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Review Article

Lasers: A Silver Lining in Periodontics

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Abstract

Atraumatic treatment of patients is the prime concern while performing a surgical procedure. A clear view of the operating site is made possible by the effective management of bleeding control. In contrary to the conventional surgical procedures, use of Lasers provide a blood-free environment for the surgeon. This ease of performing a surgery has a huge impact on carrying on the surgery. Lasers are advanced high end technologies used in periodontics. They are used with ease in all phase of periodontal treatment. Starting from diagnosis, lasers are used hand in hand with the convention techniques. They have both hard and soft tissue applications. Low level laser therapy is used for enhanced healing. Lasers are also used in disinfection in photodynamic therapy.

Keywords: *Lasers; Wound Healing; Photobiomodulation; Photodynamic Therapy*

Introduction

The term LASER is an acronym for Light Amplification by the Stimulated Emission of Radiation [1]. Lasers are monochromatic, coherent beam of light which are collimated. They can be focused easily and can be handled with predictable effects. In 1960, Lasers were introduced to dentistry by Theodore Miaman.

Lasers are used in dentistry in all fields of practice. They are used in diagnosis, in non-surgical therapy as dentinal hypersensitivity, cavity preparation, etc. and in surgical therapy as in gingivectomy, gingivoplasty etc. lasers are used both in hard tissue and soft tissue handling. They are highly efficient and they are also used in low level laser therapy and photodynamic therapies [2].

Classification

1. **Based on the Laser wavelength (nanometres):**
    - UV (ultraviolet) range-140 to 400 nm
    - VS (visible spectrum) range-400 to 700 nm
    - NIR (near infrared) range-700 nm - 1200 nm
    - FIR (far infrared) range more than 1200 nm.

2. **Based on the tissue handled:**

   A. Hard tissue laser

      - CO_2 lasers (CO_2 gas)
      - Argon laser (Argon ions)
      - Nd:YAG lasers.

   B. Soft tissue laser

      - He-Ne lasers
      - Diode lasers.

3. **Based on delivery system:**

   - Articulated arm
   - Hollow waveguide
   - Fiber optic cable.

4. **Based on type of active medium used:** Gas, solid, semi-conductor and liquid lasers.

5. **Based on pumping mechanism:**

   - Optically pumped laser
   - Electrically pumped laser.

6. **Based on operation mode:**

   - Continuous wave lasers
   - Pulsed lasers.

7. **Based on degree of hazard:** The laser classification system, based on the probability of damage occurring was given by FDA:

   - Class I- (< 39mw) there is no threat of any biological damage to the tissue.
   - Class II- (< 1 mw) causes damage on staring at the beam of light for a period of time.
   - Class IIIA- (< 500 mw) cause damage when the beam is collected by an optical instrument and directed into eye.
   - Class IIIB- (< 500 mw) causes damage if viewed briefly enough even before blinking can occur.
   - Class IV- (> 500 mw) can cause permanent damage to eye including blindness.

Laser component

The laser has three important components [10]:

- Medium: This may be a solid, liquid or a gas medium.
- Energy source or a Pump
- An optical cavity or an optical resonator.

Medium which is also known as the active medium or the gain medium is placed in the laser optical cavity. The active medium is pumped into an excited state for the stimulated emission. This energy is given by the intense light source or flash lamp [4]. This laser cavity has two mirrors, one with high reflective capacity which induces stimulated emission and a partially reflective mirror placed parallel acting as an output coupler to leave portion of light outside the optical cavity [9].

Tissue reactions to heat energy [3]

From temperature between 37 - 43ºC, it causes hyperthermia. From 43 - 50ºC, it causes decline in enzyme activity. From 50 - 60ºC, it causes protein damage by protein coagulation. From 70 - 80ºC the cell membrane is affected and the collage is damaged. From 80 - 100ºC there is molecular destruction and it results in carbonisation from 100 - 140ºC. There is evaporation and desquamation of tissues from 140 - 400 and the tissue undergoes cutting from 500 - 800ºC.

