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Dentistry

LASERS IN PROSTHODONTICS

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ABSTRACT Advances in technology are increasing and changing the ways that the patient experience dental treatment.one of the technological advancements in dentistry is the use of lasers. Lasers are becoming increasingly common in dentistry, including the field of prosthodontics, they offer a variety of advantages over traditional techniques, including improved precision, reduced bleeding faster healing times. They provide more efficient more comfortable and more predictable outcomes of the patient1.

KEYWORDS : Lasers, Nd:YAG, CO2, ER CR:YSGG

INTRODUCTION:

The introduction of lasers in the field of prosthodontics has replaced many ordinary surgical and technical methods and has offered many sophisticated products designed to improve the quality of treatment rendered to a patient. Laser is an acronym which stands for "Light Amplification by Stimulated Emission of Radiation", which have been used in many fields. The use of Lasers in dentistry provides a new standard of care. The application and role of Lasers in prosthodontics in providing fixed dental prosthesis improves the standard of care for both the patients as well as the dentist due to its precise excision, a period of wound healing and their benefits of coagulation, which increases tissue response to provided surgeries. With a thorough knowledge of Lasers, their wavelength and target tissue interaction and better handling accurate care to the patients can be delivered. Most commonly used Lasers in prosthodontics are CO2 , neodymium-doped yttrium aluminum garnet (Nd:YAG).[2]

Components Of Laser

Active medium

It is an optical cavity consists of chemical compounds or substances, molecules at the center.

Pumping Mechanism

Optical cavity is surrounded by pumping unit which is either arc light or a flash light for excitation, or it can be an electromagnetic coil or diode unit.

Optical Resonator

They are usually a polished surfaces or two mirrors which are aligned at each end of the optical cavity. The function of the optical resonators are to perform amplification and collimation of the developing beam.

Cooling System: Used to lower the temperature of the compartments.

Control Panel: Used to control variable parameters for the output of the laser.

Delivery System: It is a system through which laser reaches its targeted site. Examples are articulated arm, a hand piece, a flexible hollow wave guide or a quartz fiber-optic.[3]

CLASSIFICATION OF LASERS

According to the wavelength
1. UV (ultraviolet) range – 140 to 400 nm
2. VS (visible spectrum) – 400 to 700 nm
3. IR (infrared) range – more than 700 nm Broad classification

1. Hard laser (for surgical work)
i. CO2 lasers (CO2 gas)
ii. Nd:YAG lasers (Yttrium-aluminium garnet crystals dotted with neodymium)
iii. Argon laser (Argon ions)

2. Soft laser
i. He-Ne laser
ii. Diode lasers

According to the delivery system
i. Articulated arm (mirror type)
ii. Hollow waveguide
iii. Fiber optic cable

According to the type of active medium used: Gas, solid, semi-conductor or dye lasers

According to type of lasing medium:
E.g. Erbium: Yttrium Aluminium Garnet According to pumping scheme
1. Optically pumped laser
2. Electrically pumped laser According to operation mode

1. Continuous wave lasers
2. Pulsed lasers

According to degree of hazard to skin or eyes following inadvertent exposure, Class I- (< 39mw) Exempt; pose no threat of biological damage.

Class II- (< 1mw) The output could harm a person if he were to stare into the beam for a long period of time. The normal aversion response or blinking should prevent you from staring into the beam.

Class IIIA - (<500mv) Can cause injury when the beam is collected by optical instruments and directed into the eye.

Class IIIB – (<500mv) Causes injury if viewed briefly, even before blinking can occur.

Class IV - (>500mw) Direct viewing and specular and diffuse reflections can cause permanent damage including blindness.[4]

LASER WAVE LENGTHS USED FOR DENTISTRY

ARGON - This laser has 2 emission wavelengths - 488nm (blue) and 514 nm (blue-green).

CO2 LASER – 10,600 nm Nd:YAG - 1064 nm DIODE - 800-980nm
ER, CR:YSGG -(2790 nm) Er:YAG - (2940 nm)[5]

APPLICATIONS OF LASERS IN PROSTHODONTICS FIXED PROSTHETICS / ESTHETICS

Crown Lengthening:

Lasers have an advantage in crown lengthening regard as they cut only at the tip and can be held parallel to long axis of the tooth to remove bone immediately adjacent to cementum without damaging it.It is less complicated.[7]

Soft Tissue Management Around Abutments

Argon laser energy has peak absorption in hemoglobin, providing excellent hemostasis and efficient coagulation and vaporization of oral tissues. These characteristics are beneficial for retraction and

hemostasis of the gingival tissue in preparation for an impression during a crown and bridge procedure.[8]

Modification Of Soft Tissue Around Laminates
The removal and re-contouring of gingival tissues around laminates can be easily accomplished with the argon laser.[9]

Osseous Crown Lengthening
Like teeth mineralized matrix of bone consists mainly of hydroxyapatite (HA).The water content and HA are responsible for the high absorption of the Er:YAG laser light in the bone. Er:YAG laser has the very promising potential for bone ablation.[10]

Laser Troughing :
Lasers can be used to create a trough around a tooth before impression taking. This can entirely replace the need for retraction cord, electrocautery, and the use of hemostatic agents. The results are predictable, efficient, minimize impingement of epithelial attachment, cause less bleeding during the subsequent impression, reduce postoperative problems, and reduce chair time. It alters the biological width of gingiva. Nd:YAG laser is used.

