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LASER DENTISTRY

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ABSTRACT

In the last two decades, there has been an explosion of research studies in laser application. In hard tissue application, the laser is used for caries prevention, bleaching, restorative removal and curing, cavity preparation, dentinal hypersensitivity, growth modulation and for diagnostic purposes, whereas soft tissue application includes wound healing, removal of hyperplastic tissue to uncovering of impacted or partially erupted tooth, photodynamic therapy for malignancies, photostimulation of herpetic lesion. Use of the laser proved to be an effective tool to increase efficiency, specificity, ease, and cost and comfort of the dental treatment.

Keywords: Dental application, lasers, photostimulation

INTRODUCTION

The term LASER is an acronym for 'Light Amplification by the Stimulated Emission of Radiation'. As its first application in dentistry by Miaman, in 1960, the laser has seen various hard and soft tissue applications. (1) The word LASER is an abbreviation for Light Amplification by Stimulated Emission of radiation. The concept of lasers is based on Einstein's theory of stimulated emission. Lasers are used in a wide range of medical and cosmetic procedures. Recently it has received attention in clinical dental settings. (2) Lasers have also been used to treat oral cavity infections, a use that has become more widespread with the advent of new types of lasers and has also extended to tooth-specific therapeutic practices, such as endodontic, periodontal, orthodontic and cosmetic dentistry treatments . Indeed, precisely because of its characteristics of versatility, user-friendliness and reliability, the laser can be used as an alternative to conventional surgery, even of the oral cavity. The biostimulating properties of laser beams at the cellular level has enabled its use in all branches of dentistry. (3) The most common types are carbon dioxide (CO_2), diode, neodymium: yttrium– aluminum–garnet (Nd: YAG), and erbium: yttrium– aluminum–garnet (Er: YAG) lasers. They are used for cavity preparation, 5 tooth whitening, gingival incisions, and other applications. In this article, I have reviewed the literature and the application of LASER in dentistry. (2)

CLASSIFICATION OF LASERS (4)

I. According to the wavelength (nanometres)

1. UV (ultraviolet) range - 140 to 400 nm

2. VS (visible spectrum)-400 to 700 nm

3. IR (infrared) range - more than 700 nm

Most lasers operate in one or more of these wave- length regions.

II. 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 (for biostimulation and analgesia)

i. He-Ne lasers

ii. Diode lasers

III. According to the delivery system

i. Articulated arm (mirror type)

ii. Hollow waveguide

iii. Fiber optic cable

IV. According to type of lasing medium

EAg. Erbium: Yttrium Aluminium Garnet

V. According to type of active medium used

Gas, solid, semi-conductor or dye lasers

VI. According to operation mode

1. Continuous wave lasers

2. Pulsed lasers

VII. According to pumping scheme

1. Optically pumped laser

2. Electrically pumped laser

VIII. 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 the person, if they were stare into beam for long period of time.

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

Class IIIB- (<5OOmw) Cause injury if viewed briefly, even before blinking can occur.

Class IV- (> 5OOmw) Direct viewing and specular and diffuse reflections can cause permanent damage including blindness.

A. Carbon Dioxide Laser

- The CO, laser first developed by Patel et al in 1964 is a gas-active medium laser that must be delivered through a hollow tube-like waveguide
- Because of the water absorption, the CO, laser generates a lot of heat, which readily carbonizes tissues.
- Since this carbonized or charred layer acts as a biological dressing, it should not be removed. (5)
- Wavelength- 10,600nm.
- Suitable for application of teeth
    - Sealing of pits and fissure
    - Welding of ceramic material to enamel
    - Prevention of dental caries
    - Used in non-contact manner for tissue ablation heat diffusion and heat accumulation occur. (6)

A. Argon Laser

- Two wavelength of 488 nm blue color and 514nm blue green.
- The active medium is ionized argon gas.
- They are the lasers in the blue-green visible spectrum.
- Fibro optic delivery system.
- Argon lasers work both in the contact and non-contact mode.
- The small diameter flexible glass fibre is normally used in contact with the surgical target tissue.
- Absorbed by haemoglobin and melanin. (5)

B. Nd:YAG Laser

- Active medium- solid crystal of aluminium, yttrium-gamet doped with Neodymium.
- Delivery system- fiber optic free running pulse mode, contact mode mostly wavelengths-1064 nm.
- USES-treatment of dentinal hypersensitivity, root canal sterilization, pulp capping and soft tissue procedures. (7)

C. Diode Laser

- 940nm (810nm and 980nm also) Produced from a Solid Medium
- Absorbed by:
    - Water
    - Hydroxyapetite
    - Hemoglobin
    - Melanin
- Continuous wave with programmable pulsed setting.
- Disposable fiber-optic Delivery.
- 940nm creates a cleaner cut and less char than other wavelengths.

