Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/15652
DOI URL: http://dx.doi.org/10.21474/IJAR01/15652

RESEARCH ARTICLE

APPLICATIONS OF LASER ASA TOOL IN THE MANAGEMENT OF SOFT TISSUE LESIONS - A REVIEW

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Manuscript Info

Manuscript History
Received: 05 September 2022
Final Accepted: 09 October 2022
Published: November 2022

Key words:-
Laser In Dentistry, Soft Tissue Lesions, Diode Laser, Low Level Laser Therapy (LLLT)

Abstract

Lasers are making significant contributions to every step in the practice of dentistry, from diagnosis to preventive measures. A laser, an acronym for light amplification by stimulated emission of radiation. In recent years, improved understanding of light -tissue interactions and of greatest importance, new technologies for delivering laser light to the tissue, has transformed laser light into versatile and valuable one. Laser is one of the minimally invasive procedures, it can be used as a treatment tool for both hard and soft tissues with less discomfort to the patient. In this review article, we will be discussing about its uses in the management of soft tissue lesions

Introduction:-

LASER is an acronym of light amplification by stimulated emission of radiation. It was first built in 1960 by Theodore H. Maimanand began to gain popularity in the 1990s. Laser technology is making great inroads into lot of areas of dentistry. One of the mile stone in technological advancements in dentistry is the use of laser. Laser are intense beams producedby stimulated emission of radiation from a light source. There are three characteristic features of lasers by Albert's Einstein theory as: monochromatic, i.e., all the waves have the same energy and frequency; coherent, which describes all the waves of light to be in phases related to each other in speed and time; and collimated ensuring parallelism of the waves [1]

Classification of LASER

Even though there have been many classifications of lasers, Srivastava et al proposed a new simplified classification of lasers based on the clinical use (Figure 1). This classifies lasers on the basis of surgical and non-surgical use. Surgical lasers are subclassified into hard and soft tissue lasers [2]

Mechanism of Laser Interaction to Tissues

In dental lasers, the laser light is delivered from the laser to the target tissue via a fibreoptic cable, hollow waveguide, or articulated arm[3] (Figure 2& 3).

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Laser Application in Soft Tissues

Wound healing

Healing of skin wounds by secondary intention, daily LLLT during the postoperative period (810nm, output 30 mW/cm2, daily dose of 0.9J/cm2/wound/day) which stimulate collagen formation and increase the strength of a forming scar[5]. Major changes seen in wounds treated with Low level laser therapy (LLLT)include increased granulation tissue, early epithelialization, increased fibroblast proliferation, matrix synthesisand enhanced neovascularization [6,7].

Post herpetic neuralgia

840 nm (infrared), GaAlAs(Gallium-Aluminium-Arsenide), pulsed, 20 mW/cm, for 6 minutes. Low Level Laser Therapy (LLLT) mediate analgesia by releasing local neurotransmitters such as serotonin, promoting the release of endorphins, whilesimultaneously decreasing prostaglandin E^2 and bradykinin levels[8]. It allows for the rapid resolution of the inflammatory process and to stimulate tissue regeneration including angiogenesis, collagen production, muscle and nerve regeneration, cartilage production and bone formation[9].

Aphthous ulcer

Diode laser with the wavelength of 915nm, 300s/cm^2 fibre was used with power of 2 W, cw in non-contact mode, with irradiation time of 30s/cm^2.Four types of low-level lasers have been used to treat aphthous ulcers: CO_2, Nd: YAG, diode and GaALAs (Gallium-Aluminium-Arsenide)lasers.

Mechanism of pain relief by laser:

1. First, based on modulation of pain perception by modification of nerve conduction via the release of endorphins and enkephalins.
2. Another mechanism of pain relief is related to the enhanced ATP synthesis in the mitochondria of the neurons[10].

Burning Mouth Syndrome

The diode laser was applied to the areas with 4Watt of power, wavelength805 nm, energy 1200 Joules, irradiation time of 300s, energy density 50J/cm2, 60 mW continuous wavelaser, and irradiance 166.7 mW/cm2. The application of the laser was performed with ahandpiece, holding the handpiece exactly 4 cm away from the mucosa, which was the distance necessary forthe collimation of the light beam. All this protocol was repeated twice a week, for 4 weeks, for a total of 8 sessions (T#1/T#8)[11].

