Original Paper

Diode Lasers – Its Applications In Clinical Dentistry

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ABSTRACT

Lasers, relatively a new treatment modality applicable in all specialties of dentistry has evolved rapidly in the last 2 decades, promising predictable outcomes for the patient and stress free dentistry for the consulting doctor.

Lasers broadly classified as soft and hard tissue lasers are extremely safe and comfortable to the patients and are precise and effective to perform treatment in various fields of dentistry. In today's scenario incorporating lasers into dental practice has involved state of art technology in almost 5-10% of the clinical setup.

Keywords: Laser, Soft tissue laser, Diode, Minimal bleeding, Painfree dentistry.

INTRODUCTION

LASER is an acronym for "Light Amplification by Stimulated Emission of Radiation". In 1960, Theodore H. Maiman invented the first working ruby laser. In 1962, Robert N. Hall invented the first diode laser which is commonly used in soft tissue management in dentistry today.

In 1917, Albert Einstein a physicist described the theory of stimulated emission. Laser light is significantly different from ordinary light as it is monochromatic (single colour / wavelength), coherent (waves are in phase), collimated (beam is parallel and non-divergent) and therefore has more energy. Laser light is emitted in a very thin beam and by focusing and defocusing this beam a dentist can vary its effect on the tissue and bring about dramatic changes as laser tissue interaction in the host tissue. The various laser tissue interactions are reflection, absorption, transmission and scattering of which absorption is the most desired property of lasers. Lasers are within the visible and infrared portion of the non-ionizing part of the Electro-Magnetic spectrum and emit thermal radiation.

Lasers have to be used with caution and laser safety is very important. Few laser safety protocols generally followed are:

- Wearing protective eyewear with an Optical Density of 5 or more. "Patient first on – patient last off " is the slogan to be followed at all times.
- Laser plume hazards such as vaporized water, carbon particles, cellular products have to be evacuated with the high vacuum suction.
- Avoid using alcohol spray pre and intra laser operation to reduce fire hazard.
- Keep the laser always in stand-by mode when not in use and the protective covering over the foot switch enclosed.
- Prevent test firing with the tip on the skin.
- Minimize the reflective surfaces in the operatory and
- optimize the use of plastic instruments.
- Have a caution board placed outside the operatory to avoid traffic during laser operation.

Diode lasers[1] are the commonly used soft tissue lasers in dentistry today. The various wavelengths available are 810nm, 940nm and 980nm. The chromophore within the host tissue is hemoglobin and melanin, in which the diode laser energy is highly absorbed. The diode lasers have excellent ability to cut accurately in contact mode and can deliver continuous or gated (pulsed or chopped) mode.

Clinical Cases

Diode lasers are commonly used for bringing about a soft tissue interaction in the host tissue. The ideal laser tissue interaction includes identifying the target tissue in the host, using appropriate wavelength, and using minimal power values (laser settings) to bring about desired tissue interaction, exposure of laser energy for minimal time and to achieve maximum thermal relaxation in host tissue to prevent collateral thermal damage to surrounding tissues. Lasers use the property of reflection to diagnose dental caries with Diagnodent. However there are quite a few clinical applications of diode lasers in everyday clinical dentistry which acts as a practice builder:-

1. Frenectomy(complete removal of the frenum)/Frenotomy (displacement of the frenum apically):

Removal of the thick frenum which gets attached between the central incisors causing a midline diastema is one of the most frequently used applications of lasers. Such frenal attachment is also observed in the buccal aspect which is severed when there is a pull in the posterior region, causing gingival recession. (Figures 1a, 1b, 1c)

2. De-pigmentation:

Hyper pigmentation of melanin in the basal cell layer of the gingival epithelium gives a dark brownish hue to the gingiva. Removal of such hyper pigmented gingiva enhances the gingival esthetics in one's smile[2,3]. (Figures 2a, 2b, 2c)

3. Gingivoplasty/Gingivectomy :

Bundling of soft tissue inter dentally causes food entrapment and a nidus for the bacteria. Removal of this tissue aids in sculpting the gingiva for better esthetics and ease of maintenance especially in Orthodontic patients. (Figures 3a, 3b, 3c)

4. Crown lengthening :

Soft tissue overgrowth on a single or multiple teeth gives an unaesthetic smile. Bringing a balance between the biological width and the anatomical crown display[4,5,6] enhances one's aesthetic appearance. Such soft tissue crown lengthening procedures can be done easily with soft tissue lasers. (Figures 4a, 4b, 4c)

