Lasers- Racers in Prosthodontics - A Review

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Abstract

In the high tech era, we are fortunate to have many technological innovations to enhance treatment, including intraoral video cameras, CAD-CAM units, RVGs and air-abrasive units. However, no instrument is more representative of the term high-tech than, the laser. In clinical dentistry lasers were introduced with the hope of overcoming some of the drawbacks posed by the conventional methods of dental procedures. The speciality of Prosthodontics takes all concepts of dentistry and integrates effective comprehensive treatment planning. The practice will necessarily include a wide variety of patients seeking a diverse range of care.

This article puts forward the state of the art of laser in prosthetic dentistry. Used in conjunction with or as a replacement for traditional methods, it is observed that specific laser technologies are becoming an essential component of contemporary dental practice over a decade.

Key words: Lasers, Removable Prosthesis, Fixed Prosthesis, Implant Dentistry, Radiation etc.

Inroduction

Today is the era of high tech devices, the dentist is being offered many sophisticated products that are designed to improve the quality of treatment rendered to the patient. Lasers are frequently used in medical field and now has begun to revolutionize dentistry. Laser is the acronym for "Light Amplification by stimulated emission of radiation". It is named by American Physicist, GORDON GOULD in 1957[1].

Applicability of lasers for dental use began in 1960s and in 1985 the first documented use of a laser in dentistry was published. Earlier the efforts were limited to the soft tissue procedures which were performed using a straight optical lens/articulated arm delivery system. In 1985, an ophthalmic Nd:YAG laser was modified by Myers and Myers for dental use. Subsequent advances in laser research produced a hollow wave guide delivery system for other wavelengths, making access to the entire oral cavity much easier[2].

The purpose of this article is to provide an overview of the current and possible future clinical applications of lasers in Prosthetic and Implant dentistry. Prosthetic procedures for which conventional treatment cannot provide comparable results or are less effective are emphasized. This article outlines various laser application in Prosthodontics, and to discuss in more detail several key clinical applications which are attracting a high level of interest.

History

1917- Einstien	Theory of stimulated emission
1958- Townes and Schawlow	Laser principle
1960- Maiman	Ruby laser
1961- Johson	Neodymium ion doped yttrium aluminium garnet rod
1964- Patel	CO2 laser
1977- Shafir	First documented case in OMFS using lasers
1989- Terr Myers	First dental laser Nd:YAG

Laser Physics

Laser is a device that converts electrical or chemical energy into light energy. The ordinary light is emitted spontaneously by excited atoms or molecules. In contrast, the light emitted by laser occurs when an atom or molecule retains excess energy until it is stimulated to emit it. The radiation which is emitted by the laser include both visible and invisible light, which generally termed as electromagnetic radiation. The concept of stimulated emission of light was first proposed in 1917 by Albert Einstein (Father of Laser)[3].

Three processes were described by him

1. Absorption
2. Spontaneous emission
3. Stimulated emission

He considered the model of a basic atom to describe the production of laser. An atom consists of centrally placed nucleus which contains +vely charged particles known as protons, around which the negatively charged particles lies.

When an atom is struck by a photon, there is an energy transfer which causes increase in energy of the atom. This process is termed as absorption. The photon then ceases to exist, and an electron within the atom pumps to a higher energy level. This atom is thus pumped up to an excited state from the ground state.

In the excited state, the atom is unstable and will soon spontaneously decay back to the ground state, releasing the stored energy in the form of an emitted photon. This process is called spontaneous emission (Fig.2)[3].

It is pointed out by Einstein that:

"Atoms in an excited state can be stimulated to jump to a lower energy level when they are struck by a photon of incident lightwhose energy is the same as the energy-level difference involved inthe jump. The electron thus emits a photon of the same wavelength asthe incident photon. The incident and emitted photons travel awayfrom the atom in phase."

This process is called stimulated emission.(Fig.3)

If a collection of atoms includes, more that are pumped into the excited state that remain in the resting state, a population inversion exists. This is necessary condition for lasing. Now, the spontaneous emission of a photon by one atom will stimulate the release of a second photon in a second atom, and these two photons will trigger the release of two more photons. These four then yields eight, eight yields sixteen and so on. In a small space at the speed of light, this photon chain reaction produces a brief intense flash of monochromatic and coherent light which is termed as 'laser'.