Nicotinic Stomatitis

A carbon dioxide laser is used in a defocussed, continuous mode perpendicular to the tissue surface along the long axis of the lesion. The lesion is wiped with saline to remove the lased surface so that the non-lased surfaces will be revealed. After finishing the process, the final lased surface layer is left undisturbed to act as barrier and help in the protection of the healing surface. A palatal splint is fabricated to help the patient protect the lased surfaces during eating and drinking. An Nd: YAG contact round surgical probe can also be used in a similar manner to the carbon dioxide laser[9].

Potentially Malignant Disorders

Actinic chelitis

Ablative laser vermilionectomy procedures can be performed with either an ablative erbium or CO_2 laser. A 2940-nm erbium laser permits easy recognition of the pinpoint bleeding and allows for a precise depth of epithelial ablation. The most common settings use are 3-5 passes with depth of ablation of 40-50 microns (fluences of 10-12.5 J/cm^2), paying close attention to the endpoint of diffuse pinpoint bleeding. More hyperkeratotic areas may require additional passes to reach this endpoint than others[12].

Oral leukoplakia

Laser irradiation is performed using a semiconductor laser light source at 630 nm ± 5 nm. A power of 100Mw/cm−2 is recommended; each 3-min irradiation session is followed by 3 min of rest to maintain effective intracellular oxygen concentrations until the total light exposure dose reaches 100 J/cm^{-2}.During laser exposure, to achieve even irradiation of the targetlesion, the laser beam should be as perpendicular to the surface ofthe lesion as possible. The lesion should be treated once every 2–3 weeks, dependingon the healing of the lesion[13].

Oral submucous fibrosis
Laser fibrotomy with Er Cr: YSGG laser was done under local anaesthesia at power of 1.5 W, water 10 % and air 13 % using a sapphire tip (G6, 600 μm in diameter, 6 mm in length) in non-contact mode. An inverted Y-shaped incision, with a depth of 2 mm was made with the two arms extending from the retromolar area to the premolar area on the buccal mucosa attempting to cut through all palpable fibrotic bands [14].

Mucocele
Diode laser used under local anesthesia. This laser device emits photons at a wavelength of 980nm and operates in a continuous emission mode with a supplementary gated emission. Has a maximum power output of 8W, with a repetition rate that can attain 25kHz. The tip was directed to the surface of the lip at the base of the lesion at an angle of 10 to 15°. Movements were performed around the base, while the mucocele was grabbed by tweezers. The site was slowly and continuously mopped by sterile wet gauze to avoid tissue overheating. Care was taken to control the tip[15].

Photobiomodulation therapy
Photo-biomodulation therapy previously known as low-level laser therapy. PBM enhances wound repair and tissue regeneration by acting on different phases of injury resolution, including inflammation, proliferation, and remodelling phases. Wavelength of 660nm,15Mw,0.004cm^2, 3.8J/cm2 to control mucositis, 980 nm, density of 3 J/cm2 for 12 s on each point to treat dysgeusia and 650 nm, density of 3 J/cm2 for 12 s in a continuous and contact mode targeting major salivary glands for treatment of hyposalivation [16,17,18].

Advantages
1. Promote wound healing
2. Chronic pain management
3. Reduce the duration and frequency of herpetic lesions
4. Local anesthesia augmentation
5. Reduce orthodontic treatment time
6. Reduces pain after surgical procedures
7. Trigger point therapy
8. Reduce dentinal hypersensitivity
9. Accelerate osseointegration and bone regeneration
10. Reduce symptoms of TMJ arthralgia [19,20]

Disadvantages
1. Laser beam could injure the patient or operator by direct beam or reflected light, causing retinal burns
2. Laser - more expensive
3. Need trained personal
4. Lasers can't be used to fill cavities located between teeth, remove defective crowns or silver fillings, prepare teeth for bridges [19,20]

Contraindications
Absolute contraindications
Eye exposure

Special contraindications
1. Locally injected medication
2. Malignancy
3. Pregnancy

False contraindications
1. Hyperpigmentation
2. Tatoos
3. Implants
4. Microbial infection
5. Photosensitizing medications[20]

Precautions
1. Active epiphyses
2. Hemorrhage
3. Testicles
4. Thyroid gland

Hazards
A hazard is something with the potential to cause injury.Hazards on

Eyes
Acute exposure of the eye to lasers of certain wavelength and power can cause corneal or retinal burns or both. Chronic exposure to excessive levels may cause corneal or lenticular opacities (cataract) or retinal injury

