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RESEARCH ARTICLE

THE NEW DENTAL TREATMENT TECHNIQUE

*1Yamam A. Hammudi and 2Riam A.hammudi

*1B.D.S of Dentistry, Al Yarmouk University College, Wasit, Al Iraq,Rotator Dentist At The Specialized Dental center in wasit
2 Master Of Physics ,Physics Department, College Of Science, Wasit University Best Regards

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ABSTRACT

Laser is the new most commonly used technique in many dental procedures, the basics of laser physics and tissue interaction will be reviewed.

Laser use in dentistry is sometimes considered to be new technology, but it actually began in 1989 with the introduction of the first laser designed specifically for dentistry.[1]

The medical community began to incorporate lasers for soft-tissue procedures in the mid-to-late 1970s, and oral surgery added the technology in the early 1980s, now days laser is in every aspect in dentistry so we have to be familiar with it in order to give the best dental treatment for patients.

INTRODUCTION

The word LASER is an acronym for Light Amplification by Stimulated Emission of Radiation , a laser consists of a lasing medium contained within an optical cavity, with an external energy source to maintain a population inversion so that stimulated emission of a specific wavelength can occur, producing a monochromatic, collimated, and coherent beam of light.

All of the laser instruments used in dentistry feature parameters that are adjustable by the clinician. Each wavelength has photon energy[2]. The laser light photons produce a tissue effect, known in basic physics as work.Energy is the ability to perform work and is expressed as joules or millijoules. Power is the measurement of the work completed over timeand is measured in watts. One watt equals 1 joule delivered for 1 second.One or both of these quantities can be modulated on each device.

Laser delivery systems

1. flexible hollow waveguide or tube that has an interior mirror finish. The laser energy is reflected along this tube and exits through a handpiece at the surgical end with the beam striking the tissue in a noncontact fashion. An accessory tip of sapphire or hollow metal can be connected to the end of the waveguide for contact with the surgical site
2. Glass fiber optic cable. This cable can be more pliant than the waveguide, has a corresponding decrease in weight and resistance to movement, and is usually smaller in diameter (some soft tissue lasers have optic fibers with sizes ranging from 200–600 lm). Although the glass component is encased in a resilient sheath, it can be fragile and cannot be bent into a sharp angle. This fiber system can be used in contact or noncontact mode.[3] Laser delivery system seen in fig(1)

Tissue interaction

Different wavelengths have different absorption coefficients based on the varied composition of human tissue. Water, which is a universally present molecule, is most interactive with the two erbium wavelengths, followed by carbon dioxide. Conversely, the shorter wavelength lasers, including argon, diode, and Nd:YAG have a higher degree of transmission through water, which varies by wavelength, 980 nm having the highest water absorption in the current group of near-infrared lasers[4]. Carbon dioxide, followed closely by the erbium family, is highly absorbed by the apatite crystal that forms the structure for teeth and bone. There, lower interaction of the wavelengths of around 1,000 nm and below exist; a case similar to water. However, argon, diode, and Nd:YAG do have a high affinity for blood components such as hemoglobin, and tissue pigments like melanin; whereas the longer wavelength laser light has little interaction with the color of tissue. The laser parameters (energy, beam diameter, and duration of exposure)must be carefully monitored to produce a successful treatment result. Dental structures have different amounts of water content by weight. A ranking from lowest to highest would show enamel (with 2% to 3%), dentin, bone, calculus, caries, and soft tissue (at about 70%). Hydroxyapatite is the chief crystalline component of dental hard tissues and has a wide range of absorption depending on the wavelength.

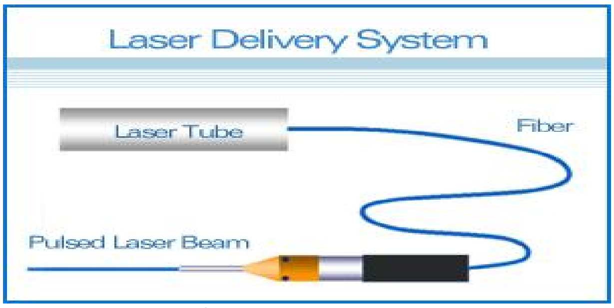


fig1 Laser delivery system

Interaction effects

1. absorption of the laser energy by the intended tissue
2. transmission of the laser energy directly through the tissue with no effect on the target tissue, the inverse of absorption.

