APPLICATION OF LASERS IN CLINICAL DENTISTRY

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Abstract

Laser light is monochromatic, directional and coherent. Laser is one of the most captivating technologies in dental practice. Albert Einstein theorized a phenomenon termed as "Stimulated emission'', the principle on which all lasers work. All lasers are named based on the active medium that is responsible for stimulating them.. The active medium can be a gas, a liquid or a solid state crystal rod or a semiconductor (diode lasers). These highly directional and monochromatic laser lights can be delivered on to target tissue as a continuous wave, gated-pulse mode or free running pulse mode. Various laser delivery systems are -Articulated arms, Hollow waveguides, Fiber optics. Among which later one is system of choice for most of lasers. This article gives an insight on laser science and instrument used in dentistry. Lasers are impressive potential treatment modality for variety of clinical conditions. This article profile several clinical application in clinical dentistry.

Keywords: Stimulated emission, Gated-pulse, Laser fluorescence, Photo mechanical

1. Introduction:

Lasers are devices that produce beams of coherent and very high intensity light. The word LASER is an acronym for "Light Amplification by Stimulated\Emission of Radiation". A crystal or gas is excited to emit light photons of a characteristic wavelength that are amplified and filtered to make a coherent light beam. The effect of the laser depends upon the power of the beam and the extent to which the beam absorbed. Several types of lasers are available based on the wavelengths. These range from long wavelengths (infrared), to visible wavelengths, to short wavelengths (ultraviolet), to special ultraviolet lasers called excimers [1,2]. Lasers are used nowadays in many areas in the field of dentistry It is of the most captivating technologies in dental practice. Even though, introduced as an alternative to the traditional halogen curing light, laser now has become the instrument of choice, in many dental applications. Its advancements in the field of dentistry are playing a major role in patient care and well being.

2. History:

The first laser, a synthetic ruby laser, was introduced in the early 1960's by Theodore Maimann[3]. The first experiment with this was a study done to evaluate its effect on human caries. The results of that study showed that the effects varied from small 2 mm deep holes to complete disappearance of the carious tissue, with some whitening of the surrounding rim of enamel, indicating extensive destruction of carious areas along with crater formation and melting of dentine [4]. As a result, ruby lasers soon lost favour. The Nd: YAG laser was developed in 1964, by the Bell Telephone Laboratories. Though it was created a year after the ruby laser, it was overshadowed both ruby laser and the CO2 laser and it was only made available in the 1990's for dental use[5].The CO2 laser was invented by Kumar N Patel when working at Bell Telephone Laboratories. It was perhaps the first laser that truly had hard and soft tissue applications[6]. In 1971, Weichmann and Johnson were the first to use lasers in Endodontics. They unsuccessfully tried to seal the apical foramen with a high power CO2 laser. It was an in vitro study[7].Further work in the 1970's focused on the effects of neodymium (Nd) and carbon dioxide (CO2) lasers on dental hard tissues. Early researchers found that CO2 lasers produced cracking and disruption of enamel rods, incineration of dentinal tubule contents, excessive loss of tooth structure, carbonization and fissuring and increased mineralization caused by the removal of organic contents[8]. It was also reported that the use of the CO2 laser was unfavourable because of the loss of the odontoblastic layer[9]. Both Hibst and Paghdiwala were the first to describe in detail the effect of the Er:YAG laser on dental hard tissues in 1988[10]. However, it was not until1997, that this laser obtained the US FDA approval for cavity preparation. Kavo was one of the first companies to release this laser into the market in1992. Subsequently, the second erbium hard tissue wavelength (Er: YSGG, 2.78 micro meter) was developed and marketed by Biolase (USA). The erbium family of laser has an emission wavelength which coincides exactly with the absorption peak of water, giving strong absorption in all biological tissue, including enamel and dentine **.**The recent rapid development of lasers, with different wavelengths and onboard parameters may continue to have major impact on the scope and practice of dentistry.