D. Er:YAG

- 2780 nm Wavelength.
- Absorbed by water and Hydroxyapatite.
- High Surface absorption.
- Excellent for hard tissue removal.
- Non-Selective for Soft tissue removal.
- Fiberoptic Delivery. (8)

LASER INTERACTION WITH BIOLOGICAL TISSUES

The principal effect of LASER energy is photothermal (ie. the conversion of light energy into beat). The physical change in target tissue achieved through heat transfer is termed photo-thermolysis.

- Effect on Biological Tissues:
  - Transmission: In this way, the beam enters the medium, but there is no interaction between the incident beam and the medium.
  - Scatter: Scatter will cause some diminution of light energy with distance, together with a distortion in the beam, whereby rays proceed in an uncontrolled direction through the medium.
  - suitable
  - Reflection: The density of the medium, or angle of incidence being less than the refractive angle, results in a total reflection of the beam.
  - Absorption: The incident energy of the beam is attenuated by the medium and transferred into another form. (9)

APPLICATION OF LASER IN VARIOUS BRANCHES. (10)

1. Oral Medicine and Diagnosis

- Soft tissue
  - Dysplastic changes within the oral mucosa can be detected at the
  - earliest by the use of blue light by the Velescope
  - Aphthous ulcers can be treated.
- Hard Tissue
  - Detection of caries & bacteria using a red light which fluorescence through

enamel/ dentine gives digital score for dental caries detection (Diagnodent).

2. Oral and Maxillo-facial Surgery

- Soft Tissue
  - Incisions and draining of abscesses
  - Removal (Incision/Excision) of fibrotic tissue, inflamed, hypertrophic / hyperplastic tissues, gingival growths, mucoceles, cysts, precancerous lesions, benign tumours, and other non- haemangioma.
  - type of lesions
  - Scar corrections
  - Exposure of soft-tissue impacted teeth
- Hard Tissue
  - Malformations
  - Pre-prosthetic surgeries
  - Re-contouring of bone

3. Oral & Maxillofacial Pathology

- Soft Tissue
  - Bacterial decontamination
  - Biopsy- incision and

4. Applications in Orthodontics

- Soft Tissue
  - Aesthetic gingival recontouring
  - Soft tissue crown lengthening
  - Tissue removal at the site for mini screw
- Hard Tissue
  - Temporo-mandibular joint discomfort.

5. Applications in Conservative Dentistry & Endodontics

- Hard Tissue
  - Caries detection (including residual caries)

- Caries removal & cavity preparation
- Pit and fissure sealants
- Dentinal Hypersensitivity
- Sterilization & cleaning of root canal
- Root canal preparation
- Pulp Capping & Pulpotomy
- Laser etching
- Removal of defective composite and glass ionomer restorations

6. Applications in Prosthodontics

- Soft Tissue
  - Gingival retraction for impressions
- Hard Tissue
  - Crown lengthening
  - Implant exposure

7. Applications in Pedodontics (Article 8_nitin)

- Hard Tissue
  - Prevention of teeth from devitalisation
  - Haemorrhage control
  - Sterilization (Destroys oral pathogens at the site of trauma)
  - Healing during soft tissue trauma or facial lacerations
  - Healing of aphthous ulcer & shortening the duration of the herpes labialis lesion
  - Controlling Gag Reflex

8. Applications in Periodontics

- Soft Tissue
  - Sub-gingival debridement
  - Laser assisted soft tissue curettage, flap & periapical surgery
  - Removal of granulation tissue
  - Gingivectomy, Operculectomy and Frenectomy (Lingual or Maxillary frenum)
  - Gingivoplasty & vestibuloplasty
  - Treating hyperpigmentation and metal tattoos
- Hrad Tissue
  - Osseous re-contouring as well as in implant surgery and its maintenance
  - Treatment of ankyloglossia

9. General

  - Haemostasis
  - To check the vitality of pulp
  - Pulpal analgesia

MECHANISM OF ACTION OF LASER

- The Laser's Diode generator converts laser energy by using electricity.
- The laser beam that creates the healing result is actually infrared, so invisible to the naked eye. The red aiming beam that you see is just to show where the laser energy will be emitted.
- The laser photons hit the skin and then penetrate to the necessary treatment depths.
- On maximum power and frequency the laser has the ability to penetrate 3 inches below the skin. (11)