5. Gingival Troughing:

Hyperplastic tissue along the finish line of prepared teeth which is the recipient of a crown/ bridge can be removed with the use of lasers. Lasers can be used within the gingival sulcus which brings about a predictable gingival retraction with minimal collateral damage[7]. (Figures 5a, 5b, 5c)

6. LANAP:

Laser Assisted New Attachment Procedure [LANAP] is a laser aided periodontal therapy which involves pocket debridement with scaling and root planning[8,9,10,11] followed by pre and post laser debridement. 1-2mm of the external pocket epithelium is also vaporized in order to promote the junctional epithelial formation within the periodontal pocket. (Figures 6a, 6b, 6c)

7. Root Canal Disinfection:

Lasers aid in sterilization of the main and lateral canals within the root canal complex. Primarily being bactericidal in their action, laser assisted sterilization[12,13,14,15,16] of root canals also reduce pain and peri-radicular pathology and helps treat them non-surgically. (Figures 7a, 7b, 7c)

8. Ulcers:

Low level laser therapy (LLLT) has significantly reduced pain, swelling, redness and burning sensation on oral ulcers. The immediate relief with ulcers is brought about by the "Eschar formation" which acts as a laser band-aid offering a protective covering over the ulcer. (Figures 8a, 8b, 8c)

9. Operculectomy:

Hyperplastic gingival proliferation or the soft tissue covering an erupting impacted tooth is painful because of the masticatory impact of the opposing tooth. Such tissue can be easily excised in to with laser using minimal or no injections, in a blood- less field thereby enabling better visualization. (Figures 9a, 9b, 9c)

10. Laser assisted bleaching:

Post bleaching sensitivity, a major concern in traditional bleaching methods has been phenomenally reduced due to laser assisted bleaching. A patented chromophore incorporated in the bleaching gel activated with laser energy thereby initiating the redox process brings about a radical change in the shade of the stained teeth. The visible shade change to a lighter hue brought about by laser assisted bleaching is much appreciable by the patients due to reduced sensitivity. (Figures 10a, 10b, 10c)

11. Excision of soft tissue pathology:

Bad oral habits, sharp teeth and other local factors initiate an irritant to the soft tissue thereby causing a proliferative overgrowth in many intra oral sites which gives rise to an oral pathology. Such lesions of clinical interest can be excised using laser bringing about desirable post operative healing[17]. (Figures 11a, 11b, 11c)

12. LLLT:

Low Level Laser Therapy is relatively a fast advancing physiotherapeutic pain relieving dental modality used in immediate relief of trismus, TMJ dysfunction syndrome, neuralgic pain, and pain at post impaction and extraction sites[18]. (Figures 12a, 12b, 12c)

13. Wound healing at extraction socket:

Lasers when used in extraction sites post tooth removal act as a bactericidal agent and bring about faster wound healing and less eventful post operative complications even in medically compromised patients. (Figures 13a, 13b, 13c)

14. Smile Design:

Soft tissue esthetic enhancement corrections such as gingivectomy, gingivoplasty crown lengthening, de-pigmentation[19] bring about an enhanced treatment outcome to ones' smile. This improves ones' appearance and also aids in enhanced psychological factors such as self confidence and increased self esteem. (Figures 14a, 14b, 14c)

15. Pontic preparation:

Lasers are used for sculpting the soft tissue in the saddle region beside the abutment teeth receiving the fixed partial denture. This aids in ease of maintenance and a healthy gingiva next to the abutment teeth[20]. (Figures 15a, 15b, 15c)

Discussion

Dental soft tissue lasers have evolved as an adjunct or alternative treatment modality in various aspects of clinical dentistry. Hemoglobin and melanin being the important chromophores for soft tissue diode lasers, management of bleeding and removal of pathological lesion is easily achieved. The advantage of laser include minimal use of local anesthetics, minimal need for medication, minimal need for suturing, bactericidal action thereby reducing the bacterial population, reduced post operative swelling and scarring, fast and better healing and more relaxed appointment for both the patient and the doctor.

Conclusion

Diode lasers have become an alternative treatment modality due to its various advantages over traditional methods such as surgical scalpel and electrocautery. Lasers have gained its inclusion as a diagnostic tool in caries detection and as therapeutic tool in treatment for various dental procedures in dental clinics.


