ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, S Iss 4 ,2022

Applications of Lasers in Dentistry

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ABSTRACT:

Background: Since the middle of the 20th century, during the last three and a half decades, lasers have transformed dental care. The ruby laser was created by Theodore Maiman in 1960, and since since, it has become one of the most alluring dental technologies. Initial periodontal treatments, surgery, and implant treatment all make use of lasers. In order for laser to become a tool in the dental arsenal, more study is required. This essay provides information about laser periodontics.

Keywords*:* Periodontology, Periodontics, Laser

INTRODUCTION:

The mechanical cutting tools used in dentistry have undergone tremendous progress throughout the last century. Dental patients continue to be terrified of the noise and vibration created by the mechanical action of the air turbine and ultrasonic scalers, despite the fact that there has been significant advancement in the field of mechanical cutting. The creation of laser-based dental equipment based on photomechanical interactions has increased steadily since the turn of the century till the present. The dental lasers of today have profited from decades of laser research and are based on a few hypotheses from the early 1900s, when danish physicist niels bohr, among others, first proposed these theories in the realm of quantum mechanics. Nearly 40years later, American physicist Townes first used the stimulated emission technique to amplify microwave frequencies, leading to the coining of the name maser (microwave amplification by stimulated emission of radiation).

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Surgery-specific lasers target tissue with concentrated, manageable energy. The energy from a laser must be absorbed for it to have any biological impact. The wavelength and optical properties of the target tissue will affect how much light is absorbed in it. A predictable and precise interaction impact will happen if the laser's peak emission fits the absorption spectrum of one or more components of the target tissue. The overall effect will be a mix of the effects on each tissue component because tissues all have more than one component.

Effects of lasers on tissue

Four potential interactions between the laser's light energy and the target tissue are possible, and each interaction is influenced by the tissue's optical characteristics.

There are four primary sorts of interactions or reactions that might happen when radiant light is received by tissue.

Photo mechanical interaction: structures can be disrupted or dissociated using laser light, a process known as photo-disruption or photo-disassociation.

Photoelectrical interaction: the process of removing tissue by creating electrically charged ions and particles that are in a semi-gasseous high energy state is known as photo plasmolysis.

Photochemical interaction: bio-stimulation is the term used to describe how laser light stimulates biochemical and molecular processes that naturally take place in tissues, such as tissue healing and repair.

Photo thermal interaction: photoablation, also known as the vaporisation and superheating of tissue fluids, coagulation, and hemostasis, is the process of removing tissue.

Dentistry applications

- Internal soft tissue surgery
- Application to hard tissues
- Endodontics
- Dental supplies
- Holography, instrument sterilisation, laser diagnostics and bio-stimulation

Laser applications in periodontics

Deepithelization using lasers for improved GTR: for periodontics to produce predictable results, the treatment of periodontal abnormalities to generate new attachment remains to be a significant therapeutic challenge. Many methods have been attempted in the past to slow epithelium down growth. The gingival tissue experiences a fairly unusual wound thanks to the co laser. Instead of a burn, there is an instantaneous vaporisation of the intercellular fluid,

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which causes the cell structure to disintegrate. Due to variables like a lowered inflammatory response and less wound contraction, the laser wound on the skin and gingiva delays reepithlization. In a 28-day investigation on monkeys, Rossman et al. Compared interproximal deficiencies at co-treated and control locations, and they found that connective tissue attachment was more common than epithelial attachment.

Laser-assisted peri-implant care: methods for maintaining implants have included those that resemble the maintenance of the periodontium following periodontal therapy or surgery. The nd:yag laser was investigated as a potential modality for detoxifying, debriding, and sterilising the surface of coated and titanium plasma-sprayed (TPS) implants with the goal of preventing detrimental alteration of the implant surface during routine maintenance procedures or in the treatment of failing implants.

Laser therapy for dentine hypersensitivity: short, sharp pain that is caused by exposed dentine in reaction to stimuli, usually thermal, evaporative, tactile, osmotic, or chemical, is a symptom of dentine hypersensitivity and cannot be attributed to any other type of dental pathology or defect. Low level lasers like he-ne and middle output lasers like Nd: YAG and co lasers are the two categories of lasers used to treat dentine hypersensitivity. According to Lan and Liu (1995), the mechanism of laser effects on dentine hypersensitivity involves both direct nerve analgesia via the pulpal nerve system and laser-induced occlusion or narrowing of dentinal tubules. According to a theory, laser radiation interferes with the sodium pump mechanism, modifies cell membrane permeability, and/or temporarily changes sensory axon ends.