3. Principle of lasers:

Albert Einstein, in 1917, first theorized about the process called "Stimulated Emission". Light energy can induce energy transition in atoms causing the atoms to move from their current state

(EO) to the excited or activated state. This is due to the absorption of a quantum of energy by the atom. This is called ‘stimulated absorption’. As the lowest energy state is the most stable, the excited atoms tend to return to normal by spontaneously emitting a quantum of energy called ‘spontaneous emission’[10].This conversion to a low energy state can also be achieved by stimulating the activated medium further by a quantum of light at the same transition frequency. This is called ‘stimulated emission’. During this process it releases a photon of the same size as of the released atom, which hits against the adjacent activated atom, setting off a chain reaction of releasing photons. This is the principle on which all lasers work[3].

Water absorption is most important factor influencing conversion of energy for surgical laser operating in infrared spectrum. Most tissues are 60-80% water, as a result, degree of water determines laser’s ability to penetrate biological tissue.

4. Different types of lasers used in Dentistry:

Dental lasers are named depending upon the active medium that is stimulated. The active medium can be a gas (e.g. argon, carbon dioxide), a liquid like dyes or a solid state crystal rod e.g. Neodymium yttrium aluminum garnet (Nd: YAG), Erbium yttrium aluminum garnet (Er: YAG) or a semiconductor (diode laser).

The following lasers can be used in high powers, from a fraction of a watt to 25 watts or even more.

4.1) The Erbium: YAG laser possesses the potential of replacing the drill. This laser is also used to alter pigmentation in the gingival tissues, providing the patient with pink gums. This laser is commonly used to prepare the patient for a cavity filling.

4.2) The Carbon Dioxide laser can be used to perform Gingivectomy and to remove small tumors. As a laser that does not require local anesthesia, it poses no discomfort for the patient and is practically a bloodless procedure.

4.3) The Argon laser is used in minor surgery. This gas laser releases blue-green light through a fiber optic cable to a handpiece or microscope.

4.4) The Nd: YAG is used in tissue retraction, endodontics and oral surgery. This laser usually does not require anesthesia. For procedures regarding the gingiva pockets, the dentist will insert the fiber between the gingiva and the tooth to sterilize and stimulate the tissue, causing the gingiva to adhere to the neck of tooth.

4.5) The diode laser— introduced in the late1990s—has been effective for oral surgery and endodontic treatment. This laser also helps treat oral cavity disease and corrects aesthetic flaws. As a compact laser, the diode is used for soft tissue procedures.

4.6) Low level lasers— less well-known— are smaller and less expensive. Sometimes referred to as “soft lasers” the therapy performed by these lasers is called “low level laser therapy.” Low level lasers improve blood circulation and regenerate tissues.

4.7) Holmium: YAG laser - This has been approved by the FDA to be used on the hard tissues of primary teeth[15].

5. Laser delivery

For a laser to be useful in clinical practice, it must be able to effectively deliver laser energy to the target site. Early delivery systems were too bulky or cumbersome to use in the oral cavity. Fiber optics were introduced into medicine as early as 1954 by Kapany, who developed the

endoscope11.Early fiber optic systems had high-energy losses, and were incapable of delivering the mid-infrared laser wavelengths efficiently, and thus most early mid infrared lasers used alternate delivery systems. The existing range of laser delivery systems includes:
5.1) Articulated arms (with mirrors at joints) – for UV, visible and infrared lasers
5.2) Hollow waveguides (flexible tube with reflecting internal surfaces) – for middle and far infrared lasers.
5.3) Fiber optics – for visible and near infrared lasers

Fiber optic delivery systems are presently the delivery system of choice for most lasers as they can deliver laser energy to most parts of the oral cavity and even within the complex root canal system. Fiber optics can deliver laser energy in a forward direction, with minimal divergence from the bare end of a plain tip. This is useful in cases like cavity preparation or certain soft tissue surgery; however the minimal divergence mean that it is difficult to transfer energy laterally and hence may be of limited use for applications such as root canal treatment. Recently a number of fiber optic modifications have been proposed that may be effective in delivering laser energy laterally [12, 13] All the invisible dental lasers are equipped with a separate aiming beam, this coaxial laser beam which can either be either a laser or conventional light. [14]

