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Lasers in Periodontal Therapy: A Review

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***Abstract*---**The unique nature of laser light and its specific absorption, led to an expansion of its use in medicine. Several medical specialties use lasers in their daily practice, and it has become the standard of care for surgical therapy. 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. The use of lasers in dentistry has increased over the past few years. Currently, lasers are generally accepted in periodontal therapy and widely used as a tool for soft tissue management. Application comfort, the silence, anesthesia reduction and other such advantages make lasers attractive for society and professionals. More long term systematic studies are necessary to evaluate the clinical and biological effects of each type of laser, the time and application mode, unique/multiple doses and application frequency.

***Keywords*---**laser, therapy, periodontitis, anesthesia, dentistry.

Introduction

Periodontitis is a chronic inflammatory disease that affects the supporting structures of teeth, resulting in tooth loss.The word Laser is an acronym for Light Amplification by Stimulated Emission of Radiation. Lasers play a pivotal role in our day to day life. In fact they show up in an amazing range of products and technologies.1 Non-surgical therapy by mechanical instrumentation is the primary recommended approach to control periodontal infection. Because conventional therapies result in wounding of the already inflamed periodontal

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tissues, the consequence of such therapeutic procedures depends largely on the cellular and molecular events associated with wound healing.2

History of lasers

Masers, coined from Microwave Amplification by Stimulated Emission of Radiation, served as sensitive preamplifiers in microwave receivers. In 1954 the first maser was built by *C. Townes* and utilized the inversion population between two molecular levels of ammonia to amplify radiation at a wavelength around 1.25 cm 3. *T. Maiman* who coined the name “laser,” in analogy to maser, as an abbreviation of Light Amplification by Stimulated Emission of Radiation.3 In early ruby laser systems the output consisted of a series of irregular spikes, stretching over the duration of the pump pulse. A key discovery made by R.W. Hellwarth in 1961 was a method called Q-switching for concentrating the output from the ruby laser into a single pulse. This Q-switch, which consisted of a cell filled with nitrobenzene, required very high voltages for Q-switching; it was soon replaced by spinning one of the resonator mirrors. Four years later, fully militarized rangefinders containing a flashlamp-pulsed ruby laser with a spinning prism Q-switch went into production. For about 10 years ruby-based rangefinders were manufactured; afterward the ruby laser was replaced by the more efficient neodymium doped yttrium aluminum garnet (Nd :YAG) laser.

The discovery of the ruby laser triggered an intensive search for other materials, and in rapid succession laser action in other solids, gases, semiconductors, and liquids was demonstrated. Following the discovery of the ruby laser, the next solid-state material was uranium-doped calcium fluoride which was lased in late 1960. The first solid-state neodymium laser was calcium tungstate doped with neodymium ions. This laser, discovered in 1961, was used in research facilities for a number of years until yttrium aluminate garnet, as a host material for neodymium, was discovered.

Applications of lasers in dentistry

Hard tissue applications

Lasers for hard-tissue procedures are considerably larger and more expensive than lasers for soft-tissue procedures. Hard-tissue lasers, designed for the preparation of teeth, are limited to creating the cavity designs predicated by most direct restorative materials. Although very useful for conservative preparations, their use for more advanced cavity preparations for indirect restorations is limited and time-consuming. The Er:YAG dental laser first was approved for cavity preparation and caries removal in 1997.4

Soft tissue applications

Soft-tissue procedures can be performed using lasers, electrosurgery units and scalpels. Each of these devices has advantages and disadvantages. The soft tissue lasers available are carbon dioxide lasers, Nd:YAG lasers, argon lasers, H:YAG lasers, Er,Cr:YSGG lasers and diode lasers; they differ in what is used to produce the energy, the wavelength of the light emitted from the laser, and whether the energy is supplied in a continuous or pulsed manner.4

Laser application in perioddontal therapy

The use of lasers for periodontal treatment becomes more complicated because the periodontium consists of both hard and soft tissues. Among the many lasers available, high power lasers such as CO2, Nd:YAG and diode lasers can be used in periodontics because of their excellent soft tissue ablation and hemostatic characteristics. However, when they are applied to the root surface or alveolar bone, carbonisation and thermal damage have been reported. Therefore the use of these lasers is limited to gingivectomy, frenectomy and similar soft tissue procedures including the removal of melanin pigmentation of gingiva.5 Lasers are also used as an alternative or an adjunctive to conventional scaling and root debridement. [Tabel.1]

Tabel 1
Different types of wavelengths used in periodontal therapy

Laser type	Wave-length (in nm)	Wave form	Delivery system	Contact	Clinical applications in periodontics
Cabondioxide (CO2) laser	10600	Gated or continuous	Hollow waveguide/ articulated arm	Beam focused at 1 to 2 mm from target surface	Soft tissue incision and ablation; subgingival curettage; biopsy; decontamination of implant
Neodymium:Yttrium-aluminium-garnet (Nd:YAG) laser	1064	Pulsed	Flexible fiberoptic system	Surface contact required	Soft tissue incision and ablation; subgingival curettage; bacterial elimination.
Erbium:yttrium-aluminium-garnet (Er:YAG) laser	2940	Free running pulsed	Flexible fiberoptic system or Hollow waveguide	Surface contact required	Soft tissue incision and ablation; subgingival curettage; scaling; root conditioning; osteoplasty and ostectomy; degranulation and

					decontamination of implants
Erbium,Chromium: yttrium-selenium-gallium-garnet (Er,Cr;YSGG) laser	2780	Free running pulsed	Air-cooled fiberoptic / handpiece	Surface contact required	Soft tissue incision and ablation; subgingival curettage; scaling of root surfaces; osteoplasty and ostectomy
Argon (Ar) laser	488 and 514	Gated or continuous	Flexible fiberoptic system	Noncontact or contact mode	Soft tissue incision and ablation
Indium-gallium-arsenide-phosphide: Gallium-aluminium-arsenide; Galliumarsenide InGaAsP, GaAlAs, GaAs(diode) Laser	635 to 950	Gated or continuous	Flexible fiberoptic system	Surface contact required	Soft tissue incision and ablation; subgingival curettage; bacterial elimination.

Lasers in oral implantology

The gingival epithelium/biological seal becomes an important factor in implant longevity. The seal must be effective enough to prevent the ingress of bacterial plaque toxins, oral debris and other deleterious substances. The Nd: YAG laser has properties suitable for welding titanium. Carbon dioxide lasers work exceptionally well for uncovering implants whether there may be single or multiple fixtures.6 For this indication, the CO2 laser simply vaporizes the overlying tissue until the surgical healing is reached. This is accomplished with a defocused mode, a circular motion and indicated power setting of 3 to 6W. This can also be referred to as a “cookie cutter” approach. The opening can then be easily contoured and enlarged as needed. When applicable, the laser eliminates the need for a flap and suturing, and reduces the level of postoperative discomfort that would normally be associated with this procedure.7

Conclusion

Introduction of lasers in implant therapy and newer laser technical modalities has revolutionised the periodontal treatment outcome with patient acceptance. Lasers have been suggested as an adjunctive or alternative to conventional techniques for various periodontal procedures and considered superior in respect to easy ablation, decontamination, and hemostasis along with less operative and post-operative pain. Introduction of lasers in implant therapy and newer laser technical modalities has revolutionised the periodontal treatment outcome with patient acceptance.

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