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PROSTHODONTICS – CAN BE ENHANCED WITH LASER ASSISTANCE???

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Abstract:

In this modern era, newer technologies and their applications improve the predictability and outcome of the conventional procedures to a great extent. Lasers are introduced into the field of dentistry in 1989, which is widely used in all branches of dentistry. In this article, the scope of lasers in various aspects of prosthodontics is discussed.

Introduction

Currently, various laser systems are available for use in dentistry. Neodymium-doped: Yittrium-Aluminium-Garnet (Nd: YAG), carbon dioxide (CO2), semiconductor diode lasers,Erbium doped: Yttrium-Aluminium-Garnet (Er:YAG) and Erbium doped: Yttrium –Scandium-Gallium-Garnet (Er:YSGG) have already been approved by FDA. The introduction of lasers into the field of prosthodontics has replaced many ordinary surgical and technical methods and has improved the quality of treatment rendered to a patient. Stability, retention, function and esthetics may be enhanced by proper laser integration in both the soft tissue and hard tissue procedures

Components of a Typical Laser[1,2]

1. Active medium: The active medium is positioned within the laser cavity, an internally-polished tube, with mirrors co-axially positioned at each end and surrounded by the external energizing input, or pumping mechanism.

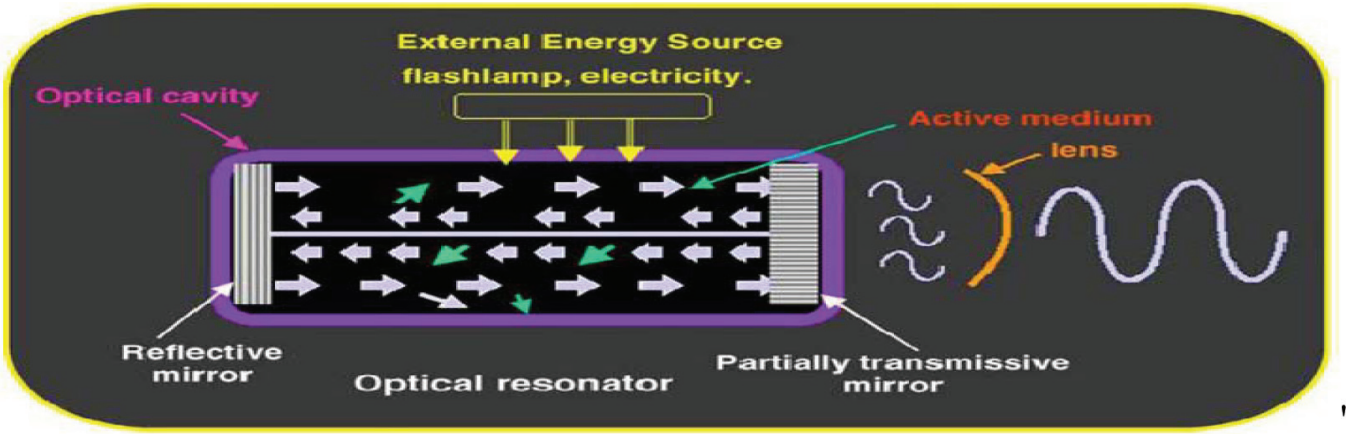
2. Pumping mechanism: This is a man-made source of primary energy that excites the active medium. This is usually a light source, either a flashlight or arc-light, but can be a diode laser unit or an electromagnetic coil.

3. Optical resonator: Laser light that is produced by the stimulated active medium is bounced back and forth through the axis of the laser cavity, using two mirrors placed at either end, thus amplifying the power. The distal mirror is completely reflective and the proximal mirror is partly transmissive, so that at a given energy density, laser light will escape to be transmitted to the target tissue.

4. Delivery system: Depending upon the emitted wavelength, the delivery system may be a quartz fibre-optic, a flexible hollow waveguide, an articulated arm (incorporating mirrors), or a hand-piece containing the laser unit (at present only for low powered lasers).

5. Cooling system: Co-axial coolant systems may be air- or water-assisted.

6. Control panel: This promotes variation in power output with time



LASER PHYSICS

Laser is the acronym for "Light Amplification by Stimulated Emission of Radiation" named by GORDON GOULD in 1957. A study of each words offers an understanding of the basic principles of how a laser operates.

1. Light

Light is a form of electromagnetic energy that behaves as a particle and a wave. The basic unit of energy is called a photon[2]. Laser light has one specific color, a property called monochromacity. Laser light possesses three additional characteristics: collimation, coherency, and efficiency.