6. **Mechanism of laser action**

The action of lasers on dental hard and soft tissue as well as bacteria depend on the absorption of laser tissue by chromphore (water, apatite minerals, and various pigmented substances) within the target tissue. Better absorption allows for a more efficient photo-thermal sterilization, ablation of dentine etc. The principle mechanism of action of laser energy on tissue is photothermal[15], other mechanisms may be secondary to this process (rapid heating of water molecules within enamel causes rapid vaporization of the water and build up of steam which causes an expansion that ultimately over comes the crystal strength of the dental structures,
and the material breaks by exploding this process is called ablation) or may be totally independent of this process. The following are the possible mechanisms of laser action:
6.1) Photo-thermal ablation: This occurs with high powered lasers, when used to vaporization or coagulate tissue through absorption in a major tissue component
6.2) Photo-mechanical ablation: Disruption of tissue due to a range of phenomena, including such as Shock wave formation, Cavitations etc.
6.3) Photo-chemical effects [16-21] (Using light sensitive substances to treat conditions such
as cancer) Factors that influence the nature of the effect of lasers on tissue comprise the laser variables of wavelength, pulse energy or power output, exposure time, spot size (and thus energy density), and the tissue variables of physical and chemical composition (e.g. water content, density, thermal conductivity and thermal relaxation).[22]

7. **Clinical uses**

With the laser, there is little or no bleeding, which provides a dry operating field and excellent visibility. This, in turn, reduces operative time in most cases. In addition to sealing blood vessels, lymphatics also are sealed, which yields minimal postoperative swelling. Lasers offer the ability to easily negotiate curves and folds in the mouth, and depending on power settings and mode of delivery, they vaporize, coagulate or cut tissue. Pain is reduced to absent 90 percent of the time, apparently due to the sealing of nerve fibers. The other 10 percent will have pain of various intensities and time frames. In some procedures, such as the maxillary midline frenectomy, patients can be almost assured th at there will be no postoperative pain. There is little chance for mechanical trauma, lasers cause minimal scarring, and sutures are rarely needed.

Lasers cause reduction in bacterial counts and in some areas may sterilize the field as well. Therefore, in patients where bacteremias are important, the use of lasers may reduce risk. One of the biggest advantages of laser use is very high patient acceptance.

Below are listed clinically proven applications for dental lasers.

7.1)Biopsies:

Lasers are used effectively for both incisional and excisional biopsies[23-32].

An important principle to remember is that even though the clinician is using a laser, all the clinical principles of the respective procedure still apply. As with conventional biopsies using a blade, both normal and pathologic tissues should be taken. Using a focused mode for all the laser types, an incision is made in the area to be biopsied. An edge is grabbed with a tissue pick-up. Using traction/ counter traction, the lesion is undermined, removed, placed in the appropriate solution to be sent to pathology and subsequently read for histopathologic examination and diagnosis.

Once removed, in most instances no sutures are needed, and the laser wound is left to heal by secondary intention. Present over the wound site will be a char layer of varying degrees. It is recommended th at only a light char layer be applied, as heavy char layers lead to more patient discomfort.

7.2)White lesions:

Most white lesions can be removed with dental lasers once the biopsy has been taken or the diagnosis established. Examples would be lichen planus, benign mucous membrane pemphigoid and various hyperkeratotic growths. White lesions on the buccal mucosa, palate and especially the floor of the mouth can be easily ablated or "painted away" using lasers. For the various white lesion ablations, it has been our experience that the CO2 laser is the most applicable, due to its ability to ablate rapidly in the defocused mode with minimal underlying tissue damage. Also, at lower powers and in the defocused mode, the CO2 laser allows the tissue to whiten and blister and causes certain lesions to separate at the basement membrane, permitting the clinician to "laser peel" the lesion away. If more lesion remains, it can be further ablated or peeled. Itching and burning are often chief complaints accompanying these lesions. Post lasing, most of these patients are symptom-free for months to years. The clinical appearance of such lesions as lichen planus often improves quite dramatically. If symptoms do recur, the process is so benign th at patients often do not mind retreatment.[24,26,33 13,15,22]

7.3)Aphthous ulcers:

One of the more remarkable laser benefits is the ridding of the painful symptoms associated with aphthous ulcers. All laser wavelengths accomplish this with resounding success. The exact methodology is not known. It appears to be a trade off of an aphthous wound, which is painful, for a laser wound, which is not painful. Immediately after laser treatment patients experience relief. All lasers perform this procedure without anesthetic, and all are used in a defocused mode at lower power settings.[34]

7.4)Herpetic lesions:

As with aphthae, lasers also have been used for symptomatic relief of herpetic lesions. Again, theresults are immediate and the lesions tend to heal quicker. However, extreme caution should be taken in these cases as the herpetic virus may be transmitted through the laser plume. Therefore, the possibility of spread is possible, although there have been no reports in the dental literature of this. We do know th a t warty viruses are spread by way of the plume, so this extrapolation may be a high possibility. This author does not use lasers at this time for the removal of herpetic lesions. All lasers perform well here and, again, like aphthae, they are used atlower powers in a defocused mode.

7.5)Coagulation:

For coagulation of bleeding areas, coagulation of soft tissue graft donor sites or other small oral bleeders, lasers are excellent in controlling the bleeding. One of the biggest concerns to the dentist is postoperative bleeding from the donor site when performing soft tissue grafting. Once laser coagulation is achieved, the chances for postsurgical bleeding are minimal to non-existent. For active bleeding sites, argon, Nd:YAG and Ho:YAG are the lasers of choice in th a t order. To prevent later bleeding in non-bleeding areas, all lasers are applicable. To coagulate a bleeding site with a CO2 laser, the bleeding must be momentarily stopped. This is easily accomplished with pressure or anesthetic administration. [35,24,26,30-32]

7.6)Exposure of implants

(Stage II): Lasers can be used to uncover implants whether they be single or multiple, and work exceptionally well for this indication. Current research shows th a t NdYAG lasers, when used with a raw fiber, can cause damage to titanium implants.24 36 At the time of this writing, therefore, it is the author's opinion that the CO2 laser should be the only laser used for this application. The use of other wavelengths, non coated tipped, coated tipped, and air and water cooled NdYAG delivery systems need to be investigated for their effects on titanium implants. The CO2 laser simply vaporizes the overlying tissue until the surgical healing cap is reached. The opening can also be easily contoured and expanded as needed. When applicable, this eliminates the need for a flap, suturing and any postoperative discomfort th a t normally would be associated with this procedure. However, depending on the case, the need for apically positioning a flap or uncovering implants within osseous structures, conventional flap procedures must be adhered to.

7.7)Removal o f granulation tissue ("Clean out"):

All laser wavelengths mentioned can be used to remove granulation tissue either for periodontal "clean-out," or for degranulating any wound site present. In certain furcation areas, circumferential defects, intra bony defects, three-wall defects, etc., where stubborn tags can persist, lasers can be a useful aid in helping either to entirely degranulate or partially degranulate these areas. Caution must be taken not to damage root surfaces or osseous structures.

7.8)Frenectomy:

Whether for maxillary midline or lingual frenectomies, there is no better use for the laser than for these procedures. In the case of the maxillary midline frenum, using the CO2 laser, the frenum is simply vaporized away. In the case of the lingual frenectomy, the tip of the tongue is grasped, tension is placed and, from the greatest concavity of the frenum moving posterior, the frenum again is simply vaporized until the desired effect is achieved. Using the other wavelengths is ju st as effective, but requires more time as the frenum must be excised rath e r th an purely vaporized away. With CO2 lasing for these procedures, operative time is extremely brief, taking from 35 seconds to two or three minutes. The fact that no suturing is needed for either frenectomy is a tremendous advantage, as sutures do not have to be removed from non-keratinized movable oral mucosa, which can be difficult and irritating to the patient. [26,32]

7.9)Crown lengthening:

Lasers can be efficaciously used for crown lengthening related to excessive soft tissue or due to a passive eruption problem. When patients have either clinical crowns that appear too short or when there is an uneven gingival line producing an uneven smile, this excessive tissue can be easily and quickly removed without the need for blade incision, flap reflection or suturing. One must first sound the area to determine where the CEJ is relative to the crest of the tissue. If this distance is short, there is a good chance that the clinical crown and the anatomic crown are almost the same. Therefore, if this situation arises, conventional crown lengthening must be performed in order to assure that the biologie width is not violated.[27,37]

