Indian Journal of Dental Sciences.
September 2011 Issue:3, Vol.:3

www.ijds.in

Review Article

Indian Journal
of Dental Sciences

E ISSN NO. 2231-2293
P ISSN NO. 0976-4003

Lasers In Prosthetic Dentistry: A Review

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Date of Submission : 10/06/2011
Date of Acceptance : 21/08/2011

Abstract
Laser treatment in dentistry has replaced many traditional electrosurgical and scalpel procedures and is beginning to replace the dental handpiece. Compared with conventional techniques, laser treatment has many advantages. These advantages include reduced overall treatment time, decreased bacterial contamination & reduced swelling, scarring, and wound contraction at of the surgical site,Excellent hemostasis.This article discusses the use of laser in Prosthetic Dentistry.

Key Words
Light Amplification , Radiation, Crystal, Excited , Photons, Coherent Light Beam

INTRODUCTION:

Some pains are physical some are mental the one that is both is dental. The fears of dentists and dental pain have influenced dentists to find pain free ways to treat patients. The introduction of lasers into dentistry was one such step. The word laser is an acronym for light amplification by stimulated emersion 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 laser depends upon the power of the beam and the extent to which the beam is absorbed.

Though at present we are unable to use lasers for all dental procedures, hopefully in the near future, with more studies and better understanding of them we will be able to use them in almost all areas of dentistry.

BRIEF HISTORY:

The idea and concept of laser capability was acknowledged in 1917. Albert Einstein first conceptualized the use of stimulated emission, which serves as the foundation of laser. In the early to mid 1950,s,Bell Labs ' Arthur L Schawlow , and Charles H. Townes invented the MASER (microwave amplification by stimulated emission of radiation), by means of ammonia gas and microwave radiation. The MASER was invented prior to optical laser, yet the technology is very comparable. On May 16, 1960 Theodore Maiman's ruby laser became the first working laser in history. In the 1960's, Dr. Ali Javan invented the first gas laser with Helium Neon. Four years later, the carbon dioxide laser was successfully shaped by Kumar Patel in 1964. A new realization of commercial and research opportunities through laser technology became wide spread, and substrates and ions such as rare earths (Nd, Pr, Tm, Ho,Er, Yb, Gd, and Ur) were all eventually successfully "lased". Over the years Goldman and other researchers documented the ability of various types of lasers to cut, coagulate, ablate and vaporize biologic tissues. Historically, the first lasers to be marketed for intraoral use generally were CO2 lasers. The Nd:YAG laser was developed In 1964 but it was over shadowed by the ruby laser and CO2 laser, and it was only made available in the 1990's for dental use. Hibst and Pashidiwala described in detail the effect of the Er: YAG laser on dental hard tissues. 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 and hence is the most popular soft and hard tissue laser today.

DIFFERENT TYPES OF LASERS USED IN DENTAL TREATMENT[1]:

Several types of lasers are available based on the wavelengths.

1. The Er: YAG laser possesses the potential of replacing the drill.
2. Co2 laser can be used to perform gingivecotomy and to remove small tumours.
3. Argon laser is used in minor surgery.
4. Nd:YAG is used in tissue retraction, endodontics and oral surgery.
5. The diode laser is effective for oral surgery and endodontic treatment. This laser helps to correct aesthetics flaws. It is used for soft tissue procedures.

ADVANTAGES OF LASER OVER THE OTHER TECHNIQUES[2]:

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

DISVANTAGES OF LASERS[2]:

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

USE OF LASERS IN PROSTHETIC DENTISTRY:

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

A. FIXED PROSTHETICS/ESTHETICS
   i. Crown lengthening
   ii. Soft tissue management around abutments
   iii. Osseous crown lengthening
   iv. Troughing
   v. Formation of ovate pontic sites
   vi. Altered passive eruption management
   vii. Modification of soft tissue around laminates
   viii. Bleaching

B. IMPLANTOLOGY
   i. Second stage uncovering
   ii. Implant site preparation
   iii. Peri-implantitis

C. REMOVABLE PROSTHETICS
   i. Tuberosity reduction
   ii. Torus reduction
   iii. Soft tissue modification
   iv. Epulis fissurata
   v. Denture stomatitis
   vi. Residual ridge modification

FIXED PROSTHETICS/ESTHETICS:

Lasers are used in fixed prosthodontics for crown lengthening, soft tissue management around abutments, osseous crown lengthening, troughing, Formation of ovate pontic sites, altered passive eruption management, modification of soft tissue around laminates, bleaching.

Crown lengthening:

Clinical scenarios where crown lengthening procedures are indicated within esthetic zone require special consideration to achieve predictable esthetic results. Crown lengthening procedures 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. Unesthetic 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 certain disadvantages as in surgical approach healing time is longer, post healing gingival margin position is unpredictable and patient compliance is poor as it needs use of anesthesia and scalpel for electrosurgery , 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[3].

Soft tissue management around abutments[4]:

Argon laser energy has peak absorption in hemoglobin, thus lending itself to providing excellent hemostasis and efficient coagulation and vaporization of oral tissues. These characterisitics are beneficial for retraction and hemostasis 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 1.0 W, continuous wave delivery, 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.

Modification of soft tissue around laminates[4]:

The removal and recontouring 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 hemostasis and tissues weld the wound.

