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Application of Lasers in Periodontics: True Innovation or Myth?

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Abstract: *LASERS have been commercially used in medicine since several decade. The main advantage of bloodless fields and painless surgical procedure with better healing has accelerated the use of Lasers in periodontics. Lasers have provided us with a potential alternative to simultaneously remove the diseased soft tissues and target the microorganisms 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. 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, Nd:YAG laser, diode laser, Er:YAG, carbon dioxide laser, low level laser therapy, LANAP, LAPIP.*

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I. Introduction

The term “LASER” is the acronym for “Light Amplification by Simulating Emission of Radiation”[1]. Lasers were introduced in the field of medicine approximately 50 years ago.[2]It refers to a device that emitslight that is spatially coherent and collimated;a laser beam can remain narrow over a longdistance, and it can be tightly focused. Whendirected at tissues, different interactions result.The absorption, reflection, transmission, andscattering of the laser light vary depending onthe wavelength of the laser and the characteristicsof the tissue.[3]The subject of lasers in periodontics now encompasses a rapidly increasing and significant volume of published literature. Despite the large number of publications, there is still controversy among clinicians regarding the application of dental lasers to the treatment of periodontal diseases, and more specifically, chronic periodontitis. The purpose of this review is to analyze the peer-reviewed research literature to determine the state of the science regarding the application of lasers to common oral soft tissue problems, root surface detoxification, and the treatment of chronic periodontitis.

HISTORY OF LASERS

Nearly 40 years later, American physicist Townes first amplified microwave frequencies by the stimulated emission process, and the acronym MASER (Microwave Amplification by Stimulated Emission of Radiation) came into use. In 1958, Schawlow and Townes discussed extending the M A S E R principle to the optical portion ofelectromagnetic field hence, L A S E R (Li g h tAmplification by Stimulated Emission of Radiation) was invented.

Maiman developed the first laser prototype in 1960.[4]Maiman’s device used a crystal medium of ruby that emitted a coherent radiant light from the crystal when stimulated by energy. Thus, the ruby laser was created. Shortly thereafter, in 1961, Snitzer[5] published the prototype for the Nd:YAG laser. The first application of a laser to dental tissue was reported by Goldman et al.[6] and Stern and Sognnaes,[7] each article describing the effects of the ruby laser on enamel and dentin. However,the current relationship of dentistry with the laser takes its origins from an article published in 1985 by Myers and Myers[8] describing the in vivo removal of dental caries using a modified ophthalmic Nd:YAG laser.[7] Four years later, it was suggested that the Nd:YAG laser could be used for oral soft tissue surgery,[9] which ultimately lead to the present relationship between lasers and clinical periodontics.[10-12]

CLASSIFICATION OF LASERS:

Classification of Lasers[13]:

Lasers can be classified according its spectrum of light,material used and hardness etc. They are also classified assoft lasers and hard lasers.

Classification based on light spectrum:

UV Light	100 nm – 400 nm	Not Used in Dentistry
Visible Light	400 nm – 750 nm	Most commonly used in dentistry (Argon & Diagnodent Laser)
Infrared light	750 nm – 10000 nm	Most Dental Lasers are in this spectrum

Classification According to material used:

Gas	**Liquid**	**Solid**
Carbon Dioxide	Not so far in clinical use	Diodes, Nd:YAG, Er:YAG, Er:Cr:YSGG, Ho:YAG

1. Soft laser

Soft lasers are of cold (athermic) energy emitted aswavelengths; those are thought to stimulate cellularactivity. These soft lasers generally utilize diodes and the manufacturers claim that these lasers can aid healing of thetissue, reduces inflammation, edema, and pain. Clinicalapplication includes healing of localized osteitis, healing ofaphthous ulcers, reduction of pain, and treatment ofgingivitis.

The current soft lasers in clinical use are the:

a. Helium-neon (He-N) at 632.8 nm (red, visible).
b. Gallium- arsenide (Ga-As) at 830 nm (infra-red,invisible).