Laser Properties

- Monochromatic
  Laser light is concentrated in a narrow range of wavelengths. All waves are of same frequency and wavelength. (Fig.4)
- Coherence
  All the emitted photons bear a constant phase relationship with each other in both time and space.
- Collimated
  Laser light is usually low in divergence and all emitted waves are parallel. This property is important for good transmission through delivery system.
- Excellent concentration of energy:
  When a calcified tissue for e.g. Dentin is exposed to the laser of high energy density, the beam is concentrated at a particular point without damaging the adjacent tissues even though a lot of temperature is produced i.e. 800-900oC.
- Zero entropy

Types of Lasers

There are many types of lasers available for research, medical, industrial, and commercial uses. Lasers are often described by the kind of lasing medium they use - solid state, gas, excimer, dye, or semiconductor.

Solid state lasers have lasing material distributed in a solid matrix, e.g., the ruby or neodymium-YAG (yttrium aluminium garnet) lasers. The neodymium-YAG laser emits infrared light at 1.064 micrometres.

Gas lasers (helium and helium-neon, He-Ne, are the most common gas lasers) have a primary output of a visible red light. CO2lasers emit energy in the far-infrared, 10.6 micrometres, and are used for cutting hard materials.

Excimer lasers (the name is derived from the terms excited and dimers) use reactive gases such as chlorine and fluorine mixed with inert gases such as argon, krypton, or xenon. When electrically stimulated, a pseudo-molecule or dimer is produced and when lased, produces light in the ultraviolet range.

Dye lasers use complex organic dyes like Rhodamine 6G in liquid solution or suspension as lasing media. They are turn able over a broad range of wavelengths.

Semiconductor lasers, sometimes called diode lasers, are not solid-state lasers. These electronic devices are generally very small and use low power. They may be built into larger arrays, e.g., the writing source in some laser printers or compact disk players.

Based On Wavelengths

Wavelengths can be characterized into three groups:

1. Diode and Nd:YAG wavelengths target the pigments in soft tissue and pathogens such as Porphyromonas-gingivalis, as well as inflammatory and vascularized tissue.
2. Carbon dioxide lasers also easily interact with free water molecules in soft tissue, as well as vaporize the intracellular water of pathogens.
3. Erbium laser (Er, Cr:YSGG and Er:YAG) are sometimes called "all tissue" instruments because of their excellent absorption in both apatite crystals and the water of soft and hard tissue.

Common laser types used in dentistry

LASER TYPE	CONSTRUCTION	WAVELENGTH (S)	DELIVERY SYSTEM
Argon	Gas laser	488, 515nm	Optical fiber
KTP	Solid laser	532nm	Optical fiber
Helium- Neon	Gas laser	633nm	Optical fiber
Diode	Semiconductor	635,670,810,980nm	Optical fiber
Nd:YAG	Solid state	1064nm	Optical fiber
Er, Cr:YSGG	Solid state	2780nm	Optical fiber

Classification of Lasers

According to ANSI (American National Standards Institute) and OHSA (Occupational Safety and Health Administration)standards Lasers are classified as:

Class I –Low powered lasers that are safe to use. E.g. Laser beam pointer

Class II - Low powered visible lasers that are hazardous only when viewed directly for longer than 1000 seconds, e.g. He-Ne lasers

Class II b - Low powered visible lasers that are hazardous when viewed for more than 0.25 seconds.

Class III a - Medium powered lasers that are normally hazardous if viewed for less than 0.25 seconds without magnifying optics.

Class III b - Medium powered lasers that can be hazardous if viewed directly.

Class IV - High powered lasers (> 0.5 W) that produce ocular skin and fire hazards.

According to CDRH (Center for Devices and Radiological Health) and ANSI system of classification Class IV are potentially hazardous from either direct or diffuse reflection.