7.10)Distal wedge and tuberosity reduction:

For soft tissue distal wedge and tuberosity reduction procedures, lasers offer many advantages. One of the problems frequently associated with these conditions is minimal access for proper protocol, and no keratinized tissue, especially distal and lingual, to lower second and third molars. Furthermore, every clinician who has performed maxillary distal tuberosity reductions has faced the following scenario: Once the wedge is prepared and the tissue thinned, the flaps overlap. These, in turn, need to be further trimmed, often more than once—and often after further trimming, the flaps are too short. Also, these can be difficult areas for suturing access. Using the laser allows the operator simply to vaporize or cut away the tissue as needed until the desired resultis achieved. All laser advantages apply here.[26,27]

7.11)Scaling, root planing and curettage:

This is without doubt the most controversial issue facing laser dentistry today. There has been much talk of using dental lasers for periodontal scaling, root planing, curettage and pocket sterilization.37-41 The main concern is that, until recently, there has been no hard evidence to support this, or refereed studies to show what effects lasers have on the root, gingival attachment and the underlying osseous structures. Because the dentist is working in a relatively blind area with this application, and because some lasers penetrate further than others, there are some concerns about safety and efficacy. Current studies, although in vitro, indicate that raw NdYAG fibers, when in contact with root surfaces, show tracking, charring and poor fibroblastic attachment to root surfaces.[42] These studies need to be repeated with variation, with other modalities and with different angles of attack by fiber to root surface. Yet other studies using sapphire coated Nd YAG tips show that damage to lased root surfaces was negligible, and at certain energy levels mimics the type of calculus removal seen with conventional hand instrumentation[43].

7.12)Hypersensitivity:

All dental lasers have proved effective in reducing or completely eliminating temperature sensitivity, especially sensitivity to cold. The exact mechanism for the various wavelengths is not yet known. It would appear that lasers effectively seal the dentinal tubules in some way. For all wavelengths, lasers are used in the defocused modes and at low power settings. Although purely anecdotal, the results are not only overwhelming but come from numerous operators and institutions.

7.13)Gingivectomy:

When patients have tissue overgrowth or hyperplasias from various causes, lasers are effectively used to perform laser gingivectomies. Tissue overgrowths can occur secondary to medication side effects such as those from Dilantin, Cyclosporin, Procardia and others. They also may result from idiopathic causes, poor oral hygiene or from orthodontic appliances, with or without poor oral hygiene. With CO2 lasers, the excessive tissue is easily vaporized away, or cut away with argon, Nd:YAG or holmium.YAG wavelengths. For larger hyperplasias, the CO2 wavelength is the choice because of its speed. Depending on the delivery system, tooth protection is sometimes needed. This can be accomplished with a periosteal elevator or No. 7 wax spatula placed in the pocket or sulcus so th at when lasing is complete, the beam hits the instrument rath er than the tooth. For mentally handicapped adults and children, this is an outstanding modality, as it allows for a relatively benign postoperative course for a patient who otherwise doesn't fully understand why there may be bleeding, pain, etc.[26,32,44-46]

7.14)Gingivoplasty:

For either small tissue aberrancies, pseudo pockets seen after periodontal surgery and small areas of reverse tissue architecture with an otherwise healthy periodontium, all dental lasers are efficacious in performing the necessary gingivoplasty. These are extremely fast procedures, often requiring no local anesthetic or only a topical anesthetic and almost always causing patients no postoperative complications of any kind.[27,46,47]

7.15)Pre-prosthetic surgery:

For removal of epuli, inflammatory papillary hyperplasia, vestibuloplasty or other preprosthetic surgical needs, once again the lasers are a superb alternative to the conventional modalities. As an example, inflammatory papillary hyperplasia can be removed either with a blade or electrosurgery with positive results, but the laser offers the advantages of negotiating curves and folds easily, no bleeding during or after the procedure, a dry field, speed and minimal post-surgical pain and swelling. In removing an inflammatory papillary hyperplasia once an area is lased, the resulting char layer can be wiped away, the underlying tissue inspected and, if more tissue needs to be removed, this process of "lasing and wipe down" is repeated until the desired tissue removal achieved. For larger preprosthetic lesions, the CO2 laser is recommended because of its speed and with inflammatory papillary hyperplasias, because of its effectiveness in vaporization ability.[24-28,30,31,48]

