LASERS IN DENTISTRY

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Abstract

The uses of Lasers in dentistry have revolutionized several areas of treatment in the last three & a half decades of the 20th century. Initially it was used for ablating the hard tissues for acid etch treatment. Later Lasers were used for cutting, coagulation & cauterization of the soft tissues. It is also been used for the diagnosis of carious lesions& to test pulp vitality with Doppler. There are more than 40 uses for Laser. Initially Lasers were very expensive, but now they have become much cheaper. Portable models are available which have increased its versatility. Lasers will be the main weapon in the armamentarium of the dental surgeons.

Keywords : Laser, Dentistry

Introduction

The word LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. Lasers have come down a long way since Albert Einstein described the theory of stimulated emission in 1917.It was Theodore Maiman in 1960, who demonstrated Laser function making use of a Ruby laser .In dentistry, it were Stern and Sognnaes who in 1964 used the Ruby laser to vaporize enamel and dentin . Weichman and Johnson in 1971 were the first to use lasers in Endodontics .The recent rapid development of lasers, with different wavelengths and onboard parameters may continue to have major impact on the scope and practice of dentistry.

Basic information

Basic physics

Einstein, early in the 20th century described three possible mechanisms involving photon radiation[1] , absorption[2] spontaneous emission and[3] stimulated emission.

Laser device components

All laser devices have the following basic components;

1) A laser medium, which can be a solid, liquid or gas. This lasing medium determines the wavelength of emitted light from the laser and the laser is named after the lasing medium. eg; CO_2 laser.

2) An optical cavity or laser tube having two mirrors, one fully reflective and the other partially transmissive which are located at either end of the optical cavity.

3) An external mechanical, chemical or optical power source which excites or 'pumps' the atoms in the laser medium to higher energy levels .

Atoms in the excited state spontaneously emit photons of light which bounce back and forth between the two mirrors in the laser tube striking other atoms and causing more stimulated emissions.

Photons of energy of same wavelength and frequency escape through the transmissive mirror and form the laser beam.

Laser delivery

For a laser to be useful in clinical practice, it must be able to effectively deliver laser energy to the target site. Early delivery systems were too bulky or cumbersome to use in the oral cavity. Today fiber optic delivery systems are the system of choice for most lasers as they can deliver laser energy to most parts of

the oral cavity and even within the complex root canal system.

Mechanism of laser action

The principle mechanism of action of laser energy on tissue is photothermal, other mechanisms may be secondary to this process [Rapid heating of water molecules within enamel causes rapid vaporization of the water and buildup of steam which causes an expansion that ultimately over comes the crystal strength of the dental structures, and the material breaks by exploding, this process is called ablation].

For a laser to have biological effect, the energy must be absorbed. The degree of absorption in tissue will vary as a function of the wavelength and optical characteristics of the target tissue.

Uses of Lasers in Dentistry

The rapid advancements in laser technology have been introduced into various fields of dentistry. Some of the present applications of laser in dentistry are as follows,

A. Diagnosis

a) Detection of pulp vitality
   1. Doppler flowmetry
   2. Low level laser therapy (LLLT)

b) Laser fluorescence - detection of caries, bacteria and dysplastic changes in the diagnosis of cancer

B. Hard tissue applications

a) Caries removal & cavity preparation
b) Recontouring of bone (Crown lengthening)
c) Endodontics Root canal preparation, sterilization and apicoectomy
d) Laser etching
e) Root canal preparation for retrofill amalgam or composite

C. Soft tissue applications

a) Laser assisted soft tissue curettage and periapical surgery
b) Bacterial decontamination
c) Gingivectomy and gingivoplasty
d) Aesthetic contouring, frenectomy
e) Gingival retraction for impressions
f) Implant exposure
g) Biopsy incision and excision
h) Treatment of aphthous ulcers
i) Hemostasis
j) Tissue fusion - replacing sutures
k) Laser assisted flap surgery
l) Removal of granulation tissue
m) Pulp capping, pulpotomy and pulpectomy
n) Operculectomy and vestibuloplasty
o) Incisions and draining of abscesses
p) Removal of hyperplastic tissues and fibroma

D. Laser induced analgesia

E. Laser activation

a) Bleaching agents
b) Restorations (composite resins)

F. Others

a) Removal of root canal filling material and fractured instrument.
b) Softening of gutta percha.
c) Removal of moisture/ drying of canal

Advantages of laser

During cavity preparation

- Erbium lasers can have some selectivity in removing diseased tooth structure, since carious lesions have much higher water content than healthy tissues.
- Elimination of micro fractures and a reported lowering of pulpal temperature as the preparation proceeds (compared with use of high speed handpiece).
- Lased enamel has a good potential for bonded restorations as long as they are subsequently etched with acid.
- Reduces the amount of bacteria and other pathogens in the operating field.

In surgery

- In case of soft tissue procedures, lasers achieve very good hemostasis, with the reduced need for sutures and surgical packing.
- Since the laser incision is more broad and irregular than that of a scalpel, the healing tissue blends well with surrounding structures.
- With good control of bleeding, there is greatly improved visualization of the surgical field.
- Initial post operative discomfort and swelling are reduced because of the sealing of nerves and lymphatics.

Other

- Lasers can successfully and safely be used on wide range of the population such as children and pregnant women. Unlike some medications, the patient will not experience allergic reactions, bacterial resistance.
- Reduces anxiety or fear of the drill
- Reduces noise from the drill.
- Needle free dentistry
- There are units which are available as chordless and can be fitted to chair side units.

Limitations of Laser

- Erbium family of Laser is unable to remove gold and vitreous porcelain and has only a small interaction with amalgam.
- For enamel removal, the laser is not as fast as a rotary bur.
- The initial investment for some devices are high
- All units operate at line voltage and the Erbium lasers require an additional air supply.
- Training and continuing education is essential
- Hazardous to human eye sight

Laser safety

- General safety requirements include a laser warning symbol outside the clinic.
- Eye protection for the operator, staff and the patient to protect against reflected laser light or accidental direct exposure. [Lasers can be focused by the eye into an extremely small spot on the retina, resulting in localized burning and permanent damage in seconds or even less time. So highly reflective instruments or instruments with mirrored surfaces should be avoided as there could be reflection of the laser beam].
- Take adequate precautions to prevent injury or damage to adjacent soft and hard tissues or to the pulp or periodontal apparatus. It is important to make sure that the equipment is serviced and checked regularly.

Conclusion

Laser is a wonderful innovation in the management of dental diseases. It has reduced the treatment time and accelerated healing, it also relieves patient from pain of needle prick or pain from trauma, when sharp instruments are used.

Lasers used to be very expensive initially (greater than 5 lakhs for dental laser), today lasers are available for less than 2.5 lakhs per unit. In a world health exhibition held in Bombay in 2010, China made lasers were available for around rupees 55000 per unit.

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