Laser Design

Laser consist of following components:

1. **A Laser Medium Or Active Medium:** It can be solid, liquid or gas. It determines the wavelengthof the light emitted from the laser and the laser is named after the medium.
2. **Housing Tube Or Optical Cavity:** It is made up of metal, ceramic or both and consists of two mirrors, one fully reflective and the other partially transmittive, which are located at either end of the optical cavity.
3. **Some Form Of An External Power Source:** This external power source pumps or "excites" the atom in the laser medium to their higher energy levels. Atoms in the excited state spontaneously emit photons of light which bounce back and forth between the two mirrors in the laser tube, they strike other atoms, stimulating more spontaneous emission.

Laser-tissue Interaction

Laser light and target tissue can have four different interactions, depending on the optical properties of that tissue[3].

A. Absorption

The amount of energy that is absorbed by the tissue depends on the tissue characteristics, such as pigmentation and water content, and on the laser wavelength and emission mode. The shorter wavelengths (from about 500-1000 nm) are readily absorbed in pigmented tissue and blood elements rather than higher wavelengths.

B. Transmission

This effect is transmission of the laser energy directly through the tissue with no effect on the target tissue. It is the inverse of absorption. This effect is highly dependent on the wavelength of laser light.

C. Reflection

It is the beam redirecting itself off of the surface, having no effect on the target tissue. The degree of sound tooth structure in carious tooth is measured by a caries-detecting laser device which uses the reflected light.

D. Scattering

It is the weakening of intended energy and possibly producing no useful biologic effect. It causes heat transfer to the tissue adjacent to the surgical site, and unwanted damage could occur.

Laser Delivery System

Laser light should be delivered to the target tissue in a ergonomic and precise manner.

1. Flexible Hollow Waveguide or Tube

A flexible hollow waveguide or tube has an interior mirror finish. The laser energy is reflected along this tube and exits through a handpiece at the surgical end with the beam striking the tissue in a noncontact fashion.

2. Glass Fiber Optic Cable

This cable is more pliant than the waveguide, less in weight and resists movement.

It is usually smaller in diameter (some soft tissue lasers have optic fibers with sizes ranging from 200-600 µm). Although the glass component is encased in a resilient sheath, it can be fragile and cannot be bent into a sharp angle. This fiber system can be used in contact or noncontact mode.

With lasers using the hollow wave guide, there is a precise spot where the energy is the greatest (focal spot) and that spot should be used for the excisional and incisional surgery.

For lasers using the optic fiber the focal point is at or near the tip of the fiber. When the handpiece is moved away from the tissue, the beam is defocused and becomes more divergent. At a small divergent distance, the beam can cover the wider area, which is useful for achieving hemostasis.

Lasers with shorter wavelengths, such as argon, diode, Nd:YAG can be designed easily with flexible glass optic fibers. But a large wavelength of Er:YAG does not fit into the crystals of conducting glass fibers easily. The largest dental wavelength, CO2, is too large for glass and has to be conducted in a hollow tube.

Laser Tissue Effects

1. PhotothermalEffects

The thermal effect of laser energy on tissue depends on: the degree of temperature rise, corresponding reaction of the interstitial and intracellular water, cooling of the surgical site, surrounding tissue's ability to dissipate the heat and laser parameters like emission mode, laser density, and time of exposure (Photoablation and Photopyrolysis).

2. Photochemical Effects

Laser light can stimulate chemical reactions (eg. the curing of composite resin).A low power laser well below the surgical threshold can be used for biostimulation, producing more rapid wound healing, pain relief, increased collagen growth, and a general anti-inflammatory effect.

3. Photoacoustic Effect

A popping sound is produced when a laser interacts with a dental hard tissues. This popping sound, is a very quick shock wave that is created when the laser energy dissipates explosively.

4. Bactericidal Effect

The laser is absorbed by water in the bacterial cells, and the cells undergo the same liquid-to-steam vaporization that is seen during ablation of soft tissue. This destruction of bacteria is one of the additional advantages of using lasers for or hard tissue dental procedures.