7.16)Malignant lesions:

Malignancies found in the mouth can be removed with dental lasers. They offer the advantages of minimal bleeding, swelling and less post-surgical pain, especially considering that large areas of tissue often are removed. A potential advantage relates to the laser's ability to seal blood vessels and lymphatics. Depending on the lesion, the chance for seeding the lesion and subsequent metastasis may be minimized or eliminated. As with all malignancies operating protocol must be followed and other associated procedures strictly adhered to.[24,26,32,34]

7.17)Gingival troughing:

One of the newest applications for dental lasers is gingival troughing. Lasers can be used to create a trough around a tooth before an impression is taken. This can replace the need for retraction cord, electrocautery and the use of hemostatic agents. The results are predictable and efficient, minimizing impingement on the epithelial attachment, causing less bleeding during the subsequent impression, minimizing postoperative problems, reducing chair time and promoting a more predictable healing. All lasers have proved highly effective here.[47,49]

7.18)Composite curing:

Argon lasers have been shown to cure composite resins quite impressively. Studies a t the University of Utah and Creighton University showed that argon laser light cures composite material faster, while also enhancing the physical properties of resin restorative materials [50,51].

7.19)**Hemorrhage disorder patients:**

Lasers have been used effectively to treat patients who have various intraoral lesions compounded by hemorrhage disorders. These would include hemophilia, idiopathic thrombocytopenia purpura and Sturge-Weber syndrome. Although these patients are still cross-matched for blood, the laser advantages of minimal bleeding during and after the procedure and coagulation mean patients lose minimal amounts of blood.

7.20)Clinical Applications Of Lasers In Removable Prosthodontics:

The successful construction of removable full and partial dentures mainly depends on the preoperative evaluation of the supporting hard and soft tissue structures and their proper preparation[52]. Many preprosthetic surgeries including hard and soft tissue tuberosity reduction, torus removal, treatment of unsuitable residual ridges including undercut and irregularly resorbed ridges, treatment of unsupported soft tissues and other hard and soft tissue abnormalities can be easily corrected. Stability, retention, function and aesthetics of removable prosthesis may be enhanced by proper laser manipulation of the soft tissues and underlying osseous structures. Compared to conventional techniques, advantages of lasers include reduced treatment time due to less mechanical trauma and oedema, decreased bacterial contamination of the surgical site, reduced swelling scarring and wound contraction of the surgical site, excellent haemostasis with superior visualisation of the surgical site. Lasers also help treat problems of hyperplastic tissue and nicotinic stomatitis under the palate of full or partial dentures and ease the discomfort of epuli, denture stomatitis and other problems associated with long term wear of ill- fitting dentures[52]. Low level laser treatment is effective in the treatment of denture stomatitis as it decreases the growth of Candida albicans and reduces palatal inflammation[4]. Desensitising effect of dental lasers is effective in preparing occlusal seats for removable partial denture prosthesis[53]. Teeth prepared for rests or for aesthetics or recontoured to fit into an occlusal scheme can be hardened and made more resistant to decay with laser treatment.

7.21)Clinical Applications Of Lasers In Fixed Prosthodontics:

Low intensity laser treatment after tooth preparation has an anti- inflammatory and bio-stimulating action thus promoting better post operative pulpal health. Nd: YAG pulsed laser can be used to sensitize hyper sensitive prepared abutment teeth[54]. Gingival retraction with lasers causes better haemostasis and minimal gingival recession and accurate impressions compared to conventional techniques as reported in many studies[55]. Using an erbium laser to achieve the trough prior to placing an indirect restoration results in little or no post operative discomfort for the patient[56]. Contamination occurring during the provisional phase is eliminated by high intensity laser treatment and the tooth prepared for final cementation. High intensity laser curettage as a follow up every 3-6 months maintains optimal gingival health and aesthetics post crown or veneer cementation[57]. When removing bonded porcelain restorations in the past, a high speed drill with a diamond bur was the only option. Now, with lasers the restoration like veneers can be removed without cutting it off. The laser energy passes through the porcelain glass unaffected and is absorbed by the water molecules present in the adhesive. It appears that the de-bonding occurs at the silane- resin interface because the underlying tooth structure appears to be unaffected. The technique takes 5-30 seconds for Feldspathic and 2 seconds to 2 minutes for Pressed, depending on the thickness of the restoration. The intact restoration aids the technician for shade matching[59]. Nd:YAG laser is a successful tool to desensitize hypersensitive prepared abutment teeth in Fixed Prosthodontics. The recommended amount of tooth reduction for full coverage restorations can be accomplished using lasers, however it may take more time compared to rotary instruments*58*.

7.22)Lasers In Aesthetic Restorations:

Harmony of function, biology and appearance is paramount in creating long term results for patients, with the more challenging aspect being maintenance of gingival symmetry and health[60]. Lasers enable the clinicians to control gingival and osseous contours with added artistry in the pursuit of aesthetic dental principles and more efficient use of patient time and service experiences. Studies have shown that gingival and osseous crown lengthening to alter gummy smiles and meet the golden proportions are easily accomplished with lasers without having to lay a flap, suturing or damaging the bone. Though the thermal ablative qualities and coagulative results were similar to dental burs, from a patient’s perspective, the simpler procedure and uneventful healing time definitely improves patient acceptance. Melanin hyper- pigmentation is a major aesthetic problem in some patients, especially on the facial surfaces visible during smiling and speaking. Treatment with Er-YSGG laser radiation in a defocused mode is a safe and effective procedure. The gingiva healed uneventfully and completely regenerated with no infection, pain, swelling or scarring.

7.23)Bleaching / Teeth whitening

Using Diode lasers resulted in lesser tooth and gingival sensitivity with immediate shade change compared to other techniques and may be the preferred in- office bleaching procedure today. Lasers can etch tooth surfaces for bonding veneers directly to teeth.

8. **Laser safety**

General safety requirements include a laser warning sign outside the clinic, use of barriers within the operatory, and the use of eyewear to protect against reflected laser light or accidental direct exposure. The selection of the correct eyewear depends on the laser system being used. The potentially damaging effect of lasers on the eye depends on their wavelength and thus absorption characteristics. High volume suction must be used to evacuate the plume from tissue ablation. The laser should be in good working condition and should be used and stored as per manufacturer's instruction. It is important to make sure that the equipment is serviced and checked regularly. In addition to general safety requirements it is important that the treating dentist takes adequate precautions to prevent injury or damage to adjacent soft and hard tissue or to the pulp and periodontal apparatus. According to Zach and Cohen [61], an intra-pulpal temperature increase of approximately 5.5°C can promote necrosis of the dental pulp in 15% of cases, while temperature increases of 11 and 17°C will cause necrosis in 60 and 100% of cases [61,62]. Several authors have studied the thermal effect of lasers on the periodontal ligament and surrounding bone [63-66]. The supporting periodontal apparatus is known to be sensitive to temperatures of 47°C, while temperatures of 60°C and above will permanently stop blood flow and cause bone necrosis [67]. On the other hand, periodontal tissues are not damaged if the temperature increase is kept below 5° Celsius [68]. A threshold temperature increase of 7°C is commonly considered as the highest thermal change which is biologically acceptable to avoid periodontal damage [69,70].

9. **Conclusion:**

The introduction of lasers has redefined the management of soft and hard tissue to the benefit of the clinician in determining the outcome and quality of results for the patient. The responsibility of the clinician is to choose the correct laser wavelength for the procedure and use minimal power to achieve the desired result. As indicated in this paper, lasers have many uses in dentistry. Laser advantages such as a bloodless operative and postoperative course, no suturing usually required, minimal to absent postoperative pain, and high patient acceptance help make lasers a highly advantageous alternative to conventional treatment modalities such as the scalpel or electrosurgery.

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