2. **Hard lasers (surgical)**

Hard lasers can cut both soft and hard tissues. Newervariety can transmit their energy via a flexible fiber opticcable. Presently more common type clinically used, underthis category

The Hard lasers are:

a. Argon lasers (Ar) at 488 to 514 nm
b. Carbon-dioxide lasers (CO2) at 10.6 micro-meter
c. Neodymium-doped yttrium aluminum garnet(Nd:YAG) at 1.064 micrometer. Holmiumyttrium-aluminum-garnet (Ho:YAG) at 2.1micro-meter.
d. Erbium,chromiummyttrium-slenium-gallium-garnet(Er,Cr:YSGG) at 2.78 micro-meter.
e. Neodymiummyttrium-aluminum-perovskite(Nd:YAP) at 1,340 nm.

Types of lasers:

On the basis of output energy:[14]

a. Low output, soft or therapeutic eg. Low-outputdiodes
b. High output, hard, or surgical eg.CO2,Nd:YAG,Er:YAG

On basis of state of gain medium:[14]

a. Solid state-eg.Nd:YAG, Er:YAG, Er,Cr:YAG
b. Gas- eg.HeNe, Argon,CO2
c. Excimer-eg.ArF, KrCl
d. Diode- eg.GaAIAs

On the basis of oscillation mode:[14]

a. Continous wave eg. CO2, Diodes
b. Pulsed wave eg.Nd:YAG, Er:YAG

FUNDAMENTALS OF LASERS:

The process of lasing occurs when an excited atom is stimulated to emit a photon before the processoccurs spontaneously. Spontaneous emission of a photon byone atom stimulates the release of a subsequent photon andsoon. This stimulated emission generates a very coherent(synchronous waves), monochromatic (a singlewavelength), and collimated form (parallel rays).[15]Laser is a type of electromagnetic wave generator.[16] Lasersare heat producing devices converting electromagneticenergy into thermal energy. Lasers can interact with their target material by either being absorbed, reflected, transmitted, or scattered.[17] Absorbedlight energy gets converted to heat and can lead to warming, coagulation, or excision and incision of the target tissue. Although the wavelength of the laser is the primarydeterminant of how much energy is absorbed by the target tissue, optical properties of the tissue, such as pigmentation,water content, and mineral content, can also influence theextent of energy absorbed.[18] The term ‘waveform’ describes the manner in which laserpower is delivered over time, either as a continuous or as a pulsed beam emission. Continuous wave lasers deliver large amounts of energy in an uninterrupted steady stream potentially resulting in increased heat production. Pulsed wave lasers usually deliver smaller amounts of energy in interrupted bursts, thereby countering the build-up of heatin the surrounding tissues.[19]

PRECAUTIONS AND RISKS ASSOCIATED WITH CLINICAL USE OF LASERS:

Precautions before and during Irradiation[20]

1. Use glasses for eye protection (patient, operator, and assistants).
2. Prevent inadvertent irradiation (action in noncontact mode).
3. Protect the patient’s eyes, throat, and oral tissues outside the target site.
4. Use wet gauze packs to avoid reflection from shiny metal surfaces.
5. Ensure adequate high-speed evacuation to capture the laser plume.

Potential risks[20]

1. Excessive tissue destruction by direct ablation and thermal side effects.
2. Destruction of the attachment apparatus at the bottom of pockets.
3. Excessive ablation of root surface and gingival tissue within periodontal pockets.
4. Thermal injury to the root surface, gingival tissue, pulp, and bone tissue.

ADVANTAGES:	DISADVANTAGES:
1. Strong ablation, hemostasis, detoxification and bactericidal action. 2. Less need of anaesthetics. 3. Rapid and painless application of light. 4. Selectivity in its effects. 5. Absence of phototoxicity-human cells. 6. No effects on taste. 7. Possible clinical and microbiological benefit with minimal impact on natural microbiota. 8. Usually No need of sutures. 9. Use of fewer instruments and materials.	1. Each laser has different characteristics because of their different wavelengths.Thus, It is difficult for the users to learn all aspects of the techniques. 2. Precautions required for the newer technologies. 3. Improper irradiation of teeth and periodontal pockets by lasers can damage the tooth and root surfaces as well as the attachment apparatus at the bottom of the pocket. 4. Possible damage to the underlying bone and dental pulp should also be considered 5. the high financial cost of a laser apparatus is a significant barrier for laser utilization by periodontal practitioners

