

## Lasers in Prosthodontics

### Review Article

**Protetik Diş Hekimliğinde Lazer Uygulamaları, Amro VARRAK, Göknil ERGÜN KUNT\* and Gözlem CEYLAN**

*On dokuz Mayıs University Faculty of Dentistry, Department of Prosthodontics, Samsun*

**Received:** Apr 16, 2020; **Accepted:** May 05, 2020; **Published:** May 08 2020

**\*Corresponding author:** GOKNIL ERGUN KUNT, DDS, PhD, Associate Professor in Department of Prosthodontics, On-dokuz Mayıs University, Faculty of Dentistry, Department of Prosthodontics 55139, Atakum, Samsun, Turkey

**Copyright:** © 2020 GOKNIL ERGUN KUNT. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

### Abstract

During the development of technology and arising creative methods to make the human life easier, the necessity of accelerating treatments has become a necessity. Laser therapy is preferred by the patient and dentist with the advantages of less time taking, bleeding, swelling, scarring and pain relief. With the development of laser types their application areas are increasing fastly. The purpose of this review is to give information about the lasers and their usage areas in prosthodontics.

**Key words:** Laser applications, Prosthodontics

### Introduction

The laser word consists of the initials of the words “Light Amplification by Stimulated Emission of Radiation”. The meaning is to emit radiation and emit light. It is distinguished from normal lights by some features resulting from the way in which the laser light is acquired. These features can be summarized as being monochromatic, collimated, and coherent. The main characteristic used in medicine and dentistry is monochrome [wavelength]. In this regard, surrounding tissue damage may be minimal when affected by laser-targeted tissues [1,2].

### History

The first laser was used in dentistry in 1960 by Maiman Ruby. With the discovery of a “pulsed” laser beam at the end of the 1980s, thus, distorted or abnormal tissues were selectively removed, ensuring that healthy environmental tissues were not damaged. By the development of scanner computer systems at the beginning of the 1990’s, it was possible to control laser beams with these systems, and

in 1990, the FDA announced a pulsed Nd: YAG laser for intraoral soft tissue surgery. Developed by Myers and Myers, the first laser designed for general dentistry was called dLase 300, it was manufactured by California Sunrise Technology [1,3].

### Physical Science

An acronym “LASER” contains three different phenomenon which occurs during the formation of an atomic spectral line are Spontaneous emission, Stimulated emission, and Absorption which described by Albert Einstein in 1916 [4]. A laser is a device that transfer electrical or chemical energy into a very thin, intensive light energy beam that transforms into visible, dense, small, almost identical monochromatic radiation [5]. The laser light used for dental procedures is a type of electromagnetic energy that have manner like a particle wave. This basic unit of energy called photons. Normal light and laser energy [or “laser light”] differs significantly. The

ordinary light, which usually appears white, is the sum of many colors of the visible spectrum, such as purple, blue, green, yellow, orange and red, but the laser energy is one single color and this feature called monochromatic [5,6].

**Amplification:** Amplification is part of a process that occurs in the laser. Lasers are generically named according to the active medium, which can be a gas, a crystal, or a solid-state semi-conductor. The generation of electromagnetic energy done by excitation of an active medium which may be argon, CO<sub>2</sub>, neodymium, erbium, aluminum or yttrium that provide the source of energy. It is raised by two mirrors which are placed parallel at each end of the optical cavity and emerges as laser light [5,6].

**Stimulated Emission:** The smallest unit of energy, is occupied by the electrons of an atom or molecule, creating a short excitation; then a quantum is released, a process called spontaneous emission. The mirrors at each end of the active medium revert the photons back and forth to allow the emission of the laser beam [5,6].

**Radiation:** Refers to the light waves produced by the laser as a particular form of electromagnetic energy. The very short wavelengths below approximately [300 nm] are called ionizing [5,6].

The photon wave that moves at the speed of light can be defined by two properties. The first property is the wavelength, which is the distance between any two significant points on the horizontal axis of the wave. The second property is the amplitude, which is the total height of the wave hesitation from the peak top to a vertical axis zero line [9,10]. Tooth laser wavelength's usually measured in micron [10<sup>-6</sup> meters], or nanometer [10<sup>-9</sup> meters] [6]. Figure 1 graphically shows both the amplitude and the wavelength.