2. Stimulated emission

A quantum which is the smallest unit of energy, is absorbed by the electrons of an atom or molecule, causing a brief excitation; then a quantum is released, and the process is called as "spontaneous emission". Albert Einstein summarised in his theory that an additional quantum of energy traveling in the field of the excited atom that has the same excitation energy level would result in a release of two quanta, a phenomenon called stimulated emission[2]. This process will occur just before the atom can undergo spontaneous emission.

3. Amplification

The photons are then reflected back and forth within the active medium to further enhance stimulated emission, and successively passes through the active medium and ultimately collimate the photo beam[2]. This is the process of amplification.

4. Radiation

Radiation refers to the light waves that are being produced by the laser as a specific form of electromagnetic energy[2]. The electromagnetic spectrum is the entire collection of wave energy ranging from gamma rays, whose wavelength is about 10-12 nm, to radio waves, whose wavelength can be thousands of meters. All the available dental laser devices have emission wavelengths of approximately 0.5 μm (or 500 nm) to 10.6 μm (or 10,600 nm)

TYPES OF LASER

Traditionally, laser have been classified according to the physical construction of the laser (e.g. gas, liquid and solid state), the type of medium which sustain lasing[3]. Several types of dental lasers are available based on the wavelengths:

1) The Erlasers possesses the potential of replacing the drill.

2) The CO_2 laser can be used to perform gingivectomy and to remove small tumours.

3) Argon laser is used in minor surgery[3].

4) Nd: YAG is used for tissue retraction, endodontics, and oral surgery.

5) The diode laser is effective for soft tissue oral procedures and sterilisation of endodontic canals. This laser helps to correct esthetic flaws too[3].

COMMONLY USED LASERS IN DENTISTRY[2]

The lasers used in dentistry are illustrated as follows:

Laser	Wavelength	Indications
Argon	488515 nm	Pigmented lesions, Vascular anomalies, Plastic surgery
Diode	620-980 nm	Periodontal surgery, Bleaching, Photodynamic therapy, Soft laser therapy, Other soft tissue procedures
CO_2	10600 nm	Soft tissue procedures
Nd:YAG	1064 nm	Soft tissue procedures
Ho:YAG	2100 nm	Soft tissue procedures, Periodontal surgeries, Pigmented lesions
Er,Cr: YSGG	2780 nm	Bone surgery, Periodontal surgery, Cavity preparations
Er:YAG	2944 nm	Bone surgery, Skin resurfacing, Cavity preparation

USES OF LASERS IN PROSTHETIC DENTISTRY

1. Depigmentation

Lip and gingival hyper pigmentation is an issue in young adults when the dark brown pigmentation gives an unsighty appearance. Diode lasers can be used for depigmentation of dark coloured gingiva and lip[4]. Pink esthetics has to be established before going for restorative procedures.

The laser is selectively absorbed by the melanin that causes pigmentation. This leads to a photothermal ablation of melanocytes which leads to its disruption and subsequent removal by the body's immune system[4]. Lasers produce a blood less field for surgery,minimal heating of surrounding tissue, causes minimum damage to periosteum and underling bone and mucosa do not need any dressing. It destroys cells at the basal layer thus reduces repigmentation.

2.Esthetic crown lengthening

When some patients have an uneven gingival line producing an uneven smile, excessive tissue can be easily and quickly removed using diode lasers without the need for blade incision. This creates a blood less field which allows for immediate impression making. Here steps for hemostasis is not needed. There will not be much recession of gingiva and repositioning of soft tissues. This also eliminates the problems associated with conventional surgery or electrocautery[3,5,6]

3. Restorative crown lengthening

This is a procedure done when inadequate crown height is present for crown restoration. An adequate crown height is created by removing either gingival soft tissue or bone or both. The diode or CO_2 lasers can be used for soft tissue removal and Argon lasers for hard tissue removal or both can be done using Erbium lasers. The thermal effect of laser seals vascular and lymphatic vessels and at the same time vaporize the excess gingival tissue. Since no flap was raised, sutures were not necessary and the wound healed by secondary intention. For Erbium lasers coagulation tendency is less compared to CO_2 and diode lasers. So hemostasis procedures are necessary before impression making[3,5,6].

