Open Access Journal
International Journal of Medical Research and Pharmaceutical Sciences
Volume 3 (Issue 11) : November 2016 ISSN: 2394-9414
DOI: 10.5281/zenodo.168099 Impact Factor- 3.109

DIODE LASERS – AN ERA OF NEW DAWN IN DENTISTRY

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Keywords: *Diode Laser, Hemostasis, Laser surgery, Low level laser therapy.*

Abstract

LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. Over the years, lasers have advanced imperceptibly in our day to day life from recording price of groceries to laser guided warfare. Lasers saw the light of day due to Ted Maiman in 1960 but it was not until 1980's that lasers saw their use in dental clinical practice. This article reviews the uses of diode lasers in dentistry.

INTRODUCTION

Diode lasers are an exceptional modality of treatment and if used ethically and efficaciously it can prove beneficial for many day to day clinical conditions. They have become the standard of care for some common conditions like frenectomies due to bloodless field, faster healing and ease of procedure.(Figure 1)

Diode lasers are relatively easy to use provided the clinician has been trained properly. It is important to acknowledge the fact that dental lasers function with an "end cutting" action while dental instruments function on a "side cutting" principle with cutting edges on the lateral surface.

Lasers in dentistry offer a variety of advantages. 1) They seal blood vessels in turn offering a dry operating field with excellent visibility and reduced operating time. 2) Minimum post operative swelling due to sealing of the lymphatic vessels and inducing neo-angiogenesis by stimulating endothelial growth factors. 3) Reduced perception of pain due to increased metabolism of endorphins, acetylcholine, serotonin and cortisol. 4) Enhanced rate of healing due to bio-stimulating effect with release of growth factors, cytokines; increased production of ATP > 30% and protein synthesis in mitochondria. 5) Lasers offer the ability to negotiate curves and folds in oral cavity and depending on their power settings and mode of delivery; they can vaporize, coagulate, or cut tissue. 6) Less chances of mechanical trauma, minimal scaring and sutures. 7) Decreased bacterial counts so more beneficial for patients at high risk for bacteremias. 8) Increased patient acceptance due to minimal post operative discomfort. (1)

MECHANISM OF LASER

Diode laser have wavelengths in the near infrared spectrum, typically from 800 nm to 980 nm. They have an affinity for hemoglobin/ oxyhemoglobin in the gingiva, mucosa and pulp with light diffusing at various depths. The modes of operation determine the thermal interaction.

Photo-thermal ablation: Interaction of the laser energy with tissue and is seen in high powered lasers used for vapourization of coagulation of tissue through absorption in major tissue components. (2) The thermal effects of laser energy on soft tissues is as per table 1. (1)

Photo-mechanical ablation: This is the disruption of tissues due to phenomenon like shock wave, cavitations etc.

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Photo-chemical effects: It is the conversion of photonic energy into biochemical energy while the secondary mechanisms are attributable to sub cellular changes due to photo-chemical effect. This is used to treat conditions like cancers. (3-8)

CLASSIFICATIONS OF LASERS (9)

Class 1: These devices have very low output power which remain under the maximum permissible exposure (MPE) values even at long irradiation times or have a high output power but are fitted with protective housing which prevents radiation to emerge outside.

Class 1 M: This device is safe for all conditions of use with naked eye but has safety hazards when used with optical instruments like microscopes, loupes etc.

Class 2: Laser devices have wavelength between 400-700 nm. Natural reactions of turning away (e.g. shutting fo the eyelid, time :approx 0.25 s) is sufficient for protection of eye. These devices are safe to view directly as long as the reflex of turning away is not suppressed.

Class 2M: This device is safe where the eye is protected by blink reflex but has safety hazards when used with optical instruments.

Class 3R: In the new laser standard EN 60825-1 the old classification of "Special Class 3 B" has been renamed as Class 3 R. Direct viewing is hazardous and a real hazard arises only at an irradiation time of several seconds.

Class 3B: Eyes are endangered and even skin in special cases and the damage can occur even at very short irradiation times.

Class 4: The output power of these lasers is > 0.5 W and the eyes and skin are endangered even at diffuse reflection. Compliance with safety standards are necessary for protection of dentist, dental assistant and patient.

CLINICAL LASER APPLICATIONS

Diode laser devices in the market have Food and Drug Administration (FDA) clearances for all minor periodontal and oral surgery procedures but not all commercial diode lasers have the same level of clearance from the federal regulatory agency. The clinical applications for diode lasers as per FDA marketing clearances are mentioned as under (10)

1. Intra-oral Soft Tissue Surgery (Ablating, Incising, Excising, Coagulating)
2. Aphthous Ulcer Treatment
3. Sulcular Debridement
4. Removal of Coronal Pulp, Adjunct to Root Canal Procedures
5. Pulpotomy as adjunct to Root Canal Retreatment
6. Tooth Whitening
7. Aid in Diagnosis of Dental Caries
8. Blood Flow Measurements
9. Treatment of herpetic lesions
10. Coagulation of Extraction Sites
11. Reduction of Bacterial Level (Decontamination) and Inflammation
12. Aid in Detection and Localization of Subgingival Dental Calculus

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TRAINING FOR LASERS

It is imperative that dentist and dental staff are well trained and well versed in use of multiple wavelengths of dental lasers so as to avoid any potential hazards associated with it. There are many certification programs and continuing dental education courses and online webinars being conducted all over the world. Some of the internationally acclaimed academies dedicated to laser dentistry imparting basic and advanced laser training certifications include Society for Oral Laser Applications (SOLA), World Clinic Laser Institute (WCLI) and Academy of Laser Dentistry (ALD). It is important for every dentist to be properly certified and trained in safe laser usage.