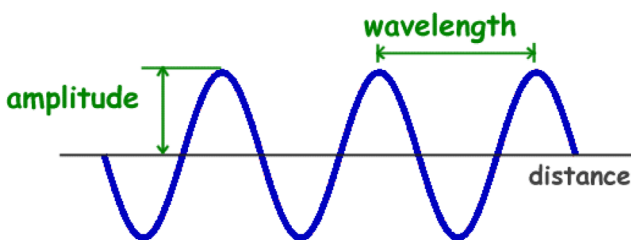


Figure 1: Graphic Pattern of Amplitude and Wavelength [6].

**Components of Laser System**

Laser light has four main properties that differentiate it from normal light. They are:

- 1) **Collimation:** Refers to the beam having specific spatial boundaries which ensure that there is a constant beam size and shape that is emitted from the laser unit.
- 2) **Coherence:** A unique property of lasers that states that they have identical frequency and identical wavelength.
- 3) **Monochromatism:** The property of lasers that it possesses one specific color which is finely focused.
- 4) **Efficiency:** At very low average power levels lasers can produce the required energy to perform their specific function [5,7].

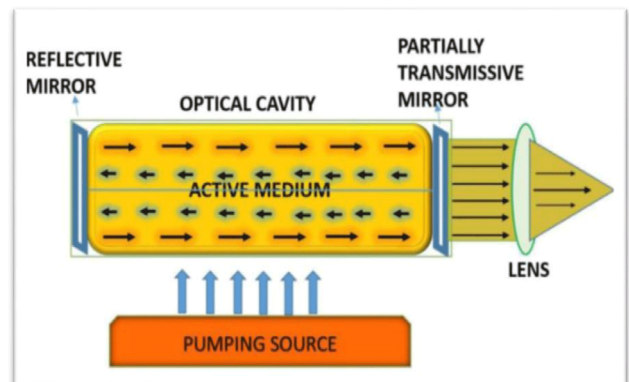


Figure 2: Basic Components of a Laser [4].

**The Laser Device Consist of Six Major Components (Figure 2):**

1. **Active Medium:** It is an optical cavity that contains chemical compounds, substances or molecules at the center. A laser medium that can be a solid, liquid or gas. This medium is what specifies the wavelength of the light emitted from the laser and the laser is named after the medium.
2. **Pumping Mechanism:** Optical cavity is surrounded by a pumping unit which is either an arc light or a flash light for excitation, or it can be an electromagnetic coil or diode unit which is a device with two terminals that allows the flow of current in one direction only.
3. **Optical Resonators:** They are usually polished surfaces or two mirrors which are designed parallel at each end of the optical cavity. The function of the optical resonators is to produce amplification and collimation of the developing beam [4,8].
4. **Cooling System:** A heat is generated during the production of laser energy. So a cooling system is used to decrease the temperature of the components.

- 5. **Control Panel:** It is used to control unsteady parameters for the output of the laser.
- 6. **Delivery System:** It is a system through which laser reaches its targeted site. Examples are articulated arm, a hand-piece, a flexible hollow wave guide or a quartz fiber-optic [4,8].

**Laser tissue Interaction**

Laser interacts with the target tissue in four different ways, depending upon the optical properties [Figure 3]:

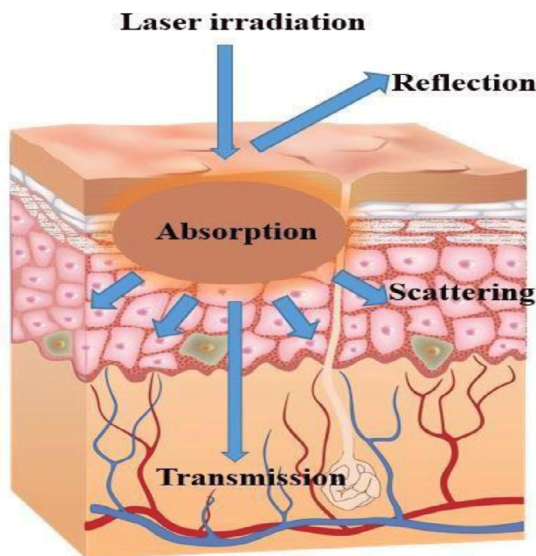


Figure 3: Laser Interaction with tissue

**1- Absorption**

The first effect of laser which means that the amount of energy absorbed by the tissue depends primarily on the tissue properties such as water content, the presence of pigments, laser wavelength and emission modes. In general, shorter wavelengths [500-1000 nm] are easily absorbed in pigmented tissue and blood components [1,4,6,7].