Bleaching :
Bleaching using diode lasers results in immediate shade change and less tooth sensitivity and is preferred among in-office bleaching systems.

Veneer Removal
Lasers like Er:YAG and Er Cr:YSGG can be used remove unwanted or failed veneers.

Crown Fractures At The Gingival Margins
Er:YAG or Er, Cr:YSGG lasers can be carried out to allow correct exposure of the fracture margin.

Formation Of Ovate Pontic Sites
The use of an ovate pontic receptor site is of great value when trying to create a natural maxillary anterior fixed bridge. This is easily accomplished with the use of a laser.

IMPLANTOLOGY

Implant recovery
One advantage of the use of lasers in implantology is that impressions can be taken immediately after second stage surgery because there is little blood contamination in the field due to the hemostatic effects of the lasers. There also is minimal tissue shrinkage after laser surgery, which assures that the tissue margins will remain at the same level after healing as they are immediately after surgery.[11]

Implant site preparation
Lasers can be used for the placement of mini implants especially in patients with potential bleeding problems, to provide essentially bloodless surgery in the bone[8].

Removal Of Diseased Tissue Around The Implant
The diode lasers alone or with toluidine O dye, CO2 lasers, and Er:YAG lasers have been used for implant maintenance, because of their bactericidal effect and technical simplicity. Debridement of implant abutment surface with lasers can effectively decontaminate the surfaces, reduce the bacterial count and improve the success rate of ailing implants. Schwarz et al. demonstrated the effectiveness of Er:YAG laser treatment to remove subgingival calculus from surfaces of titanium implant fixtures without any thermal damage. Among the disadvantages of using lasers for the purpose are that not all the lasers can be used, for example, Nd:YAG lasers and Ho:YAG lasers are unsuitable for peri-implantitis and caused melting, loss of porosity and other surface alterations even with the lowest settings.[13]

REMOVABLE PROSTHETICS

Treatment Of Unsuitable Alveolar Ridges
Hard tissue surgery may be performed with the erbium family of wavelengths.

Treatment Of Undercut Alveolar Ridges
Osseous surgery may be performed with the erbium family of lasers.

Treatment Of Enlarged Tuberosity
May be performed with any of the soft tissue lasers. Erbium laser is the laser of choice for the osseous reduction.

Surgical Treatment Of Tori And Exostoses
Soft tissue lasers may be used to expose the exostoses and erbium lasers may be used for the osseous reduction.[12]

LASER APPLICATIONS IN THE DENTAL LABORATORY

I. Laser titanium sintering
II. Laser ablation of titanium surfaces
III. Laser-assisted HA coating
IV. Laser welding of titanium components of the prostheses
V. Lasers have been used for deposition of HA thin films on titanium implants pulsed laser deposition has proven to be a promising method to produce pure, crystalline and adherent HA coatings which show no dissolution in a simulated body fluid.

Use of lasers for surface treatment of titanium castings for ceramic bonding have shown improved bond strength when compared to acid etching techniques which are commonly used.

Lasers can also be used for welding.[13]

MAXILLOFACIAL PROSTHESIS

New advances in rapid prototyping technologies have demonstrated significant advantages compared to more conventional techniques for fabricating facial prosthesis. The use of selective laser sintering technology is an alternative approach for fabricating a wax pattern of maxillofacial prosthesis. This new approach can generate directly by prototyping and reduce labor-intensive laboratory procedures[14]

SLS (SELECTIVE LASER SINTERING)

Is a method of computer aided designing using mainly the laser. models are generated directly from 3-D computer data then converted to STL files, then sliced in to thin layers using the associated computer software. The laser sintering machine produces the models on a removable platform by applying incremental layers of the pattern material. For each layer, the machine lays down a film of powdered material with an accurate required thickness, again a fresh film of powder is laid down, and the next layer is melted with exposure to the laser source. This process continues, layer by layer, until the pattern is completed[14]

CONCLUSION

The laser has become a ray of hope in dentistry. When used efficaciously and ethically, lasers are an exceptional modality of treatment for many clinical conditions that dentists treat on a daily basis. However, laser has never been the "magic wand" that many people have hoped for. It has got its own limitations. However, the future of dental laser is bright with some of the newest ongoing researches.

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