Advantages of Laser over other techniques[4]

- It is painless (depolarization of nerves), bloodless that results in clean surgical field, and fine incision with precision is possible.
- There is no need for anesthesia if at all anesthesia has to be administered, then it needs to be used minimally only.
- The risk of infection is reduced as a more sterilized environment is created as the laser kills bacteria.
- No postoperative discomfort, minimal pain and swelling, generally doesn't require medication.
- Superior and faster healing, offers better patient compliance.
- Need for suturing is eliminated.

Disadvantages of Lasers[4]

- Lasers cannot be used to remove defective crowns or silver fillings, or to prepare teeth for bridges.
- Lasers can't be used on teeth with filling already in place.
- Lasers don't completely eliminate the need for anesthesia.
- Lasers treatment is more expensive as the cost of the laser equipment itself is much higher.

Use Of Laser In Prosthodontics

Lasers are now being used in variety of procedures in prosthetic dentistry.

1. Fixed Prosthesis/Esthetics

- Crown lengthening
- Soft tissue management around abutments
- Osseous crown lengthening
- Formation of ovate pontic site

- Laser troughing
- Modification of soft tissue around laminates
- Altered passive eruption management

2. Implantology

- Micro-texturing and polishing
- Implant site preparation
- Second stage surgery/Implant recovery
- Impression
- Welding
- Removal of diseased tissue around implants
- Wound healing

3. Removable Prosthetics

- Treatment of unsuitable alveolar ridges
- Undercut alveolar ridges
- Enlarged tuberosity
- Surgical treatment of tori and exostoses
- Soft tissue lesions

4. Dental laboratory

- Laser holographic imaging
- Scanning of cast
- Surgical templates for implant surgery

I. Fixed Prosthesis/esthetics

A. Crown Lengthening:

Crown lengthening procedures with the help of lasers are indicated in following conditions:

a. Caries at gingival margin
b. Cuspal fracture extending apical to the gingival margin
c. Endodontic perforations near alveolar crest.
d. Insufficient clinical crown length.
e. Difficulty in placement of finish line coronal to the biological width.
f. Need to develop a ferrule.
g. Unaesthetic gingival architecture.
h. Cosmetic enhancements.

Lasers offer unparallel precision and operator control and may be beneficial for finely tracing incision lines and sculpting the desired gingival margin outline. All the other crown lengthening procedures has following disadvantages:

As in surgical approach

- longer healing time
- Post healing gingival margin position is unpredictable
- patient compliance is poor as it needs use of anaesthesia and scalpel for electro-surgery
- The heat liberated has a deleterious effect on pulp and bone leading to pulpal death or bone necrosis.
- Orthodontic extrusion leads to vertical bone defect adjacent to extruded tooth and it also needs patient compliance[5].

B. Soft tissue management around abutments

Argon laser energy has peak absorption in haemoglobin, thus providing efficient coagulation and excellent haemostasis and vaporization of oral tissues. These features are beneficial for retraction and haemostasis of the gingival tissue in preparation for an impression during a crown and bridge procedure. Argon laser with 300 um fiber, and a power setting of 1.0W, continuous wave delivery and the fiber is inserted into the sulcus in contact with the tissue. In a sweeping motion, the fiber is moved around the tooth. It is important to contact the fiber tip with the bleeding vessels. Provide suction and water spray in the field. Gingivoplasty may also be done using argon laser[6].

Enrico F. Gherlone and colleagues conducted a study to evaluate the tissue retraction and gingival healing using pulsed laser gingival retraction in comparison with the conventional mechanical or surgical techniques. This study showed that the laser technique was less aggressive to the periodontal tissues compared to the conventional ones .i.e., less gingival recession and less amount of bleeding from the sulcus. Also, laser technique showed hemostasis during impression making[7].

C. Osseouscrown lengthening

Like teeth mineralized matrix of bone consists mainly of hydroxyapatite. High absorption of the Er: YAG laser light in the bone is due to the water content and hydroxyapatite. Er:YAG laser has very promising potential for bone ablation[6].

D. Formation of ovate pontic site

Two of the most common causes of unsuitable pontic site are insufficient compression of alveolar plates after an extraction and non-replacement of a fractured alveolar plate. This results in unaesthetic and non-self-cleansing pontic design. Re-contouring of soft and bony tissue may be needed for favourable pontic design. Soft tissue surgery may be performed with any of the soft tissue lasers and osseous surgery may be performed with erbium family of lasers.