**2- Transmission**

The second effect is that the laser energy directly through the tissue with no effect on the target tissue, inverse of absorption. This effect is also dependent on the wavelength of laser light.

**3- Reflection**

The third effect is reflection, light is diffuse outward from the tissue surface. The target energy to be transmitted

to the tissue cannot reach the desired amount. The mirrored reflection is more than dentin and gingiva.

**4- Scattering**

The fourth effect is a scattering of the laser light which weakens the intentional energy and possibly produces no useful biological effects, instead scattering causes heat transfer to the tissue adjacent to the surgical site, and unwanted collateral damage could occur [1,4,6,7] [Table1].

| Laser                | Chromophore          |
|----------------------|----------------------|
| Erbium laser         | Water > tooth enamel |
| Carbon dioxide laser | Tooth enamel > water |
| Diode laser          | Hemoglobin > melanin |
| Nd-YAG laser         | Melanin > hemoglobin |

**Classification of Laser:**

1. **Classification According to Laser Active Material:**
  - α) Solid State Lasers: Nd: YAG, Ho:YAG, Er:YAG, Ruby, Alexandrite, Er:Cr:YSGG.
  - β) Gas Lasers: CO<sub>2</sub>, Argon, Krypton, Eximer lasers, He-Ne.
  - χ) Liquid Lasers: Dye Laser.
  - δ) Semiconductor Lasers: Diode Lasers [1].
2. **Classification by Laser Movement:**
  - a) Continuous light sources: means that energy is emitted constantly for as long as the laser is activated. Carbon dioxide and diode lasers operate in this manner
  - b) Pulsed light: pulses are produced by a flash lamp, where true pulses on the order of a few ten-thousandths of a second emanate from the instrument. Nd:YAG, Nd:YAP, Er:YAG, and Er:Cr:YSGG devices operate as free-running pulsed lasers [6].
3. **According to Level of energy emission:**
  - α) Low Level Laser [LLL]: A thermal low energy laser emitted at wavelength, which are supposed to stimulate cellular activity leading to pain reduction, modulation of inflammation, and soft tissue biomodulation.
  - β) High Level Laser [HLL]: Thermal lasers emitted at wavelength in the visible infrared and U.V range, are used in surgical procedures to cut, coagulate, vaporize, composite polymerization, microbial reduction, final caries removal, enamel/dentin etching, internal

ceramic conditioning, crown lengthening and welding purposes. Example: Er:YAG laser, Nd:YAG laser [6,8].

**4. According to The Range of Wavelength:**

- α) The ultraviolet spectrum range [approximately below 400nm].
- β) The visible spectrum range [approximately 400-700nm].
- γ) The infrared spectrum range [approximately 700 nm to the microwavespectrum] [1,4,6,8].

**Types of Lasers Used in Dentistry:**

**Argon [487-514 nm]:**

Argon is laser with an active medium of argon gas that is activated by a high-current electrical discharge. It's the most widely used ion laser. These lasers have two emission wavelengths visible. The First; [488 nm] wavelength and blue color. The second is a blue-green color with a wavelength of [514 nm]. Those with a wavelength of [514 nm] are absorbed very much in soft tissue. These properties have effects in retraction and hemostasis of the gingival tissue [1,5,11].

**Carbon Dioxide Laser [10600 nm]:**

The active substance is gas. It's soft tissue laser. The light energy, whose wavelength is [10,600 nm] has a very high absorption by water, occurring in rapid soft tissue removal and hemostasis with a shallow depth of penetration, which is important when treating mucosal lesions especially for cutting dense fibrous tissue [5,12]. Although, it has highest absorbance of any laser. Evaporation of the necrotic area is formed at a depth of around [0.5 mm] and capillary coagulation occurs in the veins and bleeding tendency is very low. The CO<sub>2</sub> laser that most absorbed by hydroxyapatite; about 1000 times greater than the Er series of lasers [5.12.13].