APPLICATIONS OF LASERS IN PERIODONTICS:

NON-SURGICAL PERIODONTAL THERAPY:

SULCULAR DEBRIDEMENT WITH FIBER OPTIC LASER DELIVERY:

Preprocedural decontamination:

Preprocedural decontamination is laser application done before any instrumentation, even probing. The objectives are to affect the bacteria within the sulcus, reducing the risk of bacteremia caused by instrumentation and to lower the microcount in aerosols created by ultrasonic instrumentation. The technique uses very low energy. The fiber is placed within the sulcus and is swept vertically and horizontally against the tissue wall, away from the tooth, with a smooth flowing motion for 7 to 8 seconds on the lingual aspect, then on the buccal aspect of each tooth’s tissue wall. The benefits are seen in the reduced microbial translocation through the circulatory system.

Coagulation:

When the biofilm has been removed the second objective in active phase 1 periodontal infection therapy is coagulation,sealing the capillaries and lymphatics of the healthy tissue. Coagulation may inhibit the biofilm’s progression. It also counteracts the swelling that occurs with the inflammatory process. Coagulation is accomplished with increased mJ and decreased Hz compared with the decontamination. It also requires less time and doesnot address every millimeter of the tissue. A newly cleaved fiber is moved back and forth through the pocket, administering laser energy beyond the end of fiber into the tissue. The application raises the temperature within the pocket slightly, to promote protein denaturation and sealings of the vessels. If continued hemorrhaging occurs when the exiting the pocket, the fiber may be used in non-contact mode to coagulate at the gingival margin, keeping the laser energy directed away from the tooth surface. After coagulation firm digital pressure is applied to areas within the deep pockets will support the readaptation of the tissue to the tooth and enhance reattachment. Coagulation assists the first stages of healing after debridement.

Nonsurgical pocket therapy
SULCULAR DEBRIDEMENT:

The micropulsed 10,600nm CO_2 laser uses a defocused, non-contact technique. Marginal dehydration and pocket decontamination are two steps applied in CO_2 lasers. The energy should be parallel to the tooth surface and toward the tissue. Begin by directing laser energy to the coronal edge of the marginal gingival. Hold the tip perpendicular to the tissue crest at a distance of approximately 1mm. tissue interaction is observed with a slight 'frosting' of the surface. Marginal dehydration will improve entry of the tip by drawing the tissue slightly away from the tooth structure. The epithelium will be inhibited by this application. This is the first step before pocket decontamination. The defocusing tip is kept 1mm for pockets upto 6mm in depth and 2mm for more than 6mm. treatment should include the complete circumference of each tooth presenting with disease. Activate the laser as the tip is drawn through the crevicular space in an even motion, slow motion, working from the distal aspect to the mesial aspect on the buccal and again on the lingual side of the tooth. The laser tip is kept parallel to the long axis of the tooth. The tip must be kept open and free of coagulum for efficient enerfy flow. Keeping the tissue slight moist and working in a single direction will enhance laser's efficiency.

CONVENTIONAL ROOT DEBRIDEMENT:

In periodontal pockets the exposed root surfaces are contaminated with an accumulation of plaque and calculus, as well as infiltration of bacterial endotoxins into the cementum. Usually, in the Initial phase of periodontal therapy, debridement of the diseased root surface is nonsurgically treated by mechanical scaling and root planing, primarily by using manual or power-driven instruments. However, complete removal of bacterial deposits and their toxins from the root surface within the periodontal pockets is not always achieved with only the use of conventional mechanical therapy. In addition, access to areas such as furcations and grooves is limited owing to the complicated root anatomy. Further conventional mechanical debridement using curettes is still technically demanding and time-consuming, and power scalers sometimes cause discomfort and stress in patients as a result of noise and vibration.[21]The debridement appointment includes definitive removal of calculus and endotoxins on the tooth surfaces along with the first application of laser decontamination of the diseased pocket walls. The objective is to greatly reduce the microbial area instrumented. Recently, the benefits of lasers, such as ablation, bactericidal and detoxification effects, as well as photobiomodification,have been reported to be useful for periodontal pocket treatment, and the application of lasers has been suggested as an adjunctive or alternate tool to conventional periodontal therapy.

