. The erbium group of lasers has shown significant bactericidal effect against *Porphyromonas gingivalis and Actinobacillus actinomycetemcomitans*.[4] Reduction of interleukins and pocket depth was also noted with the use of laser therapy. Nd:YAG, Er, Cr:YSGG, and 980 nm diode laser were also capable of modifying the dentin morphology, correlating characteristics features for each one, which are essential clinical knowledge to establish the correct indication for each case.[5]

Surgical Procedures

Laser-Assisted New Attachment Procedure (LANAP)

Many study suggest that LANAP can be associated with cementum-mediated new connective tissue attachment and apparent periodontal regeneration of diseased root surface in humans.[2] Er:YAG as monotherapy gained significantly more CAL at 3 months than did SRP.[6] Many studies showed an increased coagulation and a relatively dry surgical field for better visualization. Laser increases tissue surface sterilization leads to decrease bacteremia, swelling, edema, and scarring.[2,5] Use of argon Laser for soft tissue closure is well documented and now can be effectively used to perform gingivectomies, gingivoplasties, frenectomy, vestibuloplasty, gingival enlargement, gingival depigmentation using laser ablation, free gingival graft procedures, crown lengthening, operculectomy, and many more as an effective and a reliable technique.[7] inding predictable approaches for root surface biomodification is an important challenge in the treatment of gingival recession. There was gain in root coverage percentage by subepithelial connective tissue graft (SCTG) following root surface conditioning with erbium, chromium: yttrium scandium gallium garnet (Er,Cr:YSGG) laser.[8]

Lasers In Implant Therapy

Gingival enlargement is relatively common around implants when they are loaded with removable provisional or fixed prosthesis. Lasers can be used for the hyperplasia removal as well as in the treatment for peri-implantitis. Peri-implantitis (PI) is an inflammatory disease of peri-implant tissues, it represents the most frequent complication of dental implants.[2,9,10]

Er:YAG lasers are used for soft tissue incision, hemostasis, cutting , due to its bactericidal and decontamination effect, can be used in the maintenance of implants. It has high bactericidal effect without heat generation around implants. cleaning of contaminated dental implant surfaces by means of the Q-switch Nd:YAG (Neodymium-doped Yttrium Aluminum Garnet) laser and an increase in temperature at lased implant surfaces during the cleaning process. The increase in temperature generated at lased implant surfaces during cleaning was below 1 °C. According to our findings, Q-switch Nd:YAG laser with short pulse duration in nanoseconds is able to significantly clean contaminated implant surfaces.[10]

Analgesic Effect

Laser therapy blocks the pain signals transmitted from injured parts of the body to the brain. This decreases nerve sensitivity and significantly reduces the perception of pain by Increasing the production and release of endorphins and enkephalins which are natural pain-relieving chemicals. Low-level laser therapy (LLLT) has been promoted for its beneficial effects on tissue healing and pain relief for skin and oral applications.[11]

Inflammation Reduction

Laser therapy causes the vasodilation causes inflammation, swelling, and edema to be cleared away from injury sites and promotes lymphatic drainage which enhances the healing.[2]
Soft And Hard Tissue HealingPhotons of light emitted by therapeutic lasers penetrate deeply into the tissues to stimulate the cells. This stimulation increases the energy available to these cells, causing them to absorb nutrients and expel waste products more rapidly as photostimulation effect.

It has been reported that low-level semiconductor diode lasers could enhance the wound healing process. The periodontal ligament is crucial for maintaining the tooth and surrounding tissues in periodontal wound healing. There is biological effects of semiconductor diode lasers on human PDLFs. Despite the controversy regarding clinical efficacy, dental hygienists use the diode laser as an adjunct to non-surgical periodontal therapy. Current concept of periodontal biofilm behavior, tissue response to laser therapy being dependent on tissue type and health, and that the successful therapeutic treatment window is specific to the target tissue, biofilm

composition, laser wavelength, and laser energy delivered. Using evidence-based laser guidelines would allow dental hygienists to provide more effective non-surgical periodontal care. Laser therapy significantly increases the formation of new capillaries (tiny blood vessels) within damaged tissues. Laser therapy reduces the formation of scar tissue (fibrous tissue) following tissue damage related to cuts, burns, and surgery and more effectively carrying away waste products.[12] wound-healing effects of LLLT on primary human vocal fold epithelial cells (VFECs). It also increased cell migration and the expression of some genes, such as EGF, TGF-β1, TGF-β3, and IL-10, involved in the tissue healing process. was capable of stimulating the proliferation and migration of human vocal fold epithelial cells in culture as well as increase the expression of some genes involved in tissue healing process. Additionally, successive laser treatments at 24 h intervals have an additive beneficial effect on the healing of injured tissues.[11] Waterlase system is a revolutionary dental device that uses laser energized water to cut or ablate soft and hard tissue and Periowave™, a photodynamic disinfection system, utilizes nontoxic dye (photosensitizer) in combination with low-intensity lasers enabling singlet oxygen molecules to destroy bacteria (Thomas, 2006).[2]

Inspite of several advantages and advances of lasers there is need of general safety requirements include laser warning sign outside the clinic, use of barriers during the treatment procedure, and the use of eyewear to protect against reflected laser light or accidental direct or indirect exposure. High volume suction must be used to evacuate the plume from tissue ablation. Also several authors have studied the thermal effect of lasers on the periodontal ligament and surrounding bone. Hence, periodontal tissues are not damaged if the temperature increase is kept below 5°C. A threshold temperature increase of 7°C is commonly considered as the highest thermal change, which is biologically acceptable to avoid periodontal damage.[2,3]

CONCLUSION

No doubt more researches with better designs are important before lasers can become a part of dental armamentarium. With conventional mechanical hand and rotary instruments, complete access and disinfection may not be achieved during the treatment of periodontal pockets and bone defects which is desirable properties for the successful treatment outcome of periodontal therapy. Lasers have the potential advantages of bactericidal effect, detoxification effect, and removal of the epithelium lining and granulation tissue, with osteotomy and ostectomy by applying the ablation and cutting effect of light energy which is completely different from conventional mechanical debridement. So LASERS may emerge as a new technical modality for periodontal therapy in the near future.

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