**ND:YAG Neodymium-Doped Yttrium Aluminum Garnet Laser [1064 nm]:**

Nd: YAG laser has a solid active medium, which is a garnet crystal combined with rare earth elements yttrium and aluminum, doped with neodymium ions. The Nd:YAG wavelength highly absorbed by pigmented tissue and is about 10,000 times more absorbed by water than an argon laser. Common clinical applications are for cutting and coagulation of dental soft tissues with good hemostasis. Nd: YAG laser energy is absorbed slightly by dental hard tissue;

but there is little interaction with sound tooth structure, which make tissue surgery adjacent to the tooth to be safe and precise. They can be used with or without contact. Since it can only be a few millimeters in diameter when used non-contact, it can be used to provide hemostasis, aphthous ulcer treatment or pulp sensitivity. Since Nd: YAG laser light is easily absorbed by amalgam, titanium and unworthy metals, it has been reported that careful study of the presence of these materials is required [1,5,8,12,13].

**Diode Laser [800-980 nm]:**

The Diode is a solid active medium laser consist of semi-conductor crystals using some combination of aluminum or indium, gallium, and arsenic. This chip of material has optical resonator mirrors joined to its ends, and an electrical current is used for pumping mechanism. The available wavelengths for dental use range from [800-980 nm]. All the diode wavelengths are very well absorbed by pigmented tissue, although hemostasis is not quite as rapid as with the argon laser. It is poorly absorbed by tooth structure so that soft tissue surgery can be performed safely in close proximity to enamel, dentine and cementum. For that it is an excellent soft tissue surgical laser indicated for cutting and coagulating gingiva and mucosa and for soft tissue curettage, or sulcular debridement [5,8].

**Erbium Laser:**

The erbium family of laser has two wavelengths:

- α. Er:Cr:YSGG [2790 nm] has an active medium of a solid crystal of yttrium – scandium – gallium-garnet that is doped with erbium and chromium.
- β. Er:YAG [2940 nm] has an active medium of a solid crystal of yttrium-Al-Garnet that is doped with erbium.

They have the highest absorption in water of any dental wavelength and have a high affinity for hydroxyapatite. These lasers are ideal for caries removal and tooth preparation when used with a water spray. In addition to hard tissue methods, erbium lasers can be used for soft tissue ablation because the dental soft tissue carry a high percentage of water, but the hemostatic ability is limited [1,5,8,12].

**Factors Affecting Tissue Absorption of Laser Light:**

*There are several factors affecting tissue absorption of laser light.*

- a) Laser wavelength
- b) Tissue composition



- c) Tissue thickness
- d) Surface wetness
- e) Angle of beam
- f) Exposure time
- g) Contact mode of laser [14]

**Table 2: Classification According to the Lasing Medium [5]**

| Laser Type        |                               | Wavelength | Color        |
|-------------------|-------------------------------|------------|--------------|
| Eximer Laser      | Argon fluoride                | 193 nm     | Ultraviolet  |
|                   | Xenon chloride                | 308 nm     | Ultraviolet  |
| Gas Laser         | Argon                         | 488 nm     | Blue         |
|                   |                               | 514 nm     | Blue-Green   |
|                   | Carbon dioxide                | 20600 nm   | Infrared     |
|                   | Helium Neon                   | 637 nm     | Red          |
| Diode Laser       | InGaAsP                       | 655 nm     | Red          |
|                   | GaAlAs                        | 670-830 nm | Red infrared |
|                   | GaAs                          | 840 nm     | Infrared     |
|                   | InGaAs                        | 980 nm     | Infrared     |
| Solid State Laser | Frequency doubled Alexandrite | 337 nm     | Ultraviolet  |
|                   | Potassium Titanyl Phosphate   | 532 nm     | Green        |
|                   | Neodymium: YAG                | 1064 nm    | Infrared     |
|                   | Holmium: YAG                  | 2100 nm    | Infrared     |
|                   | Erbium, Chromium: YSGG        | 2780 nm    | Infrared     |
|                   | Erbium: YSGG                  | 2790 nm    | Infrared     |
|                   | Erbium: YAG                   | 2940 nm    | Infrared     |

**Laser Energy and Tissue Temperature**

When the tissue is exposed to the temperature above normal, the initial phase hypothermia occurs, but the tissue is not destroyed. Denaturation and coagulation of the protein occurs approximately at 60°C. The clinical practitioner can remove the granulomatous lesion by utilizing the laser parameters within the temperature range, without vaporization of the surrounding tissue. Adherence of the tissue layers occurs at 70°C to 80°C. At 100°C, vaporization of the water within the tissue occurs.