Laser depigmentation: melanin pigmentation of the gingiva and skin frequently causes aesthetic issues. Each person has a unique level of pigmentation, both in intensity and coverage. The elimination of pigmentation from the gingiva has been described using a variety of techniques. Cryotherapy, gingivectomy, and argon laser irradiation are a few of them. Additionally, a number of lasers, including the ruby, dyed pulsed, nd:yag, co, and eximer lasers, are utilised to remove mouth lesions and cutaneous pigmented lesions.

Applications for soft tissue:

Gingivectomy, frenectomy, excision of muco-cutaneous lesions (both benign and malignant), and gingival sculpting procedures connected with implant therapy and mucocutaneous surgery are traditional uses of lasers for soft tissue ablation.

Laser whitening

Utilizing the most effective energy source while avoiding any negative effects, laser bleaching aims to accomplish the most powerful bleaching procedure possible. There are more benefits to using the 488-nm argon laser than other heating methods for the hydrogen peroxide molecule. Contrarily, plasma-arc lamps, halogen lamps, and other heat sources emit short wavelengths as well as longer invisible infrared thermal wavelengths (750 nm to 1

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mm), with lower-energy photons and predictable high thermal character. Argon lasers emit relatively short wavelengths (488 nm) with higher-energy photons. The pulpal reactions caused by this high thermal energy may not be desirable.

Gingival cosmetic treatments

Lasers can be used in aesthetic procedures including crown lengthening and gingiva recontouring or reshaping. Some lasers provide for more delicate and accurate control over the depth and volume of soft tissue ablation than mechanical tools. Because it can accurately ablate soft tissues using a variety of small contact points and because there is little thermal modification to the treated surface, the Er:YAG laser is particularly safe and effective for managing aesthetic periodontal soft tissues.[10]

SURGERY-FREE POCKET TREATMENT:

Standard root debridement

Plaque, calculus, and bacterial endotoxins have penetrated the cementum and accumulated on the exposed root surfaces of teeth with periodontal pockets. The damaged root surface is often debrided by mechanical scaling and root planing, generally using hand-held or power-driven devices, during the initial phase of periodontal therapy.

The benefits and drawbacks of using laser therapy in periodontal care

The exorbitant price of a laser device is a major deterrent for periodontal practitioners from using lasers. Second, due to their various wavelengths, each laser has unique properties. Therefore, users of lasers should be familiar with their basic specifications. However, very few academic institutions offer thorough training in the application of lasers in dentistry. Because of this, it might be challenging for users to grasp every part of the procedures and safety precautions needed for the more modern devices. The tooth and root surfaces, as well as the attachment mechanism at the bottom of the pocket, can all be harmed by improper laser irradiation of teeth and periodontal pockets. It's also important to take into account any potential harm to the dental pulp and underlying bone. [1-5]

Laser therapy in periodontal therapy may be used in addition to or as a substitute for mechanical methods. The use of previously available laser technologies has negative side effects that included the melting, cracking, and carbonization of hard tissues like bone and root. However, the recently created Er: YAG and Er,Cr:YSGG lasers may safely ablate both soft and hard tissues with water irrigation and are suited to periodontal therapies like scaling, debridement, and bone surgery, and they have no thermal impact. Erbium laser technology has thus far demonstrated potential as a laser system for periodontal treatment methods on hard tissues. [5]

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CONCLUSION

In conclusion, laser periodontal therapy is anticipated to complement or replace traditional mechanical periodontal therapy. Nd-YAG, Er:YAG, and Er,Cr:YSGG lasers now on the market have qualities that make them excellent for dental treatment since they can simultaneously ablate both soft and hard tissues with little collateral damage. It is also a promising tool for periodontal treatment, including scaling and root surface debridement, due to its bactericidal effect with elimination of lipopolysaccharide, capacity to remove bacterial plaque and calculus, irradiation effect limited to an ultra-thin layer of tissue, and faster bone and soft tissue repair. Finally, patients must be motivated for a periodontal therapy to be successful over the long run. When it comes to practising oral hygiene before, during, and after periodontal therapy to maintain a healthy and stable periodontal condition, the motivation and psychology matter more than the technology.

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