LASER ROOT CONDITIONING:

The use of CO2 lasers to decontaminate root surfaces has been investigated, providing more information about the exact power settings and parameters required to avoid root damage.Barone *et al*.[22] showed that a defocused, pulsed CO2 laser isable to create smooth and clean root surfaces compared to afocused, continuous wave; the latter leads to melting and root surface damage. Later studies using the same parameters for CO2 lasers reported root conditioning with a better fibroblastic activity, cellular proliferation, and greater fibroblast attachment.[23] Different clinical case reports have demonstrated these advantages of CO2 laser de‑ epithelialization.[24] This technique has also been used in clinical studies and has shown that coronal flap advancement in conjunction with CO2 laser root conditioning leads to improvements in clinical parameters and long‑ term tissue stability after 15 years, compared to the modified Widman periodontal flap procedure.[25] The authors concluded that this laser technique seemed to have greater effects and should be used in treating deep periodontal pockets (more than 7 mm deep).

REMOVAL OF SUBGINGIVAL CALCULUS:

The CO_2 laser cannot be used for calculus removal because this laser readily causes melting and carbonization on the dental calculus. The Nd:YAG laser is also ineffective for calculus removal when the clinically suitable energy is employed. Unlike these lasers, the Er:YAG laser is capable of easily removing the subgingival calculus without a major thermal change of the root surface. The level of calculus removal by this laser is similar to ultrasonic scaling, and the depth of cementum ablation has been reported generally to be 15-30µm when the contact tip is applied obliquely to the root surface.[21]Furthermore, Er:YAG laser treatment in vivo might provide selective subgingival calculus removal to a level equivalent to that provided by scaling and root planing.[21] Recently, a similar performance for calculus removal with the Er:Cr:YSGG laser. However, a lower degree of calculus removal with the Er:YAG laser than with the scaling and root planing has been noted in another in vivo study.

TREATMENT OF DENTIN HYPERSENSITIVITY WITH LASERS:

Dentin hypersensitivity is characterized by short, sharp,pain arising from exposed dentin in response to stimuli typically thermal evaporative tactile, osmotic or chemical and which cannot be ascribed to any other form of dental defect or pathology. The lasers used for the treatment of dentine hypersensitivity are divided in to two groups: Low level lasers like He-Ne, GaAlAs, and Middle output lasers like Nd:YAG and CO lasers.[21] The mechanism of laser effects on 2 dentin 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.[21] 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.

SURGICAL PERIODONTAL THERAPY:
GINGIVECTOMY:

The gingivectomy can be used when suprabony pockets are present and osseous structures is not necessarily important. The procedure assists in decreasing gingival enlargement and altering fiberoptic gingival. Clinical observation demonstrates that resecting gingival with a laser enhances access because of increased visualization resulting from sealing of capillaries and lymphatics during laser irradiation. The laser generally demonstrates delayed epithelialization, collagen production and inflammation with a lower tensile strength. In later wound healing, however, the laser wound accelerates with collagen production and epithelialization. There are fewer myofibroblasts present during healing of a laser-resected wound site, which leads to less wound contraction and less scar formation. There is no clear evidence on healing rates of laser-induced wounds versus conventional scalpel wounds. However, Nd:YAG, CO_2, erbium-doped YAG (Er:YAG) and diode lasers demonstrate wound healing that is accelerated.[26] The initial cut is made slightly apically to the pocket depth measurement. A slow unidirectional motion hand motion is used, moving the tip at an external bevel toward the tooth structure. Caution is necessary when approaching the tooth, especially near root structure, because of the possible laser-hard tissue interaction, which could result in tissue damage.