Figure 1a - Pre-operative view of the frenum


Figure 1b - Intra-operative view using lasers


Figure 1c - Post-operative view after the frenectomy procedure


Figure 2a - Dark pigmented band of gingiva


Figure 2b - Intraoperative view of the depigmentation procedure


Figure 2c - One day post operative view of the gingiva


Figure 3a - Pre-operative view of hyper plastic gingiva


Figure 3b - Intra-operative view using lasers


Figure 3c - Post-operative view after gingivoplasty procedure


Figure 4a - Pre-operative view of partially erupted canine


Figure 4b - Intraoperative view using lasers


Figure 4c - Immediate post-operative view after crown lengthening procedure


Figure 5a - Pre-operative view after crown preparation 25


Figure 5b - Intra-operative view using lasers for troughing


Figure 5c. Post-operative view after gingival troughing procedure

Figure 6a - Pre-operative view before LANAP

Figure 6b - Intra-operative view using lasers

Figure 6c - One week post-operative view

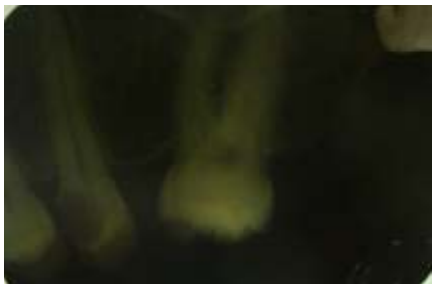

Figure 7a -Radiographic view of decayed premolar

Figure 7b - Mid- endodontic usage of lasers for bactericidal effect

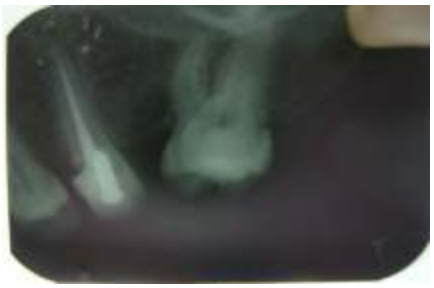

Figure 7c - Post obturation radiographic view

Figure 8a - Pre-operative view of multiple aphthae in the lower labial mucosa

Figure 8b - Intra-operative view using lasers for LLLT

Figure 8c - Immediate post-operative view of LLLT effect on ulcer healing

Figure 9a - Pre-operative view of operculum covering 48 distally

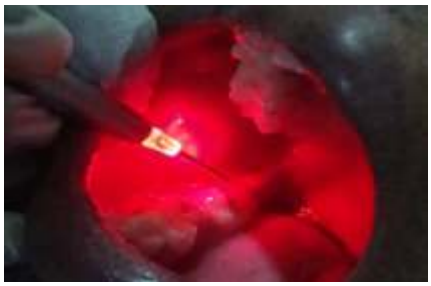

Figure 9b - Intra-operative use of lasers

Figure 9c - Immediate post-operative view

Figure 10a - Preoperative view of the stained teeth

Figure 10b - Laser assisted bleaching procedure

Figure 10c - Immediate postoperative view showing 4 shades lighter


Figure 11a - Eruption cyst present on erupting 43 region


Figure 11b - Intraoperative view using lasers for excision


Figure 11c - One day postoperative view


Figure 12a - Only one finger mouth opening due to TMJ pain


Figure 12b - LLLT on the TMJ


Figure 12c - Two finger mouth opening post operative view


Figure 13a - Decayed 46 with suppuration


Figure 13b - Extraction followed with LLLT


Figure 13c - One week post operative view


Figure 14a - Hyperplastic gingiva bundling between the teeth midorthodontically


Figure 14b - Intraoperative view using lasers


Figure 14c - Sculpted gingiva giving an aethetic smile


Figure 15a - Bundled soft tissue in pontic region


Figure 15b - Intraoperative view using lasers


Figure 15c - Sculpted pontic region

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About the Author

Dr.Vidyaa Hari Iyer is a leading practitioner in T.Nagar, Chennai practicing since 1994 and Director of Smile Dental Clinic – a Laser assisted multi-specialty clinic. She is the President of Indian Dental Association, Madras Branch. She has done her Fellowship in LASER Dentistry from University of Genova-Italy, and Diplomate in Laser Dentistry conducted by AALZ & RWTH Aachen University, Germany at IALD Mumbai. She has undergone training in Laser Applications from World Clinical Laser Institute (WCLI) – Taipei Taiwan. She conducts a number of hands-on courses on Hard and Soft tissues both locally and nationally. She has won Outstanding Academic Excellence Award, Bronze award from International College of Dentists for Lasers. She has lectured widely in almost all cities of India and is the visiting faculty for Manipal University and IALD – Mumbai. She has numerous International and National publications to her credit. She has held the post of Treasurer both during the IALD, Chennai workshop and IALD International Conference at Chennai. She is a life member of IALD and SOLA.

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