The ablation starts at this temp but the dental tooth structures will not be ablated. At about 200°C, dehydration is complete and the tissue carbonizes [Table 3]. Continuous application of laser produces carbonization of the tissue which prevents normal tissue ablation, causing tissue necrosis [1,6]

**Table 3: Summary of Thermal Effects on Soft Tissue [6].**

| Tissue Temperature [C] | Observed Effect                      |
|------------------------|--------------------------------------|
| > 37                   | Hyperthermia                         |
| > 50                   | Non-sporulating bacteria inactivated |
| > 60                   | Coagulation, Protein denaturation    |
| 70-80                  | Tissue welding                       |
| 100                    | Vaporization                         |
| >200                   | Carbonization                        |

**Applications of Laser in Prosthodontics:**

**1. Laser in Fixed Prosthodontics:**

**1.1 Crown lengthening:** During the smile design procedures crown lengthening procedure are specified within esthetic zone. It refers to the surgical exposure of longer gingivoincisor length. Crown lengthening methods with the help of lasers are included in following situation:

- a) Caries at gingival margin.
- b) Cuspal fracture extending apically to the gingival margin.
- c) Endodontic perforations near the alveolar crest.
- d) Insufficient clinical crown length.
- e) Need to develop a ferrule.
- f) Unaesthetic gingival architecture.
- g) Cosmetic enhancements.

Erbium lasers provide to be a best tool for bone removal without raising a flap, in another hand all other methods has disadvantages in surgical approach and long healing time, post healing gingival margin position is suspicious with more patient compliance as it needs use of anesthesia and scalpel for electro-surgery, the heat generated has effect on pulp and bone leading to pulp death or bone necrosis [4,5].

**1.2 Tooth preparation:** Er: YAG laser is the choice of treatment for preparing dental hard tissues. The Er: YAG laser anesthetize the tooth, so there is usually no need for anesthetic. A high-speed hand piece may cause microfractures in the enamel, whereas there is no risk of microfracture with the laser.

**1.3 Gingival troughing:** Lasers such as [Diode, Nd:YAG, and Er:YAG] can be used to produce a groove around a tooth before getting the best cosmetic results to get the impression. The use of the traditional double cord technique takes time and can damage the periodontium.

Electro surgery also has a disadvantage of delayed wound healing, bone recession etc. Laser allows the gingival margin clearly seen with minimal bleeding and reduce patients visit and also quite acceptable for them [4,5,8].

**1.4 Soft tissue management around abutments:** Argon laser energy has the highest absorption in the hemoglobin, thus providing excellent hemostasis and well-regulated coagulation and evaporation of oral tissues. These properties are useful for retraction and hemostasis of gingival tissue as an impression taking during a crown and bridge preparation.

**1.5 Modification of soft tissue around laminates:** Removal and re-contouring of gingival tissue cover can be easily effective with an argon laser. The laser can be used as a primary surgical instrument to separate the excess gingival epithelium from the secondary to medication or orthodontic treatment. The laser separates the tissue and provides hemostasis and the tissues join the wound [4,5,8].

**1.6 Formation of ovate pontic sites:** Inappropriate pontic site causes pontic design that is not aesthetic and does not clean itself. Soft tissue surgery can be obtained with the soft tissue lasers and lasers can be provided with erbium family and bone surgery.

**1.7 Laser phototherapy:** The 660 nm laser [LLLT], such as GaAlis used in the gingival surrounding the crown preparation to support soft tissue biomodulation in gingival sulcus Thus, there should be no inflammatory signal in the gingival tissue before the last luting procedure [4].

**1.8 Dentinal decontamination:** [HLLT] is used as a final step before final cementation of the crown due to their better penetration and microbial inhibition properties in dental clinic tissues [4].

**1.9 Removal of veneer:** The laser energy is transmitted from the ceramic glass and absorbed by the water molecules present in the adhesive. De-bonding occurs at the silane-resin interface. The technique lasts approx. Based on the thickness of the ceramic restoration, two seconds to two minutes for ceramic restorations without causing trauma to the underlying tooth [4,5].

**1.10 Altered passive eruption management:** Lasers can be easily made to control passive eruption problems. When the patients have too short clinical crowns or when they have a gingival line creating an irregular smile, excessive tissue can be removed without the need for blade incisions, flap reflection, or suturing [4,5].