ADVANTAGES AND DISADVANTAGES OF LASERS

- Advantages
  - They are often less painful and so this reduces the need for administering anaesthesia.
  - Some people are afraid of the conventional drill. They are more at ease with lasers.
  - When soft tissue has to be handled, lasers lessen the swelling and the bleeding.
  - During cavity treatment, lasers help in retaining more of the tooth that is intact. (12)
- Disadvantages
  - Lasers can't be used on teeth with fillings that are already in place. Lasers can't be used in many commonly performed dental procedures. Eg. lasers can't be used to fill cavities located between teeth, cavities around old fillings, and large cavities.
  - Traditional drills may still be needed to shape the filling, adjust the bite, and polish the filling even when a laser is used.
  - Do not eliminate the need for anesthesia.
  - More expensive since the cost of the laser is much higher. (13)

CONCLUSION

Laser use in dentistry is proven to be beneficial in treating a wide range of dental conditions as well as a therapeutic tool in tissue management. The dynamics of laser energy beams pose general risks to non-oral tissues and the immediate environment. Safety measures have been devised to safeguard those personnel staff and patients who may be involved in dental treatment using lasers. (14)

REFERENCES

1. Verma, S. K., Maheshwari, S., Singh, R. K., & Chaudhari, P. K. (2012, Jul-Dec). Laser in dentistry: An innovative tool in modern dental practice. *National Journal of Maxillofacial Surgery, 3*, 124-132. doi: 10.4103/0975-5950.111342

2. Srivastava, A., shrivastava, R., Srivastava, R., Deepak, G., Kumar, K. R., & Setu, M. (2019, Oct-December 12). LASERS IN DENTISTRY. *International Journal of Medical Science and Education, 6(4)*, 99-104. Retrieved December 12, 2019

3. Malcangi , G., Patano, A., Trilli, I., Piras, F., Maria, A. C., Inchingolo, A. D., . . . Inchingolo, A. M. (2023, June 5). Therapeutic and Adverse Effects of Lasers in Dentistry: A Systematic Review. *Photonics, 10*, 650. doi:10.3390.
4. Maheshwari, M., Jaan, A., Vyaasini, C. S., Yousuf, A., Arora, G., & Chowdhury, h. (2020, August 14). Laser and its Implications in Dentistry : A Review Article. *Journal of Current Medical Research and Opinion, 3*, 579-588. doi:10.15520/jcmro.v3i08.323.

5. Ranghani, A. (2017). *LASER IN DENTISTRY.* Power-Point Presentation, Govt. Dental College and Hospital, Ahmedabad, Oral medicine and Radiology, Ahmedabad. Retrieved january 6, 2017, from https://www.slideshare.net/AshishRanghani/laser-in-dentistry-77468474

6. Patel, A. (2017). *Laser in dentistry.* Health and Medicine . Retrieved july 2017, from https://www.slideshare.net/ankitpatel14473/laser-in-dentistry-76815112

7. Rana, D. P. (2020). *Lasers in Conservative dentistry.* Power Point Presentation, Conservative dentistry. Retrieved july 2020, from https://www.slideshare.net/DPR12345/lasers-in-conservative-dentistry
8. Licht, F. A. (2016). *The Application of Lasers in Dentistry.* Tennessee State University, Sophomore Clinic Coordinator , Tennessee, United States. Retrieved 2016, from https://www.slideshare.net/FrankLichtRDHBSDHMSD/the-application-of-lasers-in-dentistry

9. Arora, D., Yadav, G., Tripathi, A. M., Saha, S., & a Arora, T. C. (2018, Jan-Feb). Concepts and Applications of LASERs in Dentistry: An Insight. International Journal of Oral Health and Medical Research, 4(5), 75-79. Retrieved Jan-Feb

2017, from https://www.researchgate.net/publication/350870867_Concepts_and_Applications_of_LASERs_in_Dentistry_An_Insigh

10. NK, P., NK, S., Ramakrishna, A., & GS, M. (2014). Lasers in dentistry - Thinking ahead. CODJournal of Dentistry , 6(2), 102-107. doi:10.5005/cods-6-2-102

11. Armstrong, E. (n.d.). HIGH INTENSITY LASER THERAPY. Retrieved from HIGH INTENSITY LASER THERAPY<iframe src="https://player.slideplay

12. KAKODKAR, G., DE ATAIDE, I. N., & PAVASKAR, R. (2012, may 1). Lasers in Conservative Dentistry: An Overview. Journal of Clinical and Diagnostic Research, 6(3), 533-536. doi:JCDR/2012/3564:1934.

13. Raj, D. (2016). Lasers in Dentistry. Oral And Maxillofacial Surgery, Kota Bharu, Malaysia. Retrieved 2016, from https://www.slideshare.net/dineshraj891/lasers-in-dentistry-56849044

14. Hamed, H. (2015). Laser in dentistry. Alexandria university, public health department , Egypt. Retrieved 2015, from https://www.slideshare.net/HamsHamed/laser-in-dentistry-56411815