* Corresponding author: **Yamam A. Hammudi**
B.D.S of Dentistry, Al Yarmouk University College,Wasit,Al Iraq,Rotator Dentist At The Specialized Dental Center In Wasit

3. reflection which is the beam redirecting itself off of thesurface, having no effect on the target tissue
4. scattering of the laser light, weakening the intended energy and possibly producing no useful biologic effect. Scattering of the laser beam could cause heat transfer to the tissue adjacent to the surgical site, and unwanted damage could occur.[5] fig(2)

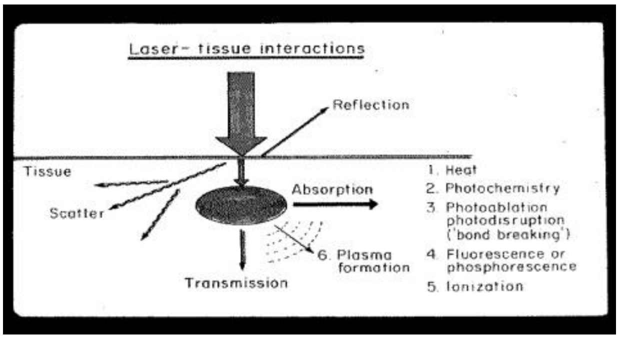


Fig2laser-tissue interactions

Laser modes

1. continuous wave, meaning that the beam is emitted at onlyone power level for as long as the operator depresses the foot switch.
2. gated-pulse mode, meaning that there are periodic alternations of the laser energy, much like a blinking light. This mode is achieved by the opening and closing of a mechanical shutter in front of the beam path of a continuous wave emission. All surgical devices that operate in continuous wave have this gated pulsed feature.
3. free-running pulsed mode, sometimes referred to as ''true pulsed.'' This emission is unique in that large peak energies of laser light are emitted for a short time span, usually in microseconds, followed by a relatively long time in which the laser is off

The important principle of any laser emission mode is that the light energy strikes the tissue for a certain length of time, producing a thermal interaction[6] .

Laser types

The main types of lasers used in dentistry are the diode laser (810nm–980nm), CO_2 (carbon dioxide, 10600nm) and the YAG family (2100nm – 2940nm) ie ErYAG (erbium yttrium aluminium garnet), ErCrYSGG (erbium chromium yttrium selenium gallium garnet), and HolYAG (holmium yttrium aluminium garnet). These feature predominantly as hard tissue lasers. NdYAG (neodynium, yttrium aluminium garnet) is an effective dental laser wavelength in soft tissue procedures but doesn't feature commonly in many of the units on the British market. These lasing media produce wavelength specific light, which is selectively absorbed in certain tissues. YAG lasers have an absorption peak in water; therefore the water component of tissues is volatilised before breakdown of structure. Diode andNdYAG lasers have an absorption peak in pigmented tissue and therefore are good for periodontal tissue lasing and coagulation.

The operator can control the energy applied to the optical resonator, and can vary the beam diameter on the target tissue. The operator can also control pulsing or continuous lasing, pulse duration and pulse relaxation times. These combined will control the target tissue effects.[7] fig(3)shows the different ypes of laser in dentistry.

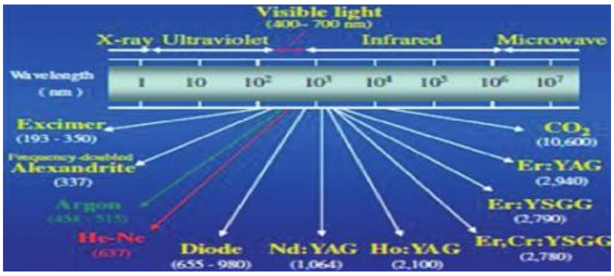


Fig3 Various types of lasers and their corresponding wavelengths

Laser wavelengths used in dentistry

There are several laser manufacturers with various product offerings, and the reader should consult other sources for specific information for current details about companies and their instruments. The marketplace continues to change, and so does the availability of the devices.