FRENECTOMY:

The use of the frenectomy procedures in periodontics is limited because of minimal increase in attached gingivae after postfrenectomy wound healing. Frenectomy procedures with a laser are predictable as long as the following steps are followed: A) Creation of a periosteal fenestration at the base of the fenectomy to prevent reattachment of fibers. B) Removal of all impeding muscle fibers. All laser wavelengths can be used to perform a frenectomy successfully; however depth of penetration of the diode and Nd:YAG is much higher than for the Erbium and CO_2 lasers and therefore, settings must be monitored closely to prevent thermal damage to the underlying periostium and bone.[27] The technique for a laser frenectomy is similar to using a blade. Local anaesthesia is administered. The clinicial makes a mental outline of the frenectomy and then begins at the coronal attachment and moves the laser tip unidirectionally, pulling on the lip for tension. If correct parameters are used, one pass of laser is sufficient to serve all the fibers. To ensure minimal regrowth and frenum relapse, the periosteum should be fenestrated with a hand instrument. All lasers are effective for a frenectomy with the settings according to the manufacturer. Care must be taken not to char the tissue and cause thermal tissue damage. The erbium laser creates a wound that may have some hemorrhage, so sealing the wound with the bandage approach may be required. No suturing or dressing is necessary.

CROWN LENGTHENING PROCEDURE:

A crown-lengthening procedure is used to gain access to subgingival caries, expose margins and explore fractures. The procedure allows for developing a proper form of restoration and increasing surface area for retention. The patient's smile can be enhanced by manipulation of the gingival contour. The technique of laser crown lengthening varies with the laser type. If the objective is soft tissue, the diode, Nd:YAG and CO_2 wavelengths are sufficient. However, to alter underlying osseous structures, erbium lasers are used. Few studies using diode and Nd:YAG lasers relative to bone response exist; however the chromophores that absorb diode and Nd:YAG are essentially absent in osseous tissue. In laser crown-lengthening procedure, first determine the apical extent of the presumed restorative margin. If it is determined that the margin will be within 2 to 3 mm of the osseous crest, within osseous surgery inevitably will be required to maintain the biologic width. Therefore, a flap reflection will be necessary or a 'closed' flap crown lengthening procedure may be considered.

DEPIGMENTATION WITH LASER:

Gingival and cutaneous melanin pigmentation if often a source of aesthetic problem. It is a major esthetic concern for many people. The extent and intensity of pigmentation varies widely among individuals. It is carried out using non-surgical and surgical procedures. Among the various methods, cryotherapy, gingivectomy and argon laser irradiation. In addition several lasers used for ablation of cutaneous pigmented lesions and oral lesions, among them are ruby, dyed pulsed, Nd:YAG and eximer lasers. Recently, laser ablation has been recognized as a most effective, pleasant and reliable technique[28]. Er:YAG laser in defocused mode with a brush technique[29] or contact mode mostly requiring only topical anaesthesia was followed by uneventful healing with no recurrences at 3 and 6 months check up respectively[30].

MUCOGINGIVAL SURGERY:

Lasers can be used in mucogingival procedures for a variety of therapies. Donor material may When donor material is taken from these areas using blades, hemorrhage can be reduced significantly by using a laser to 'seal' the wound. In some patients the resulting recipient area is overcontoured at several weeks postoperatively because an overly thick donor graft was used. Any soft tissue laser can be incorporated to recontour the site with a positive esthetic result. In other patients, rather than performing a graft, the zone of attached gingiva may be increased by *vestibuloplasty*. A vestibuloplasty releases the tightly bound fibers resulting in a wider band of attached gingiva, without performing a graft procedure.

LASERS IN FLAP SURGERY:

Clinicians perform periodontal flap procedures wither exclusively or adjunctively with a laser. Once a flap is reflected, lasers again can be used for sulcular debridement and de-epithelialization on the inside of flap. If root debridement will employ a laser, it is strongly suggested that only erbium laser can be used, because of thermal damage with diode and Nd:YAG lasers, CO_2 lasers may be used according to the protocol of Crespi et al to increase fibroblast attachment to the root surface. When osseous surgery is necessary after flap reflection, again it can be performed with erbium lasers or conventional instruments.