Skin
Acute exposure to high levels of optical radiation may cause skin burns, while carcinogenesis may occur for ultraviolet wavelength(290-320nm)

Chemical
Some lasers require hazardous or toxic substances to operate (i.e., chemical dye, excimer lasers)

Electrical
Most lasers utilize high voltages that can be lethal

Fire
The solvents used in dye lasers are flammable. High voltage pulse or flash lamps may cause ignition. Flammable materials may be ignited by direct beams or specular reflections from high power continuous wave (CW) infrared lasers [21]

Laser Safety Measures
Nature of effect of lasers on tissue comprises wavelength, exposure time, spot size, and tissue variables of physical and chemical composition. To ensure safe and effective operation of dental lasers, precautionary measures must be considered. Lasers are not advised in patients with pacemakers, pregnant women, epileptic patients, and arrhythmic patients and avoided in glands, tumors, or on lupus lesions. According to the ANSI Z136 series of laser safety standards, control measures are categorized as:

Engineering control measures
1. Laser barriers and protective curtains
2. Protective housing
3. Master switch control
4. Optical viewing system safety
5. Beam stop or attenuator
6. Interlock requirements
7. Laser activation warning system
8. Administration control
9. Appointing laser safety officer
10. Safe working procedures
11. Trained and experienced personnel
12. Hazard signs using color, dimension, and location of symbol (sunburst pattern)
13. Eye and skin examinations
14. Test firing
15. Personal protective equipment
16. Eye protection using safety goggles
17. Laser filtration masks to prevent airborne contamination
18. Evacuation of laser plume using high-volume suction
19. Protective clothing, surgical gloves, and footwear to be worn by operator [21,22]

Recent Advancement
Currently, erbium lasers are considered suitable for dental treatment,due to its dual ability to ablate hard and soft tissues with minimal damage.

Periowave™:
Photosensitizer with low-intensity laser to destroy bacteria and toxins after scaling and root planning

Periodontal Waterlase MD:
Er, Cr; YSGG for minimally invasive surgical periodontal laser therapy

Piezosurgery:
It is an ultrasound device using ultrasonic vibration for osteotomy and osteoplasty

Photon-induced photoacoustic streaming:
A recent advance in root canal therapy developed by DiVito EE that creates powerful shockwaves at sub ablative levels to clean with disinfecting irrigants, three-dimensionally throughout the entire root canal system [23]

Conclusion:-

Not all lasers are created equal. Selecting a wavelength or specific laser is dependent upon what the clinician hopes to accomplish and possibly who will be using the laser. Different wavelengths are absorbed into various target tissues differently. Although similar in design and function, diode laser wavelengths range from 805 nm to 1064 nm. This variable in wavelengths has an effect on absorption within water and ultimately, the depth of penetration of light energy within soft tissue. Wavelengths such as the 980-nm class diodes are more readily absorbed into water, thereby penetrating less deeply and potentially creating less thermal collateral damage. A further area of future growth is expected to be a combination of diagnostic and therapeutic laser techniques. Looking to the future, it is expected that specific laser technologies will become essential components of contemporary dental practice over the next decade [24].