Osseus crown lengthening :

Like teeth mineralized matrix of bone consists mainly of hydroxyapatite. The water content and hydroxyapatite are responsible for the high absorption of the Er: YAG laser light in the bone. Er: YAG laser has very promising potential for bone ablation[4].

Formation of ovate pontic sites:

There are many causes of unsuitable pontic site. Two of the most common causes are insufficient compression of alveolar plates after an extraction and non replacement of a fractured alveolar plate. Unsuitable pontic site results in unesthetic and non self cleansing pontic design. For favorable pontic design recontouring of soft and bony tissue may be needed. Soft tissue surgery may be performed with any of the soft tissue lasers and osseus surgery may be performed with erbium family of lasers.

Altered passive eruption management:

Lasers can be used very efficaciously to manage passive eruption problems .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[4].

Laser troughing:

Lasers can be used to create a trough around a tooth before impression taking. This can entirely replace the need for retraction cord, electrocautery, and the use of hemostatic agents. the results are predictable, efficient, minimize impingement of epithelial attachment, cause less bleeding during the subsequent impression, reduce postoperative problems, and reduce chair time[4].

It alters the biological width of gingiva. Nd:YAG laser is used. It vaporizes the epithelium which is attachéd 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 terminatiion 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.

Bleaching:

Esthetics and smile has become important issues in modern society. Bleaching has become the common method for tooth whitening. Bleaching using diode lasers results in immediate shade change and less tooth sensitivity and is preferred among in office bleaching systems. In most cases excellent results are obtained in a single sitting of about 45 minutes to an hour. Besides this laser energy is capable of inducing a decomposition reaction of the staining agent[5].

IMPLANTOLOGY:

Dental lasers are used for a variety of procedures in implantology.

I. Implant Recovery
II. Implant site preparation
III. Removal of diseased tissue around the implant.

Implant recovery:

Following the placement of an implant and its integration into the osseous substrate, the current method of treatment 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. Use of lasers can greatly expedite this procedure because the implant can be uncovered and impressions can be obtained at the same appointment[4.]

All types of lasers can be used to expose dental implants. 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 hemostatic effects of the lasers. There also is minimal tissue shrinkage after laser surgery, which assures that the tissue margins will remain at the same level after healing as they are immediately after surgery.[6, 7]

In addition the use of laser can eliminate the trauma to the tissues of flap reflection and suture placement.

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[7.]

Removal of diseased tissue around the implant:

Lasers can be used to repair ailing implants by decontaminating their surfaces with laser energy. Diode, CO2 & Er:YAG lasers can be used for this purpose. Lasers can also be used to remove granulation tissue in case there is inflammation around an already osseointegrated implant.[7, 8]

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.[9, 10] Lasers may now be used to perform most pre-prosthetic surgeries. These procedures include hard and soft tissue tuberosity reduction, torus removal, and treatment of unsuitable residual ridges including undercut and irregularly rsesorbed ridges, treatment of unsupported soft tissues, and other hard and soft tissue abnormalities.

Lasers also may be used to treat the problems of hyperplastic tissue and nicotinic stomatitis under the palate of a full or partial denture and ease the discomfort of epuli, denture stomatitis, and other problems associated with long term wear of ill fitting dentures. Stability, retention, function, and esthetics of removable prostheses may be enhanced by proper laser manipulation of the soft tissues and underlying osseous structure.

Treatment of unsuitable alveolar ridges:

Alveolar resorption usually is uniform in vertical and lateral dimensions. On occasion, 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 soft linings[11] 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.

Treatment of undercut alveolar ridges:

There are many causes of undercut alveolar ridges. Two of the most common causes 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, thus causing the denture to become increasingly 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 prolapse 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.[12, 13]

Treatment of enlarged tuberosity:

The most common reason for enlarged tuberosities usually is soft tissue hyperplasia and alveolar hyperplasia accompanying the over-eruption of unopposed maxillary molar teeth. The enlarge tuberosities may prevent the posterior extension of the upper and lower dentures, thereby reducing their efficiency for mastication and their stability. The bulk of the hyperplastic 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 undercut s are present, then osseus reduction may be required. Erbium laser is the laser of choice for the osseus reduction[14, 15]

Surgical treatment of tori and exostoses:

Prosthetic problems may arise if maxillary tori or exostoses are large or irregular in shape. Tori and exostoses are formed mainly of compact bone. They may cause ulceration of oral mucosa. These bony protuberances also may 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.

Soft tissue lesions:

Persistent trauma from a sharp denture flange or over compression of the posterior dam area may produce a fibrous tissue response. Hyperplastic 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 to re-epithelialize.

CONCLUSION:

As the use of laser in the practice of general dentistry continues to increase, there will be many procedures that were once done by traditional mechanical methods, but will now be seen through laser safety glasses.

If a clinician decides to use a laser for a

dental procedure, he or she needs to fully understand the character of the wavelength being used, and the thermal implications & limitations of the optical energy. Prognosis of treatment depends upon the selection of appropriate laser type and the parameter settings, following manufacturer's instructions and application technique.

Lasers offer unparallel precision and operator control and show less thermal necrosis of adjacent tissue than electrosurgical devices, while also achieving excellent hemostasis and post surgical healing.

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