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# Laser Dentistry

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***ABSTRACT :***
*The term LASER is 'Light Amplification by the Stimulated Emission of Radiation'. As its first application , in 1960, the laser has hard and soft tissue applications. In past decades, there is research studies in laser application. In hard tissue application, it is for caries prevention, bleaching, restorative removal and curing, cavity preparation, dentinal hypersensitivity, growth modulation and for diagnostic purposes, In soft tissue application it is used for wound healing, removal of hyperplastic tissue to uncovering of impacted or partially erupted tooth, photodynamic therapy . Use of the laser proved to increase efficiency, specificity, ease, and cost and comfort of the dental procedure.*

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## I. INTRODUCTION :

Studies in the field of equipment technology has been helpful to learn about our surrounding. Our field of dentistry has been touched in a large way by these latest technology. Gone are the days of the old belt driven motors to remove caries from the teeth and now a days air abrasion devices are used. (1) The radiographs one of the most outstanding examples of how technology change touched the way dental therapy was conceived and carried out.

LASER technology is making great inroads into lot of areas of dentistry. (2) .simple to complex laser used in hospitals. Lasers have been tried out in dentistry has been in practice for more than 10-15 years but have attainedrecent developments. (3) Latest advancements in technology have found more applications in dentistry

## II. CLASSIFICATION :

According to the wavelength (nm)

a. UV (ultraviolet) range – 140 to 400 nm
b. VS (visible spectrum) – 400 to 700 nm
c. IR (infrared) range – more than 700 nm

Other,Based on hazard to skin or eyes The laser classification system is based on the probability of damage occurring.

Class I : (< 39mw) Exempt; pose no threat of biological damage.

Class II : (< 1 mw) The output could harm a person if they were to stare into the beam for a long period of time. The normal aversion response or blinking should prevent you from staring into the beam. No damage can be done withinthe time it takes to blink.

Class IIIA : (<500mw) Can cause injury when the beam is collected by optical instruments and directed into the eye.Class IIIB : (<500mw) Causes injury if viewedbriefly, even before blinking can occur.

Class IV : (> 500mw) Direct viewing and specular and diffuse reflections can cause permanent damage including blindness. Even though there have been many classifications of lasers, Srivastava et al proposed a new simplified classification of lasers based on the clinical use. This classifies lasers on the basis of surgical and non surgical usesurgical lasers are subclassified into hard and soft tissue lasers

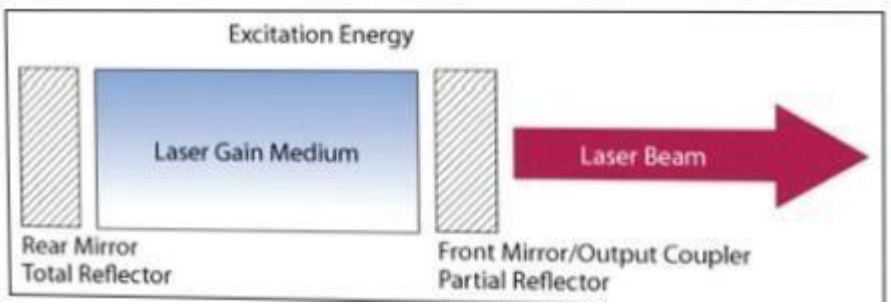
## III. MECHANISM OF ACTION :

Laser light is a monochromatic light and consists of a single wavelength of light. It has three principal parts: An energy source, an active lasing medium, and two or more mirrors that form an optical cavity or resonator. For amplification, energy is supplied to the laser system by a pumping mechanism, that is , a flash-lamp strobe device, an electrical current, or an electrical coil. This energy is pumped into an active medium contained within an optical resonator, producing a spontaneous emission of photons.

, after that amplification by stimulated emission takes place as the photons are reflected back and forth through the medium by the highly reflective surfaces of the optical resonator, before to their exit from the cavity via the output coupler . In lasers, the laser light is delivered from the laser to the target tissue via a fiber optic cable, hollow waveguide, or articulated arm . Focusing lens and cooling system controls the system. The wavelength and properties of the laser are determined by the composition of an active medium,such a gas, a crystal, or a solid-state semiconductor. The light energy produced by a laser can have four different interactions with a target tissue(1,2): Reflection, Transmission, Scattering, and Absorption. When a laser is absorbed, it rises the temperature and produces photochemical effects depending on the water content of the tissues. When a temperature of 100°C ,

within the tissue vaporization of water occurs, a process called ablation. At temperatures below 100°C, but above approximately 60°C, proteins begin to denature, the underlying tissue without vaporization. at temperatures above 200°C, the tissue is dehydrated and then burned, resulting in an undesirable effect called carbonization. Absorption requires a light, termed chromophores, which have affinity for particular wavelengths of light. The primary chromophores are Melanin, Hemoglobin, Water and Hydroxyapatite. Different laser wavelengths have different absorption coefficients with respect to these primary tissue components, making the laser selection procedure-dependent(3-5). Depending on application on various tissues, use of laser application in dentistry can becategorized as follows:

Soft tissue application and hard tissue application.




## IV. SOFT TISSUE APPLICATION

***Wound healing***

At low doses (e.g., 2 J/cm2), laser application stimulates Proliferation, while at high doses (e.g. 16 J/cm) Suppressive(6,7). It affects fibroblast maturation and movement,(8) Higher tensile strengths reported wound healing.(9) Low-level laser treatment (LLLT) of gingival fibroblasts, Stomatitis in humans have also been recorded.(11) Are some positive data, which indicate that LLLT Promotes healing and dentinogenesis following

Pulpotomy,[12] also the healing of mucositis and Oropharyngeal ulcerations in patients undergoing Radiotherapy for head and neck cancer.[13]Post herpetic neuralgia and apthous ulcer It has been demonstrated that photostimulation of Aphthous ulcers and recurrent herpetic lesions,[14] with Low levels of laser energy

(HeNe) Relief and promote healing.[15-17] In the case of recurrent Herpes simplex labialis lesions, photostimulation During the prodromal (tingling) stage seems to arrest The lesions before painful vesicles form, accelerate the Overall healing time, and decrease the frequency of Recurrence.[18]Photoactivated dye disinfection using lasers Low power laser energy is useful for photochemical Activation of oxygen-releasing dyes, causing membrane And DNA damage to the microorganisms. The Photoactivated dye (PAD) technique can be undertaken With a system using low power (100 milliwatts) Visible red semiconductor diode lasers and tolonium Chloride (toluidine blue) dye. The PAD technology is used to destroy microbes, such as, subgingival plaque, which Are typically resistant to the action of antimicrobial Agents[19-21] and can be made species-specific by Tagging the dye with monoclonal antibodies (22)

## - - V. HARD TISSUE APPLICATION

***Photochemical effects***

The argon laser produces high intensity visible blue light (488 nm), which is able to initiate photopolymerization of light-cured dental restorative materials, which use Camphoroquinone as the photoinitiator.[23]

***Argon laser***

Radiation is also able to alter the surface chemistry of Both enamel and root surface dentine,[24] which reduces The probability of recurrent caries. The bleaching effect depands on the absorption of a narrow spectral Range of green (510-540 nm) into the chelate formed between the apatites, porphyrins, And tetracycline compounds.[25]

***Laser fluorescence***

Enamel demineralization on The buccal surfaces of the teeth is a common Side effect of orthodontic treatment with fixed Appliances.[26,27] There is evidence, however, which Suggests that such small areas of superficial enamel Demineralization may re-mineralize.[30]Cavity preparation, caries, and restorative removal Various studies depict the use of Er: YAG, since 1988, for Removing caries in the enamel and dentine by ablation,Without the detrimental effect of rise in temperature on The pulp,[31] even without water-cooling,[61] with low 'fluences' laser(LLLT), similar to air-rotor devices, except That the floor of the cavity is not as smooth.[32] The Er: YAG laser is capable ofremoving cement, composite Resin, and glass ionomer.[33]

***Etching***

Laser etching has been evaluated as an alternative To acid etching of enamel and dentine. Enamel and Dentine surfaces etched with (Er, Cr: YSGG) lasers show Micro-irregularities and no smear layer.[34] Adhesion to Dental hard tissues after Er: YAG laser etching is inferior To that obtained after conventional acid etching.[35,36]

Treatment of dentinal hypersensitivity Dentinal hypersensitivity is one of the most common Complaints in clinical dental practice. Comparison Of the desensitizing effects of an Er: YAG laser with Those of a conventional desensitizing system on Cervically exposed hypersensitive dentine[37] showed That desensitizing of hypersensitive dentine with an Er: YAG laser is effective, and maintenance of a positive Result is more prolonged than with other agents.

