



## LASERS IN DENTISTRY: AN INCEPTION OF NEW EON

## Dental Science

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## ABSTRACT

Lasers in dentistry began to gain popularity in the 1990s. Lasers in dentistry are used as a treatment tool or as an adjunct tool. By using the laser in the field of dentistry, the main goal is to triumph over the disadvantages, which are currently being experienced in conventional dental treatment procedures. The ability of lasers to provide minimally invasive procedures with less discomfort to the patient has been useful in the patient delivery system in dental practice. This article emphasizes the various indications of lasers in meadow of dentistry.

## KEYWORDS

Laser dentistry; Dental lasers.

## INTRODUCTION

The word laser is an acronym for Light Amplification by Stimulated Emission of Radiation. Laser is an optimal source that emits photons incoherent beam. It behaves according to basic law of light.<sup>[1,2]</sup> Many researchers have been investigating various applications of lasers in dentistry, such as cavity preparation, caries prevention, laser surgery, analgesic effects, biostimulation and laser welding of dental prostheses. The CO<sub>2</sub>(carbon dioxide) and Nd:YAG (neodymium-doped:yttriumaluminum, and garnet) lasers are used in oral soft tissue surgery.<sup>4-5</sup> Low power lasers, such as He-Ne and diode, have been used for control of dentine hypersensitivity.

Several types of lasers are used in dentistry, depending on the range of their wavelength and their associated absorption by biological chromophores, e.g water and hemoglobin, the lasers are used for different clinical aspects<sup>[3,4]</sup>. The other modalities include ablation of biological tissue hemostasis and pain relief. Lasers are being used with greater frequency in dentistry to treat both hard and soft tissues. Lasers are effective due to various advantages like vaporization, hemostasis and bactericidal effect. Additionally they have potential to reduce patient's physical and mental stress.<sup>[5]</sup>

## Historical Background

The basic concept of lasers was first given by an American scientists Charles & towns. Laser is a powerful source of light having extraordinary properties which is not found in normal light source like tungsten lamps, mercury lamps etc. The unique property of laser is that its light wave travels very long distance with a very little divergence.<sup>[6,7]</sup>

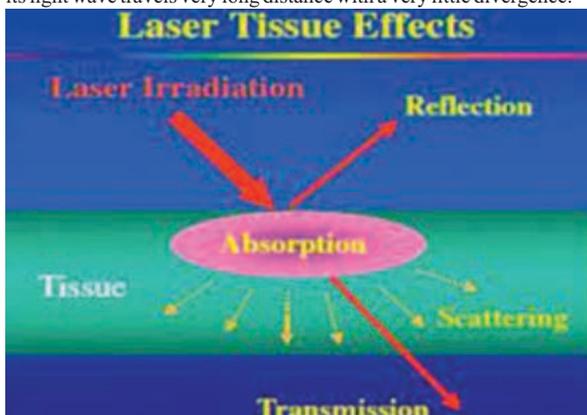


Fig 1. Interaction of lasers on tissues

## Principles &amp; Properties Of Lasers

Laser light possesses three basic characteristics; coherent, collimated and monochromatic. These provide laser light with special biological properties. It travels in straight line with a constant velocity in space. It presents a particular chromatic purity. It can be transmitted, reflected, refracted and absorbed. It has a capacity for transmitting energy without loss through the air. It presents a spatial and temporal coherence. When the laser reaches biological tissues, the light is reflected, scattered, absorbed and transmitted to the surrounding tissue Fig 1.<sup>5,8,9</sup>

## Classification

- 1) According to their mode of emission: a) Fractioned b) Continuous c) Pulsed
- 2) According to their power: a) High power b) Medium power c) Low power
- 3) According to the Emitting material a) Gas b) Solid state c) Dye d) Semi conductor diode
- 4) Ring laser
- 5) According to the type of body tissue a) hard tissue b) Soft tissue
- 6) Acc to their potential causing biological hazard a) Class I b) Class II c) Class III d) Class IV

## Types of laser

Gas, Solid state, Chemical, Excimer, Fiber, Photonic crystal, Semi conductor, Dye, Free electron Biolasers<sup>[4,8,10]</sup>

## Lasers In Dentistry

## Common Indications

## Laser in pain management:

Laser by its property of photostimulation induces thermal photochemical reaction that changes the pain threshold of receptors by reducing PGE<sub>2</sub> concentration and Tumor necrosis factor (TNF). The use of laser is for alleviating pain in post operative follow ups and third molar extraction.<sup>[1]</sup>