E. Laser troughing

Lasers can be used to create a trough around a tooth before impression taking. This entirely replaces the need for retraction cord, electrocautery, and the use of haemostatic agents. The results are predictable, efficient, minimize impingement of epithelial attachment, cause less bleeding during the subsequent impression, reduce postoperative problems, and reduce chair time6. It alters the biological width of gingiva. Nd:YAG laser is used. It vaporizes the epithelium which is attached to the marginal finish lines, the epithelium getting vaporized is only a transient loss and it forms again. After laser troughing the impression is taken and sent to the lab for prosthetic work. The most important function of marginal finish line is to maintain the biological width, it acts as the termination point of tooth preparation, help in ease of fabrication, helps in taking a proper impression. In brittle teeth to maintain the biological width and finish line laser troughing plays an important role[8].

F. Modification of soft tissue around laminates

The removal and re-contouring of gingival tissues around laminates can be easily accomplished with the argon laser. The laser can be used as a primary surgical instrument to remove excessive gingival tissue, whether diseased, secondary to drug therapy, or orthodontic treatment. The laser will remove tissue and provide haemostasis and tissues weld the wound.

HILT (High Intensity Laser Treatment) laser curettage in the gingival sulcus every 3 to 6 months after final cementation of porcelain crowns and laminate veneers. This follow up is necessary to maintain good esthetics obtained at the time of cementation[8].

LILT (Low Intensity Laser Treatment) gingival conditioning at follow up. Whenever the patient comes to the clinic for a follow up, low power laser should be applied to the gingiva surrounding the luted porcelain to maintain the esthetics achieved8.

G. Altered passive eruption management

Passive eruption problems efficaciously managed by the use of Lasers. When the patients have clinical crowns that appear too short or when they have an uneven gingival line producing an uneven smile, excessive tissue can be easily and quickly removed without the need for blade incisions, flap reflection, or suturing[6].

II. Implantology

A. Micro-texturing and polishing

Excimer laser are commonly used to treat implant surfaces, since these can achieve micro texturing and polishing. This highly polished surfaces favours the interaction of implants with soft tissues and inhibit plaque accumulation. This patterned surface results in significantly more bone to implant contact requiring greater peak removal torque values than if the surface has not been so modified[9].

B. Implant site preparation

Lasers can be used for the placement of mini implants especially in patients with potential bleeding problems, to provide essentially bloodless surgery in the bone[10].

C. Second stage surgery/implant recovery

After the placement of implant and its integration into the osseous substrate, next step is to surgically uncover the implant, wait for the tissue to heal, and then proceed with impressions and fabrication of the restoration. The reason for the delay is to facilitate the impression-taking process. Uses of lasers can greatly expedite this procedure because the implant can be uncovered and impressions can be obtained at the same appointment[6]. All types of lasers can be used to expose dental implants.

The middle infrared wavelength can be used for precise bone surgery. For example for creating windows before sinus lifts are undertaken with Nd: YAG and Ho: YAG lasers are not suitable for second stage implant surgery, because they can interact with Ti and damage the surface of theses fixtures. The middle infrared lasers with H2O mist spray are used for 2nd stage implant surgery. An ablative technique can be used with these lasers for 2nd stage expect for in anterior areas, there is lack of keratinized gingival tissues[11].

D. Impression

One advantage of use of lasers in implantology is that impressions can be taken immediately after second stage surgery because there is little blood contamination in the field due to the haemostatic effects of the lasers.

There also is minimal tissue shrinkage after laser surgery[12], which assures that the tissue margins will remain at the same level after healing as they are immediately after surgery[10,13].In addition the use of laser can eliminate the trauma to the tissues of flap reflection and suture placement.

E. Laser welding

Laser welding is becoming a more popular procedure. It minimizes finishing and reduced time is major advantages for dental laboratory[14].