**1.11 Crown fractures at the gingival margins:** Er:YAG or Er:Cr:YSGG lasers can be moved out for accurate exposure of the fracture margin.

**1.12 Bleaching:** Aesthetics and smile are the main condition in our modern society. Bleaching of teeth can be provided in Dental OPD. Diode lasers are used to bleach teeth without causing more teeth sensitivity and altering the tooth color [4,5].

## 2. Laser Implantology

Dental lasers are used in implantology for methods such as implant rescue, preparation of the implant site, and separation of diseased tissue around the implant. The advantages include increased hemostasis, minimal damage to surrounding tissue, reduced infection, reduced swelling and reduced postoperative pain [3,5].

**2.1 Second stage uncovering:** CO<sub>2</sub> laser and almost any type of laser are used to remove the overlying soft tissue. Due to minimal blood contamination and tissue contraction, an immediate impression can be obtained after the second stage of surgery [4,5].

**2.2 Implant site preparation:** Removal of the overlying structure of the implant site results in faster recovery process, better integration, minimal patient complaints and more bone contact with the implant [4,5].

**2.3 Removal of diseased tissue around the implant:** Lasers can be used to restore implants by sterilizing their surfaces with laser energy. For this reason, diodes, CO<sub>2</sub> and Er:YAG lasers can be used. In the case of inflammation around an Osseointegrated implant, lasers can be used to remove the granulation tissues [4,5].

## 3. Laser in Removable Partial Denture Prosthodontics:

The creation of removable partial and partial prostheses depends on the preoperative analysis of supporting hard and soft tissue structures and their appropriate preparation. Lasers can now be used to perform most pre-prosthetic surgeries. These methods include hard and soft tissue tuberosity reduction, torus removal and treatment of unsuitable residual residues containing undercuts and irregular resorbed ridges, treatment of unsupported soft tissues, and hard and soft tissue malformation [5].

**3.1 Treatment of unsuitable alveolar ridges:** Unstable dentures due to the stress bearing area increase the load on the natural tissue structures that are not fully

treated with soft liners. Soft tissue lasers have been used today to perform surgery to divulge hard tissue such as bones in various soft tissue wave lengths. [CO<sub>2</sub> laser, diode, Nd:YAG]. Erbium lasers are usually made for hard tissue treatment procedures [5].

**3.2 Treatment of enlarged tuberosity:** The soft tissue hyperplasia and alveolar hyperplasia are the most common cause for enlarged tuberosity usually, the expand tuberosity may obstacle the distal extension of the upper and lower dentures which may affect their mastication and strength. The Soft tissue depletion can be accomplished by any of the soft tissue lasers [5,8].

**3.3 Treatment of tori and exostoses:** Prosthetic problems may arise if maxillary torior exostoses are large or irregular in shape. Tori and exostoses are consistmainly of compact bone. [Er:YAG] laser is the first treatment option to alleviate bony protrusions. The main advantage of using anEr: YAG laser is the lack of smear layer production that interferes with overheating, decontamination, biostimulation and healing processes [5,8].

**3.4 Treatment of denture stomatitis:** [DS] is a chronic candidal infection associated with 60% to 65% of denture wearers. Laser beam not only helps in ablation of superficial candida contaminated epithelial surface, but also prevents inflammation of adjacent normal mucosa. Since the laser itself acts as veridical and bactericidal, no postoperative antibiotic or non-steroidal anti-inflammatory drugs [NSAID] prescription will be required [5,8].

**3.5 Treatment of other complications which effect on the removable prosthodontics:**

- α) **Fibroma:** Fibrous tissue can be created due to sharp denture flange or excessive pressure of posterior palatal seal area which causes permanent damage to the tissue [4].
- β) **Frenectomy:** The presence of high labial frenulum [median or laterals] may cause instability of the prosthesis and should be removed to increase the retention of it [4].
- χ) **Epulis Fissuratum:** It's caused by the chronic irritation of the tissue leading to overgrowth of the mucosa in CD wearing patients [4,8].
- δ) **Vesituplasty:** It is selected when prosthetic stability is poor because of mandibular or maxillary crest atrophy and a small vestibule length. CO<sub>2</sub> technology provides a simple and safe process [4,8].