## Laser Hemostasis:

Many patients are on anticoagulant drugs, due to deeper penetration in soft tissues, laser is very effective. Optical characteristics of blood result in scattering and dispersion of laser light, thereby reducing the adverse effects on bony tissues. There are basically three photo thermal techniques for oral use and on face which are incisional and excisional biopsy, ablation and vaporization, Hemostasis<sup>[1]</sup>. This nature of the laser is of great value in oral and maxillofacial surgery. It allows surgery to be performed more precisely and accurately because of increased visibility of surgical sight. This character is useful in cases of hemangioma or removal of inflamed epulis, fissuratum, and procedure

involving incision of the palate, soft palate and tonsillar pillars.

### **Esthetic and Plastic Indications:**

The advantage of laser surgery in cases of esthetic and plastic surgery decreases scarring and post operative disability. Minimal Post operative swelling and safety within the airway. None of the lasers can treat all tissue conditions but a variety of lasers can be useful for various conditions.<sup>1</sup>

Lasers in Oral and Maxillofacial lesions Bacterial, Fungal and viral infections of head and neck are most common disease in human beings. Lasers used for Odontogenic infections like pulpal, periodontal, secondary infected cyst, remaining root fragment and pericoronal infections.

Excision of benign oral lesions such as fibroma, pailoma, mucocele, gingival lesions, benign salivary gland lesions, salivary stones, epulis fissurata, tongue lesions and hyperplastic tissue excisions are well documented in literature. This technique is minimally invasive and can make surgery less extensive and reduce need for general anesthesia or inpatient hospital care resulting in lowered cost.

Laser is used in precancerous lesions and conditions as a treatment modality in continuous and gated modes using focus or non focus methods. Advantages include Precise dissection, Immediate tissue destruction, Minimal damage to adjacent structures, bloodless field allowing good visibility, little postoperative scarring & Minimal interference in Oral function.

It is also used in Trigeminal neuralgias because its effect on generation of myelin sheath and promoting axonal growth in injured nerves. It acts on endothelial cells. The primary benefit is its non-invasive nature and its capability to treat without surgical intervention. Helps Nerve repair and regeneration.<sup>[1]</sup>

Laser therapy has been reported to provide pain relief and resolution for isolated lesions of aphthous ulcer. Lasers can decrease the healing time, pain intensity.<sup>[1]</sup> Lasers used to treat Traumatic ulcer, Oral malignancies, sinusitis with mild benefits,<sup>[1]</sup> Pemphigus Vulgaris, Bechets disease. Pain considerably declined after laser therapy.<sup>[1]</sup> Oral mucositis. Ulcerative lesions healed proficiently after laser therapy and follow ups. Tissue ablation and vaporization is used for the removal of the leukoplakia, dysplasia, papillary hyperplasia and osteotomies.

Laser Biopsy done in Mucocutaneous and soft tissue lesions. CO2 laser surgical excision is widely used in oral lesions like pyogenic granuloma, Peripheral fibroma, Peripheral giant cell granuloma, Peripheral ossifying fibroma, spongiotic gingival hyperplasia and mucocele. The advantage of CO2 being so extensively used is bloodless and minimal damage to neighboring tissue and comparatively laser wound contraction.

In case of oral sub mucous fibrosis average mouth opening increased with less tissue shrinkage, scar formation with release of Fibrotic bands. Interesting feature of laser in Oral Lichen Planus is local hemostasis, cauterization of nerve endings and sealing of lymph vessels.

Sleep apnea and snoring is most common social problem affecting 20% to 30% of adult population and has been associated with morning fatigue, restless and day short naps and hypoxia. Laser associated palatoplasty (LAUP) & Uvulopalatoplasty (UPPP) is done. It enlarges posterior air space and reduces pharyngeal obstruction during sleep.

Lasers in Orthodontics: Er:YAG laser has been tried for bonding and found inadequate and unfavorable to etching.<sup>[12]</sup>

Lasers in Oral & maxillofacial surgery Laser therapy is indicated in treatment of congenital vascular malformation such as hemangiomas, Nevi flammei which are treated by lasers. Use of CO2 laser was shown to be effective in cleft surgery of infant.

Arthroscopic surgery of TMJ has become choice for internal derangements of the TMJ. Procedures such as discotomy, discoplasty, sinorectomy, hemostais posterior attachment contraction and eminectomy can be performed on patient using lasers. Lasers resolve soft tissue injury especially muscular involvement and can prevent fibrosis. It improves microcirculation and oxygen supply to hypoxic

cells and improves jaw movement. Lasers Provides deepest penetration and increased production of ATP & endomorphin.