F. Removal of diseased tissue around implants

Salvaging ailing implant by decontamina-ting their surface with laser energy is one of the most interesting use of lasers in implant dentistry. A number of studies have examined lasers for treatment of periimplantitis. Diode, CO2 &Er:YAG lasers can be used for this purpose.Er:Cr:YSGG and Er:YAG lasers have been used for debride calculus and other deposits from implant surface. Several studies have shown that bacterial reduction of greater than 98% can be achieved using only low level laser energies[9].

Lasers can also be used to remove granulation tissue in case there is inflammation around an already osseointegrated implant[10,15].

Low power lasers with photo sensitizers have also been used for treating periimplant-itis. (PAD) The photo activated disinfection tech. which uses photosensitive dyes, such as toluidine blue, and diode laser has been shown to give rapid elimination of P.gingivalis, P.intermedia and A. actinomycetemco-mitans[12].

G. Wound healing

Achieving biostimulation is the final area of interest is in relation to lasers. Biostimulation which shows its value in terms of accelerating wound healing and tissue maturation after injury. Not surprisingly, several studies have shown that low levellaser treatment can accelerate the interaction of bone and implant in the immediate post placement period[14].

III.Removable Prosthetics

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[16,17]. Lasers can be used to perform various preprosthetic surgeries.

Stability, retention, function, and aesthetics of removable prostheses may be enhanced by proper laser manipulation of the soft tissues and underlying osseous structure.

A. Treatment of unsuitable alveolar ridges

Alveolar resorption usually is uniform in vertical and lateral dimensions. Occasionally, irregular resorption occurs in one of the dimensions, producing an unsuitable ridge. As the available denture bearing area is reduced, the load on the remaining tissue increases, which leads to an ill-fitting prosthesis, with discomfort that is not alleviated by application of soft liners18 to remove sharp bony projections and to smooth the residual ridge soft tissue lasers surgery to expose the bone may be performed with any number of soft tissue wavelengths (CO2, diode, Nd:YAG,) Hard tissue surgery may be performed with the erbium family of wavelengths.

B. Undercut alveolar ridges

Two of the most common causes of undercut alveolar ridges are dilated tooth sockets that result from insufficient compression of the alveolar plates after an extraction and non-replacement of a fractured alveolar plate. Naturally occurring undercuts such as those found in the lower anterior alveolus or where a prominent pre-maxilla is present may be the cause of soft tissue trauma, ulceration, and pain when prosthesis is placed on such a ridge. Soft tissue surgery may be performed with any of the soft tissue lasers. Osseous surgery may be performed with the erbium family of lasers.

During mastication, the upper denture oscillates, causing disproportionate resorption in the maxilla. The soft tissues are compressed due to which denture become unstable. Pain is not felt until the anterior nasal spine is nearly exposed and subject to trauma from the denture base. Unsupported maxillary alveolar soft tissues are bulkier than those in the lower jaw that tend to pro lapse in the lingual direction. Traditional surgery consists of removing wedges of soft tissue from the alveolar crest until the wound edges are closed easily. Any of the soft tissue lasers are able to perform this procedure[19,20].

C. Enlarged tuberosity (hard and soft tissue)

Soft tissue hyperplasia and alveolar hyperplasia is the most common reason for enlarged tuberosity accompanying the over-eruption of unopposed maxillary molar teeth. The enlarge tuberosity may prevent the posterior extension of the upper and lower dentures, thereby reducing their efficiency for mastication and their stability. The bulk of the hyper plastic tuberosity may lie toward the palate. Surplus soft tissue should be excised, allowing room for the denture bases. The soft tissue reduction may be performed with any of the soft tissue lasers.

If undercuts are present, then osseous reduction may be required. Erbium laser is the laser of choice for the osseous reduction[21,22].

D. Surgical treatment of tori and exostoses

Prosthetic problems may arise if maxillary tori or exostoses are large or irregular in shape. They are formed mainly of compact bone and may cause ulceration of oral mucosa. These bony protuberances may also interfere with lingual bars or flanges of mandibular prostheses. Soft tissue lasers may be use to expose the exostoses and erbium lasers may be use for the osseous reduction. A smooth, rounded, midline torus normally does not create a prosthetic problem because the palatal acrylic may be relieved or cut away to avoid the torus.