#### 4. Laser in Removable Complete Denture Prosthodontics

- α) Analysis of occlusion by CAD/CAM.
- β) Analysis of accuracy of impression by the laser scanner.
- χ) Prototyping and computer aided design and computer aided manufacturing [CAD/CAM] technology [7].

#### 5. Laser Applications in Dental Laboratory:

- a) Laser titanium sintering – direct metal laser sintering.
- b) Laser ablation of titanium surfaces.
- c) Laser assisted hydroxyapatite coating.
- d) Laser welding of titanium components of the prostheses [7].

#### 6. Laser in Maxillofacial Prosthodontics:

- α) Planning the shape and position of the prostheses.
- β) Three-dimensional acquisition of optical data of the extra oral defects - selective laser sintering technology [7].

#### 7. Applications of Soft Laser on Dentistry:

Low-level laser therapy [LLL] is also known as “soft laser therapy” and bio-stimulation. It has beneficial effect on pain relief, wounds, and nerve injury [16].

##### 7.1 Application on Soft Tissue:

- a) Aphthous ulcers
- b) Herpes simplex infections
- c) Oral lichen planus
- d) Xerostomia
- e) Mucositis
- f) Periodontitis

##### 7.2 Application on Hard Tissue

- α) Dental hypersensitivity
- β) Temporomandibular disorders
- χ) Pain during orthodontic tooth movement
- δ) Sterilization of hard tissue
- ε) Bone implant interface [16].

#### Laser Safety in Dental Practice:

Dental practitioners, producers, educators and scientists are responsible for the practical application of

dentistry. When appropriate training and appropriate precautions are taken, lasers can be used safely for the mutual benefit of both the patient and the dentist [17].

**Classification of Lasers and Associated Hazards:**

The US Food and Drug Administration [FDA] Devices and Radiological Health Center [CDRH] sets out the standards governing laser production in the Federal Regulations Code [CFR]. All laser devices are divided into four classes according to their total energy output and wavelength [Table 4]. Lasers used in dentistry generally fall into the class IV category, which is considered the most dangerous laser group [18,19].

| Class | Description  |
|-------|--|
| I     | Low powered, safe to view.   |
| IIa   | Low powered, visible, cannot produce any known eye or skin injury during operation based on a maximum exposure time of 1,000 seconds.  |
| IIb   | Low powered, visible, incapable of emitting laser radiation at levels that are known to cause skin or eye injury within the time period of the human eye aversion response [0.25 sec]. |
| IIIa  | Medium powered, visible, harmful, if viewed less than 0.25 seconds without magnifying optics.  |
| IIIb  | Medium powered, hazardous, if viewed directly.   |
| IV    | High powered (> 0.5 W), ocular, skin and fire hazards e.g. lasers used in dentistry].  |

**Laser Hazards Encountered in Dentistry:**

- a) Ocular hazards
- b) Tissue damage
- c) Respiratory hazards/environmental hazards
- d) Combustion hazards [fire and explosion]
- e) Electrical hazards [shock] [18].

**Personal Protective Equipment:**

All persons present during dental treatment should wear eye protection, including the patients. When choosing protective eyewear, several factors must be considered, they are as follows:

- a) Wavelength of laser emission.
- b) Maximum permissible exposure limits.
- c) Degradation of absorbing media or filter.
- d) Optical density of the eyewear.
- e) Radiant exposure limits.
- f) Need for corrective lenses.
- g) Multiple wavelength requirements.
- h) Restriction of peripheral vision.
- i) Comfort and fit [17].

**Conclusion**

Since the introduction of dental lasers, lasers have been used for preserving and curing complex resin in areas, photo activated in office bleaching, and fluoroscopic examination of adjacent caries. Lasers are currently used as a preferred treatment method in all areas of dentistry. It is used routinely for gingivectomy and prolonged chronotherapy as preparation for prosthetic dentistry. Ongoing research shows many benefits of laser therapy. The ability to perform less invasive procedures with greater patient comfort is something that the modern dentist should consider. Training has been required to use these devices effectively and safely.

**Ethics**

**Peer-review:** Internally peer-reviewed.

**Authorship Contributions:** Concept: A.V., G.C., G.E., Design: A.V., Data Collection or Processing: A.V., G.C., G.E., Analysis or Interpretation: A.V., G.C., G.E., Literature Search: A.V., G.C., G.E., Writing: A.V., G.C., G.E.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study received no financial support.