The following are brief descriptions of laser devices that have dental applications. The lasers are named according to their active medium, wavelength, delivery system, emission mode(s), tissue absorption, and clinical applications. The shortest wavelength is listed first[8] .

Laser Advantages in Dentistry

Laser dentistry offers numerous benefits over many traditional dental treatments and surgical procedures. The advantages of laser dentistry include:

- Eliminates the need for anesthesia in some surgeries
- Eliminates the need for stitches in some procedures
- Faster treatment time
- Faster recovery
- Increased accuracy
- Leaves more healthy gum tissue and tooth structure than some surgeries
- Less discomfort
- Less invasive than many surgical options
- Minimizes swelling and bleeding
- No drilling
- Reduces risk of infection[1,9]

Limited Use

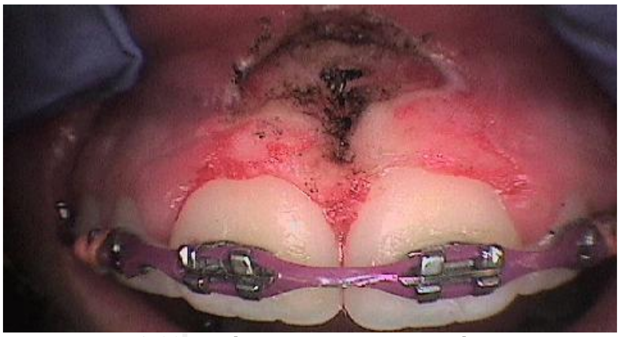
A disadvantage of lasers is the limited use that they currently have in dentistry. The technology is still evolving and it is only a matter of time before lasers completely innovate the way that dentistry is performed, but currently lasers cannot be used in work involving an existing filling or in preparing a tooth for a dental crown. Cavities between teeth also cannot be worked on with laser technology.[8,9]

Aplications In Dentistry

Soft tissue clinical applications

Dental lasers have been used for many soft tissue procedures in pediatric dentistry.

Clinical applications include maxillary and lingual frenectomies, operculectomies, exposure of teeth for orthodontic purposes, gingival contouring gingivectomies, removal of mucosal lesions and biopsies, and treatment of aphthous ulcers and herpetic lesions.[9,10,12] CO_2 ,diode, and Nd:YAG lasers all have the capability of effectively incising tissue, coagulating and contouring tissues.[9,10] fig(4),fig(5)



Fig(4) CO2 laser Frenectomy/ Gingivplasty

Fig 6 Laser Caries Detector

Diagnostic applications

Laser fluorescence (LF) can be used as an additional tool combined with conventional methods for detection of occlusal caries.[11] The portable diode laser-based system interprets the emitted fluorescence on the occlusal surface which correlates with the extent of demineralization in the tooth.[9,10] Laser digital readings can indicate the proportional amount of caries present. LF may be used as a complementary instrument when diagnosing occlusal caries in cases of questionable findings after visual inspection. LF caries detection is not recommended under dental resins or sealants due to a high probability of unreliable readings as a result of the intrinsic fluorescence from the sealant material.[7,11] fig(6)

Hard tissue clinical applications

The Nd:YAG, Er:YAG, and Er,Cr:YSGG lasers have all been used successfully for removal of caries and preparation of teeth for restorative procedures in children and adolescents. Lasers also have been used effectively for indirect and direct pulp capping treatments.[7,10,11] The erbium lasers are the predominant lasers[13] used for hard tissue procedures. Dental lasers have been utilized for endodontic procedures such as primary tooth pulpotomies and root canal disinfection. Success rates of laser pulpotomies have been comparable to those of formocresol pulpotomies.[14,15]

CONCLUSIONS

It is most important for the dental practitioner to become familiar with those principles and then choose the proper laser(s) for the intended clinical application.

Each wavelength and each device has specific advantages and disadvantages. The clinician who understands these principles can take full advantage of the features of lasers and can provide safe and effective treatment.

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