## - VI. DIAGNOSTIC APPLICATION

The laser is being used for diagnostic purposes. In clinical dental practice as well as in research purposes .3-D Laser scanner for e-model preparationOur understanding of the growth of craniofacial structures Is improving with the development of accurate, low-cost, 3-dimensional (3D) imaging systems, which can be Classified as destructive or non-destructive devices,[38]Hard or soft tissue imaging devices,[39] and contact or Non-contact devices.[40] The laser scanner can be usedas a soft tissue scanner and is a valuable tool for its Ease of application and creation of 3D images of oral Dental structures. There is no need of cast preparation asE-models are prepared from scanned impressions. Images Have been created to establish databases for normative Populations[41] and cross-sectional growth changes,[42] and Also to assess the clinical outcomes in surgical[43-45] and Non-surgical treatments [46,47]in the head and neck regions

## - VII. MISCELLANEOUS APPLICATION

***Analgesic effect of the laser***

Studies shown that LLLT Decreases the firing frequency of the nociceptors of oral cavity, with a Threshold effect seen in terms of the irradiance required To exert maximal suppression.[48] There have been claims That successful analgesia following oral surgery can be Achieved with all major LLLT wavelengths from 632 nm To 904 nm.[49,50] Local CO2 Laser irradiation will reduce The pain associated with orthodontic force

application, Without interfering with tooth movement.[51,52]Nerve repair and regeneration Low level laser therapy has been seen to decrease the Production of inflammatory mediators from injured nerves, and to aid neuronal Maturation and regeneration following injury.[53,54] The LLLT protocols used, typically involve daily irradiation For prolonged periods, for example, 10 days at 4.5 J Per day. The direct application of this technique to Dentistry has yielded positive results in The regeneration of IDN tissue, during surgical procedure it is damaged

***Post surgical pain***

A single episode of LLLT (irradiance 0.9-2.7 J) is 100% effective for apical periodontitis following root Canal treatment and post-extraction pain.[55] There are Conflicting results with regard to pain reduction post Extraction byLLLT verses placebo controls.

***Sinusitis***

There are mixed findings on the sinusitis By laser therapy. One study[89] denies any significant Benefit, while others found that LLLT improved Microcirculation, reduced edema, and reduced the Frequency of relapses.[56]Of late, the diode laser has also been tried in experimental Animals for controlling the excessive growth of the Mandibular condyle. It was found that the laser is Effective in regulating facial growth and could be a Substitute for the current conventional methods such As a chin-cup.[57] McDonald and Pitt Ford found that The human pulpal blood flow was decreased when Continuous light tipping forces were applied to a Maxillary canine.[58] Barwick and Ramsay evaluated The effect of a four-minute application of laser-Doppler flowmetry concluded that the pulpal Blood flow was not changed during the application of a Brief intrusive orthodontic force.[59]

Recent studies have demonstrated that low-energy laser Irradiation stimulates bone formation in vitro and in vivo. The macrophage colony-stimulating factor (M-CSF) Is essential and sufficient for osteoclastogenesis. Low-energy laser irradiation stimulates the velocity of Tooth movement via the expressions of M-CSF.[60]

***Laser safety***

While most dental lasers are relatively simple to use, Certain precautions should be taken to ensure their Safe and effective operation.First and foremost is Protective eyewear by anyone in the vicinity Of the laser, while it is in use. It is critical that all protective eyewear Worn is wavelength-specific. An accidental Exposure to the non-target tissue can be prevented by use of warning signs posted outside the Nominal hazard zone, limiting access to the surgical Environment, minimizing the reflective surfaces, and Ensuring that the laser is in good working order, with All manufacturer safeguards in place. With regard to Prevention of possible exposure to infectious pathogens, High volume suction should be used to evacuate any Vapor plume created during tissue ablation, and Normal infection protocols should be followed. Each Office should have a designated Laser safety officer

## VIII. DISADVANTAGES

Teeth that have fillings cannot be treated with a dental laser Lasers cannot be used to treat interdental cavities Lasers cannot be used to treat excessive tooth decay Lasers haa no application in removing damaged oral restorations

## IX. CONCLUSION:

Laser technology has higher degree of precision For hard tissue application and soft tissue surgery and further improvement still required. In The dentistry, laser is a non invasive Approach. In future, emphasis should be laid upon For combination of diagnostic and therapeutic laser Techniques. It can be expected that laser technology Willbecome essential components of contemporary in Dental practice over the next decade.

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