Laser-tissue interaction

Light interacts with tissue in four different ways [12]. They are: reflection, scattering, absorption and transmission. Reflection is when the laser light is bounced off the tissue surface without any interaction. Scattering is the change in direction of laser without loss of energy. Absorption is when laser light is absorbed by the tissue and all tissue reactions occur. Transmission is just the passing through of the laser light.

Types of lasers:

- Diode lasers
- Argon lasers
- Nd: YAG lasers
- Er: YAG lasers
- Er-Cr: YSGG lasers
- CO_2 lasers.

Applications

Wound healing

Low levels of lasers are efficient in proliferating fibroblastic activation [13]. They enhance the tensile strength of healed wounds and improvise the protein synthesis and mRNA activation resulting in improvised wound healing. Low level lasers achieve this biostimulation

by decreased thermal production and increased action on protein synthesis [6]. There is vasodilation, enhanced lymphatics drainage, increased cellular activity leading to secretion of more anti-inflammatory prostaglandins, like PgL2, immunoglobulin, lymphokines and beta endorphins. The low level lasers act on the redox potential of the cells and they shift the anaerobic metabolism towards aerobic which aids in wound healing [6].

Photobiomodulation

The lasers with low level output power of 500 mW are used as low level laser for photobiomodulation. It is a non-invasive process with target of pain relief and anti-inflammatory effects. Photobiomodulation targets the mitochondria in cells. They improve glycolysis and production of ATP. They activate transcription factors. Bone healing is improved due to stem cell differentiation as a result of photo-biomodulation. Osteogenesis, angiogenesis are all enhanced [8]. There is increased tissue regeneration after photobiomodulation due to enhanced differentiation of mesenchymal cells. In surgical therapy, significant improvement in healing and post-operative discomfort is seen in implant placement.

This healing variant of laser treatment is also used in treatment of recurrent oral ulcers, herpetic infections, stomatitis etc. low level of radiation is also used in treatment of peri-implantitis patients.

Photodynamic therapy

PDT or Photodynamic therapy is used in elimination of resistant microbial organism by using lasers and photosensitive dyes. The photosensitiser in the dye, undergoes decay releasing free radicals. They act on the cell membrane of micro-organism and cause rupture of cell membrane causing cell death [5]. Red light in range of 630 - 700 nm is used. Neon lasers, Ga-Al-Arsenic diode laser or argon lasers are used. Acridine, methylene blue, porphyrin derivatives, phthalocyanines etc are used [14,15]. The photosensitiser dye is placed in the periodontal pocket and is activated by the light source. This PDT eradicates the microbes and also detoxifies the operating site off the lipopolysaccharides [13].

Adjunct to surgical treatments

In parallel to conventional therapy, lasers are used in surgery. Some of the laser assisted surgical procedures which are commonly performed are:

- Laser assisted new attachment procedures (LANAP)
- Laser assisted gingivoplasty
- Laser assisted gingivectomy
- Laser assisted flap surgery
- Laser assisted peri-implant procedures (LAPIP)
- Laser assisted frenectomy
- Laser assisted exposure of unerupted teeth.

Hard tissue applications:

Lasers are used in cavity preparation, caries removal, scaling [11], in treatment of dentinal hypersensitivity, root surface biomodification etc. Er:YAG lasers are effective in treating dentinal hypersensitivity. They occlude the exposed dentinal tubules [7].

Conclusion

Lasers are widely used in dentistry. They have a wide range of use in all branches of dentistry. There a various potential advantages of using lasers like clear vision of operating site, bloodless field, patient convenience etc. the additional photo stimulated usage of lasers have a like prospective applications. In few decades, no wonder lasers may become an additional essential component in contemporary dentistry. Judicious and cautious use of lasers in experienced and confident hands is sure to give remedy to aching hands.

Conflicts of Interest

Nil.

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