Preparation of Implant surgical site, Decontamination and implant placement, Soft tissue incision, hard tissue osteotomy, and Block Graft procedure Uncovering implants. Lasers used in perimplantitis on soft and hard tissue healing reduce pain wound healing, bone remodeling. Lasers use to uncover dental implants.<sup>13</sup> D laser scanner used for e model preparation.<sup>1</sup> Reduced post pain and edema.<sup>[11]</sup> Sterilization of socket in immediate implant dentistry after extraction of tooth. Used in cases of Perimplantitis. To debride the implant surface.

### **Lasers in Endodontics**

To disinfect root canals, Caries detection, Removal of caries & Cavity preparation. Er:YAG has great promise for caries removal and cavity preparation.<sup>10,14,15,16</sup> Lasers are used to desensitize hypersensitive dentin.<sup>[17]</sup>

### **Lasers in Periodontal Condition**

High frenum attachment in Infants, hemostasis, excellent visualization, reduced operating time; sterilization of wound site is achieved by lasers.<sup>[1,5]</sup> Laser techniques for frenectomy have now been advocated by clinicians concerning high vascular oral tissue present in labial frenum. Midline frenectomies, lingual frenectomies.<sup>[5]</sup> There is positive effect of lasers in tissue healing and repair process. There is revascularization which helps in wound healing following gingivectomy.<sup>[15]</sup> It has been prescribed for use gingivoplasties, operculum removal, and biopsies of benign lesions.

Potential of lasers in periodontal therapy in sub gingival applications, such as root debridement, soft tissue curettage, and excisional new attachment, bacterial reduction on periodontally diseased root surfaces, sub gingival curettage, and scaling and root planing have been introduced. The laser application in the field of periodontics has been focused on the treatment of sub gingival pockets and root surfaces. Decontamination of periodontal pockets, due to strong bactericidal and detoxification effects.<sup>[15,18]</sup> Recontouring, reshaping of gingiva and crown lengthening.<sup>[1,8]</sup> For treating melanin pigmentation.<sup>[8]</sup> Lasers have been tried for scaling of subgingival calculus.<sup>[15]</sup> Low power lasers with appropriate photosensitizers have been tried in treatment of inflammatory periodontal disease.<sup>[19]</sup>

### **Lasers in Prosthetic rehabilitation**

Lasers used in Prototyping and CAD/CAM technology. Laser rapid forming of a complete titanium denture base plate. Analysis of accuracy of impression by laser scanner. To study complete denture occlusion with the help of laser scanner technique and three dimensional reconstruction. Crown lengthening, Crown preparation, Laser welding, Selective lasers sintering technology used to fabricate a wax pattern.<sup>[20]</sup>

### **Laser protection in Dentistry.**

It is a precise but potentially dangerous surgical instrument that must be used with caution. Prior experience is necessary for a surgeon to operate. Educational policy for surgeons, anesthetists and nurses working with laser should be initiated.<sup>[12]</sup> Depending on the wavelength, corneal or retinal burns or both are possible from acute exposure to the laser beam. Possibility of corneal or lenticular opacity (cataract) or retinal injury occurs following chronic exposure to laser radiation. This occurs because of focusing effects of cornea and the lens. To reduce risk of ocular damage following precaution should be taken.

Sign should be placed outside the operating door warning all the persons to wear the protective glasses. Surgeon and other staff should be addressed. The doors of room should be closed during laser surgery with CO2. Doors should be locked when working with Nd YAG or argon laser. All staff members should wear protective glasses with side protectors. When working with lasers one should wear protective eye glasses which are usually of amber color.<sup>12,21</sup> A double layer of saline saturated surgical gloves, sponges or lap pads should be used to protect the skin and mucous membrane of patient outside surgical field. Teeth in operating field also need to be protected with surgical sponges. Two separate suction tips should be maintained one for smoke and steam evacuation and other for aspiration of blood and mucous. This helps in preventing inhalation of smoke by the patient and personnel in dental office. The instrument used for the procedures should provide low specula and large diffuse reflectance of the beam and it should strike inadvertently.

### Summary

Lasers now a day have become popular in use due to its unique properties like non invasiveness, hemostasis and reduced post operative complication A further area of growth is expected to be a combination of diagnostic and therapeutic laser techniques.

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**Conflicts of Interest:** NONE

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