4. Frenectomy

Frenectomy using lasers can be done for the following situations

i. High frenal attachments before complete denture fabrication in cases where it will result in loss of retention of the denture

ii. Soft tissue cause of diastema closure using laminates

iii. For the correction of the lingual frenum when it is at the crest of the ridge which will hamper the peripheral seal while relieving the complete denture

iv. Vestibuloplasty

The argon laser is a valuable tool in performing frenectomy procedures. While the argon laser is very effective in cutting fibrous tissue at higher energies, it is also particularly beneficial for lingual frenectomies, because of the haemostatic properties. The use of argon laser during these procedures results in efficient tissue removal with a bloodless field. Excellent haemostasis occurs, sutures are not required, and the patient experiences minimal discomfort during the healing period[6]

5. Laser assisted tooth bleaching

Harmonisation of pink and white esthetics has become important in modern society. Bleaching with diode lasers results in immediate shade change and less tooth sensitivity and is preferred among in office bleaching systems. All the bleaching procedures should be carried out before restorative procedures[3,5].

6. Laminate preparation

Erbium lasers can be used for tooth preparation for laminates which will produce an etched tooth surface. The finish line has to be refined using carbide burs

7. Removal of existing Laminates or All ceramic crowns

Lasers like Er:YAG and ErCr:YSGG can be used to remove unwanted or failed veneers due to cement discolouration or tooth discolouration. Restoration can be removed with the help of laser beams without any cutting. The laser energy passes through the porcelain glass unchanged and is occupied by the water molecules present in the adhesive. Debonding takes place at the silane-resin junction without causing any trauma to the underlying tooth[1,7]

8. Laser assisted Implant management.

a. Implant placement

Minimally invasive implant placement methods, using the tissue punch method, has become a popular way to place implants when proper bone height and width are available. Erbium lasers can be used to obtain the initial breach for implant placement rather than using micromotor. Laser can be used to remove the soft tissue and the cortical plate of bone in a circular pattern to approximately 2–3 mm and rest of the osteotomysite can be prepared using a handpiece drill. Unlike conventional drills, the laser tip has less tendency to slip. This leads to quick healing time, fast integration, minimal patient discomfort, and superior bone-to-implant contact. This will also eliminate the need for trauma during flap elevation and suture placement[6,8].

b. Second stage surgery

Lasers of all wave lengths can be used to uncover implants in stage II implant surgery with precision and ease for the practitioner and significant patient comfort by vaporizing the soft tissue overlying the implant till the cover screw is reached. If tissue overlying the implant is thick and fibrous, Erbium lasers are used and if the tissue is thin, diode or CO_2 lasers are used. Nd: YAG laser is contraindicated since it may cause temperature build up around the implants and also melting of

the implant surface[6,8,9]

c. Peri implant tissue management

In the case of peri-implantitis, the implant surface is contaminated with soft tissue cells, bacteria and other bacterial by-products. It is difficult to remove entire bacterial plaque and endotoxins by mechanical instrumentation between the implant threads. Debridement and degranulation of implants, degranulation and decortication of bone and removal of infected soft tissue can be done using Erbium lasers[8,12]

d. For sterilisation of socket:

In immediate implant placement after extraction of tooth,without any infection, socket can be sterilized immediately without any pain. It also helps in osteoblastic proliferation, collagen synthesis by fibroblasts, activation of lymphatic system, proliferation of epithelial cells and fibroblasts, increased angiogenesis and bone formation[10].

9. Soft tissue lesions

Continuous and persistent trauma from a sharp denture flange or over compression of the post dam area may produce a fibrous tissue response. Hyperplastic fibrous tissue may be formed at the junction of the hard and soft palate as a reaction to constant trauma and irritation from the post dam area of the denture. The lesion may be excised with any of the soft tissue lasers and the tissue allowed re-epithelialized. Lesions like epulisfissuratum, denture stomatitis can also be corrected using lasers.[6,11]

10. Gingival tissue retraction/ Gingival Troughing

Application of lasers on gingival tissue was made possible particularly by the use of flexible optical fibers (320-400 microns for prosthetic applications) ensuring high precision of laser action at crevicular sulcus level[3]. Sulcus conditioning with laser is an innovative method in the process of restoration with a fixed prosthesis, and the ever increasing operator interest in its atraumatic properties has made its development possible. It is also known as laser troughing[11].

Argon lasers have peak absorption of hemoglobin, thus lending itself to provide 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 impression making during a crown and bridge procedure (Kutsch, 1993).

CONCLUSION

Laser-based techniques have been in use for many years with extremely predictable results. The advantage of laser prosthetic/cosmetic reconstruction surgery over traditional techniques is documented strongly in the literature[12]. The addition of laser treatment modalities will enhance the dentist's ability to perform more clinical procedures, increase confidence and experience, and keep the procedures in office instead of referral to specialists. In general, increased awareness of laser treatments as reported in today's media has intensified the contribution of the patient, within the patient–dentist relationship, in determining comprehensive treatment.

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