CONCLUSION

Lasers have added a spark in the field of high end dentistry and dental lasers offer the dentist not a single modality of treatment but an entire ocean of possibilities with a plethora of benefits still awaiting exploration.

The future of dental lasers is lustrous with some of the latest ongoing research addressing the use of dental lasers for GTR, connective tissue attachment, and tissue welding. In future we may see incorporation of multiple wave lengths (some of them perhaps not yet known) into a single unit.

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Table 1: Thermal effects of laser energy on soft tissue (1)

Tissue temperature (0C)	Observed Effect
>37	Hyperthermia
45-50	Development of edema – blanching
>50	Nonsporulating bacteria inactivated

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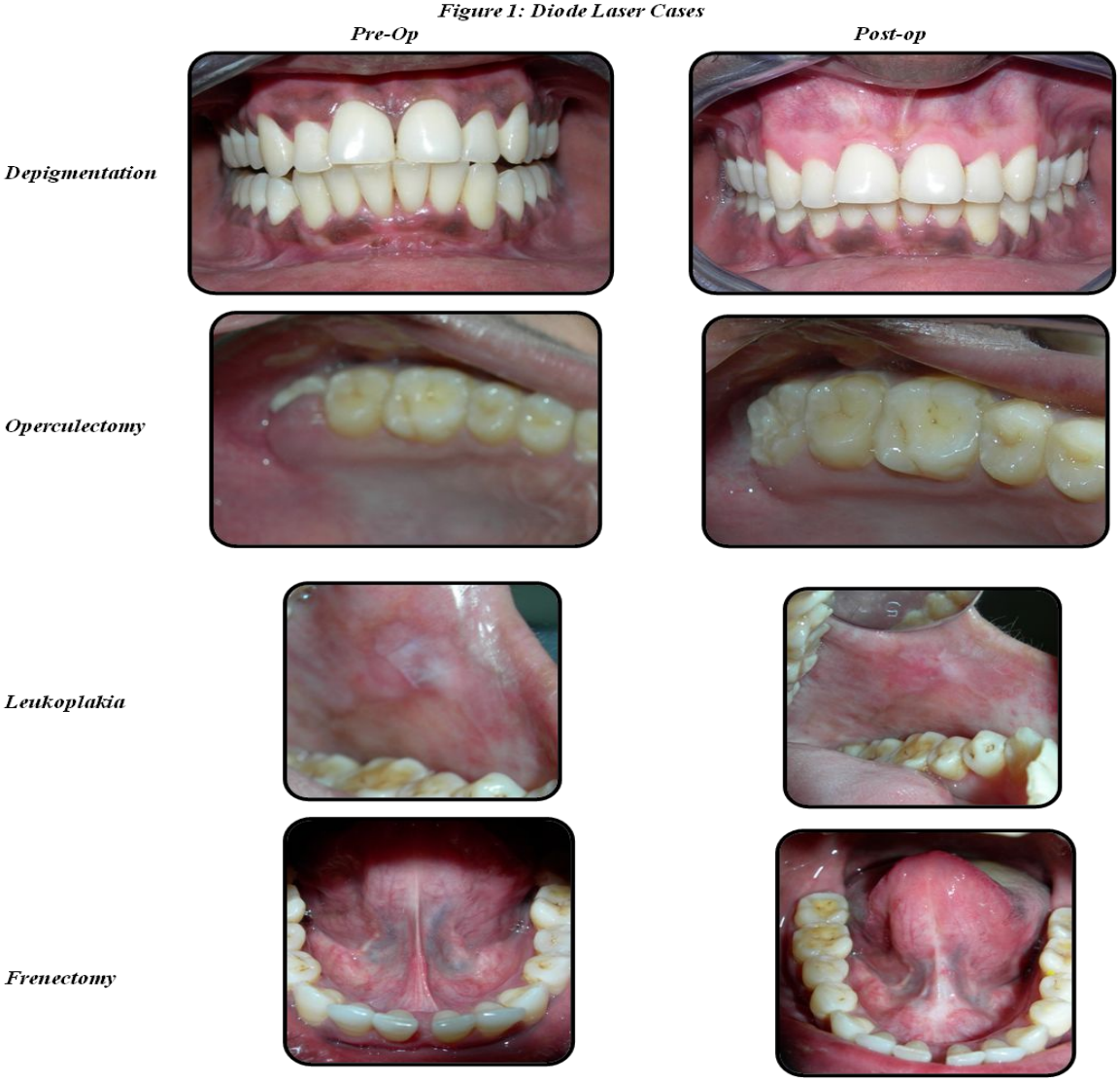
>60	Coagulation and protein denaturation
>100	Vapourization or incision
>200	Carbonization

Figure 1: Diode Laser Cases



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