E. Soft tissue lesions

Persistent trauma from a sharp denture flange or over compression of the posterior dam area may produce a fibrous tissue response. Hyper plastic fibrous tissue may be formed at the junction of the hard and soft palate as a reaction to constant trauma and irritation from the posterior dam area of the denture. The lesion may be excised with any of the soft tissue lasers and the tissue allowed re-epithelialized.

IV. Dental Laboratory

A. Laser holographic imaging

Laser holographic imaging is a well-established method for storing topographic data, such as crown preparations, occlusal tables, and facial forms. The use of two laser beams allows more complex surface detail to be mapped using Interferometry[23,24], while conventional diffraction gratings and interference patterns are used to generate holograms and contour profiles[25-27]. Lasers aid in creating a visually realistic prosthesis that can provide an illusion of normal appearance.

B. Scanning of cast

Laser scanning of casts can be linked to computerized milling equipment for fabrication of restorations from porcelain and other materials. An alternative fabrication strategy is to sinter ceramic materials, to create a solid restoration from a powder of alumina or hydroxyapatite. The same approach can be used to form complex shapes from dental wax and other materials which can be sintered, such that these can then be used in conventional 'lost wax' casting.

C. Surgical templates for implant surgery

An ultraviolet (helium-cadmium) laser-initiated polymerization of liquid is done resin in a chamber, to create surgical templates for implant surgery and major reconstructive oral surgery. These templates can be coupled with laser-based positioning systems for complex reconstructive and orthognathic surgical procedures.

Conclusion

Lasers have become a ray of hope in dentistry. When used effectively and ethically, lasers prove to be an exceptional modality of treatment for many clinical conditions that dentists treat on a daily basis. But it has never been the "magic wand" that many people have hoped for due to its own limitations. Before application dentist needs to fully understand the character of the laser wavelength being used, and the thermal implications & limitations of the optical energy. However, the future of the dental laser comes out to be bright with some of the newest ongoing research. Lasers have made a tremendous impact on the delivery of dental care in the 21st century and will continue to do so as the technology continues to improve and evolve. Lasers today offers dentist not only a window but a door into this hi-tech, rewarding and potentially profitable arena.

References

References are available on request at editor@healtalkht.com

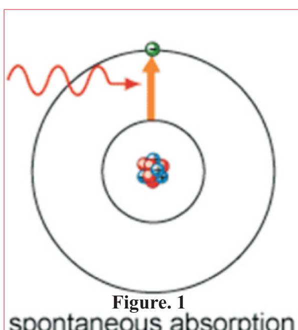
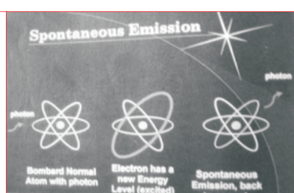


Figure. 1



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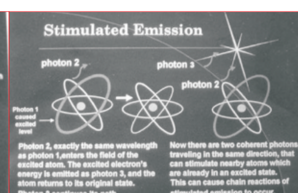

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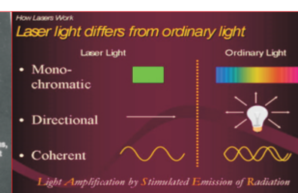

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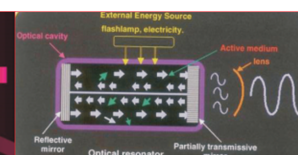

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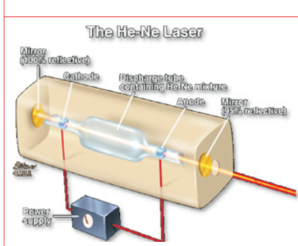

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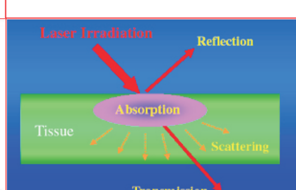

Figure. 5


Figure. 8 Wave Guide Delivery System

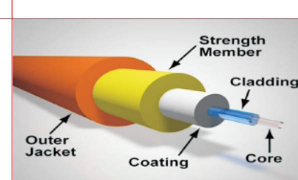

Figure. 9


Figure. 10. Articulated Arm Delivery System