OSSEOUS SURGERY:

Bone recontouring and reshaping are often part of periodontal surgical therapy to establish the physiologic anatomy of the alveolar bone and to allow for an optimal gingival contour after surgery. In addition to conventional instruments, in recent years, the use of Erbium lasers has becomeincreasingly popular for bone surgery. Erbium lasers in general offer more precision andbetter access than mechanical instruments. They reduce the risk of collateral damage,particularly when compared with rotary instruments that may become entangled with softtissues {eg. the reflected flap}. Lasers also improve the comfort of both patients andsurgeons by markedly reducing the noise and eliminating the vibration associated with themechanical cutting and grinding of bone tissue. Nevertheless, despite the advantages of lasers overmechanical instruments, some issues still hinder a broader use of lasers in bone surgery.These include the reduced cutting efficiency of lasers compared with mechanicalinstruments, lack of depth of control and the effects of the laser on the surroundingirradiated tissue.Recently, clinical applications for the Er:YAG laser in osseous surgery have beenreported. Although in procedures involving large amounts of bone removal, thecutting efficiency of the Er:YAG laser has been reported to be lowerthan conventionaldrilling. Er:YAG laser irradiation with water cooling for removal of impacted teeth andintra-oral bone grafting showed good clinical results with precise bone ablation without any visible, negative, thermal side effects impairing the wound healing. However, the lack ofdepth control when cutting bone immediately above critical structures such as nerves orlarger blood vessels, and longer treatment time of laser osteotomy, were deemedlimitations to routine clinical application. Currently, the Er:YAG laser is safe and useful for periodontal bone surgery in procedures such as osseous removal or recontouring, when used concomitantly with saline irrigation.

REGENERATIVE PERIODONTAL THERAPY:

Periodontal regeneration has been reported following a variety of surgical approaches involving root surface biomodification, placement of bone grafts or bone substitutes and the use of organic or synthetic barrier membranes or guided tissue regeneration (GTR). Evidence suggests that the use of bone grafts or GTR procedures produce equal benefit in treating intraosseous defects. The treatment objective is to obtain a swallow, maintainable pockets by reconstruction of the destroyed attachment apparatus as well as limit recession of gingival margin. The laser wound on skin and gingiva causes a delay in reepithialization because of factors such as reduced inflammatory response and less wound contraction. 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.[21]

LASERS AND IMPLANTS:

Dental implants have been widely used in clinical practice for the replacement of missing teeth in the rehabilitation of fully and partially edentulous patients, and have become an option in comprehensive periodontal treatment plans. Various lasers have been applied in the field of implant dentistry for uncovering the submerged implant (secondstage) prior to placement of the healing abutment.[31] Use of lasers in these procedures 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.[32,33] Furthermore, because of the ability of the laser to produce effective bone tissue ablation, it is suggested to use the Er:YAG laser to prepare the bone by osteotomy. Although these studies demonstrated uneventful wound healing of the laser prepared fixture holes and effective osseointegration, the results are still controversial and there was no consensus regarding the superiority of the application of lasers. In most of these studies, no superior results were reported regarding the speed of osseointegration,with similar levels of wound healing in comparison with the drill.[34,35,36]Also, the preparation time when using the Er:YAG laser was much longer than when using conventional drilling[34]. However, Kesler et al. reported a statistically significantly higher percentage of early bone-to-implant contact following the use of the Er:YAG laser in comparison with the conventional methods.[37] Thus, the favorable results of the application of lasers in the first and second stages of implant surgery suggest their potential in the field of implant dentistry. Currently, the use of lasers is generally limited to the second stage soft tissue procedures.[31]

PERIIMPLANTITIS:

Recently lasers have been used in the treatment of peri-implantitis. The term periimplantitis, describes the bone loss around an implant. The loss may be induced by stress, bacteria, or a combination of both.[38] Conventional mechanical instruments, such as steel curettes or ultrasonic scalers, are not completely suitable for granulation tissue removal and implant surface debridement because they readily damage the implant titanium surfaces[39] and thus may interfere with the process of bone healing. Therefore, non-metal mechanical means for implant debridement, such as the use of plastic curettes and carbon fiber curettes, have been recommended.[40,41] However, these methods are apparently ineffective for complete debridement of the bone defect as well as the contaminated implant surface.[42,43] Mechanical debridement around implants may also be time consuming.Furthermore, implants with micro-structured surfaces have been recently clinically employed to improve anchorage to alveolar bone and to increase the bone-toimplantcontact, resulting in better osseointegration.[44,45]Among the lasers applied in dentistry, the Er:YAG laser is considered to possess thebest property for both degranulation and implant surface decontamination as a result of itsdual actions of both soft and hard tissue ablation without causing thermal damage of theadjacent tissue. Irradiation using the Er:YAG laser seems to cause no change to the titaniumsurface[46,47]and the irradiated titanium surface appears not to influence theattachment rate of osteoblasts on its surface.[47] However, irradiation at high energyoutputs may cause distinct surface changes of titanium.[46] Irradiation using the Er:YAGlaser facilitates effective removal of calculus and plaque from contaminated abutments andbiofilms grown on sand-blasted and acid-etched titanium surfaces.[45,46] Furthermore, ahigh bacteriocidal potential on the implant with different surface characteristics, even atlow energy densities, is obtained following Er:YAG laser irradiation.[48] In a recent animal study for the treatment of periimplantitis in a circumferential crater-like bone defect, Schwarz et al.[49] reported thatapplication of Er:YAG laser irradiation during flap surgery resulted in improvements in allinvestigated parameters, and that laser treatment seemed to be more suitable. Most recently, Takasaki et al.[50], demonstrated safe and effective application ofEr:YAG laser irradiation for degranulation and implant surface debridement in the treatmentof experimentally induced peri-implant infections in dehiscence-type defects in dogs.Degranulation and implant surface debridement was easier to perform using Er:YAG laserirradiation than using plastic curette instrumentation. Histologically, after 24 weeks ofhealing, the newly formed bone was more coronally-positioned on the laser-treated implantsurface in comparison to mechanical treatment. The Er:YAG laser-treated implant surfacedid not inhibit the formation of new bone, suggesting that the laser achieveddecontamination of the implant surface with increased biocompatibility. Overall, thoughmost previous clinical studies have not shown significant differences between laser andconventional therapies, laser treatment generally showed tendencies for better results inanimal studies. Further clinical and animal-comparative studies between differenttreatment approaches with laser treatment are necessary to prove the superiority of theapplication of lasers in the treatment of peri-implantitis. Nevertheless, based on previousreports, it can be concluded that application of lasers holds great promise as an alternativeor adjunctive tool in the treatment of peri-implant diseases.[31]

RECENT ADVANCES:

LANAP: LASER ASSISTED NEW ATTACHMENT PROCEDURE

Initial reports suggest that LANAP can be associated with the cementum-mediated new connective tissue attachment and apparent periodontal regeneration of diseased root surface in humans.

LAPIP:LASER ASSISTED PERIIMPLANTITIS PROCEDURE

LAPIP is a cutting-edge laser treatment to save failing dental implants. Preformed by using the MVP periolase Dental laser. The treatment involves disinfecting the dental implant and creating a healing clot around the dental implants, which calls on your body's healing ability to produce bone around the implant and and in essence stabilizes the implant.

LOW LEVEL LASER THERAPY

LLLT can accelerate bone healing in extraction sites, bone fracture defects and distraction osteogenesis.The mechanism of action might be through stimulation of cellular proliferation and differentiation and acceleration of the healing process.

WATERLASESYSTEM

Waterlase system is a revolutionary dental device that uses laser energized water to cut or ablate soft and hard tissue.

PERIOWAVE

Periowave is a photodynamic disinfection system utilizes nontoxic dye (photosensitizer) in combination with low intensity lasers enabling singlet oxygen molecules to destroy bacteria.The most important recent development in laser dentistry is the advent of the Er,Cr:YSGG laser, which is used with a water spray (Hydrophotonics effect).

II. Conclusion

There is a great potential for laser systems to be developed further include additional futures and functions. Current research focuses on optical coherence tomography (OCT) in dental diagnosis, new dental applications for the alexandrite laser and photoactivated disinfection in daily. Carbon dioxide lasers, including the prototype of the TEA, have also shown to be effective in many fields of dentistry, with advantages such as less bleeding, selective removal of tissue, short operating time and reduced post operative pain. Further studies will show the feasibility of using these new technologies as everyday tools in many clinical applications. Other wavelengths, such as erbium lasers, are also being widely investigated.

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