Figure 1:-

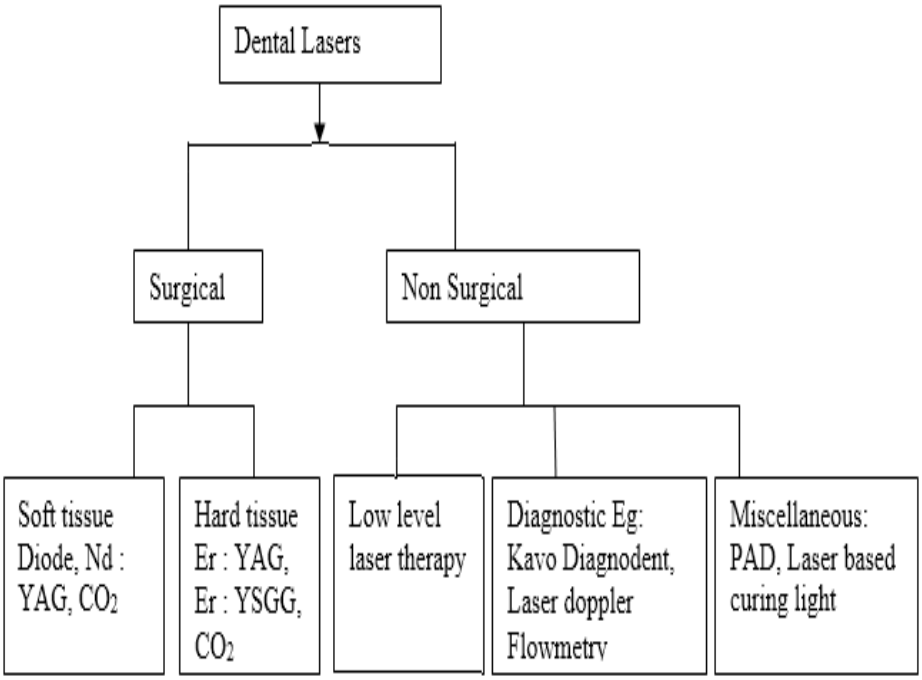


Figure 2:-

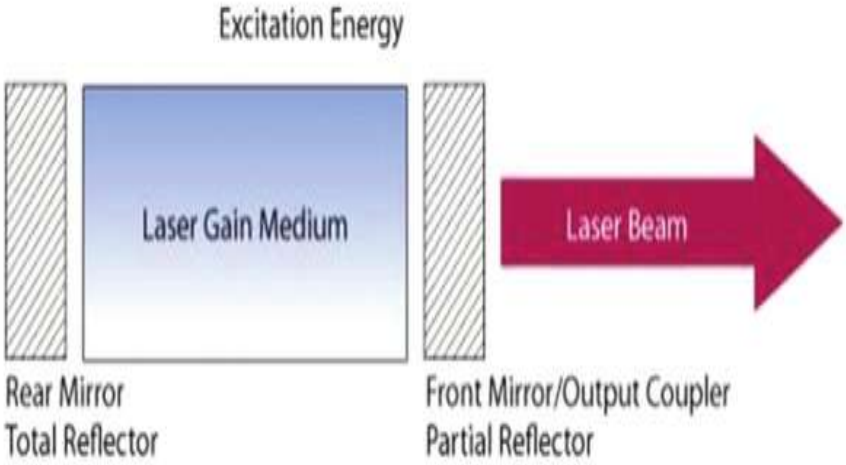
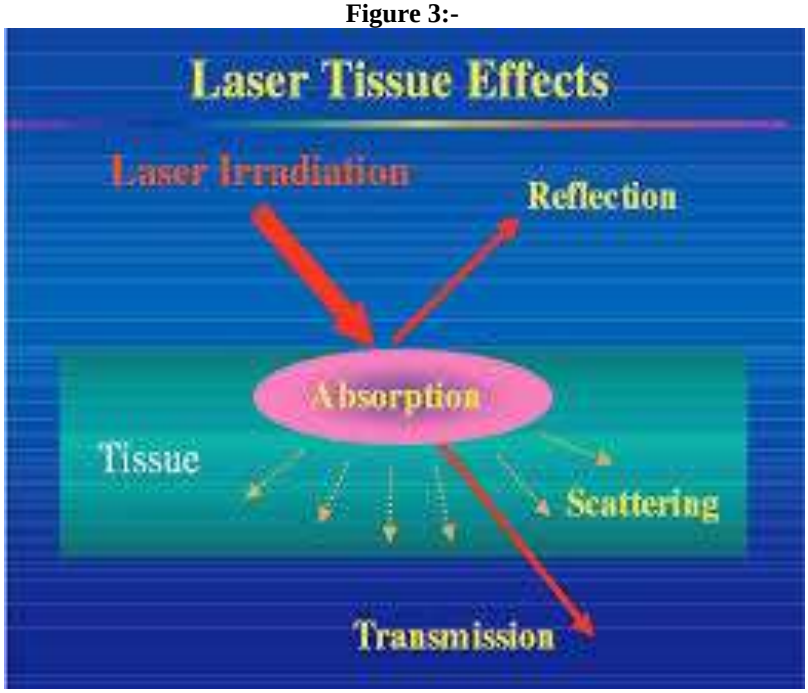


Figure 3:-



Reference:-

1)Luke AM, Mathew S, Altawash MM, Madan BM. Lasers: a review with their applications in oral medicine. JLasersMed Sci. 2019;10(4):324-329. doi:10.15171/jlms.2019.52.

2)Srivastava VK, Srivastava SM, Bhatt A, Srivastava A. Lasers classification revisited, Famdent Practical Dentistry Handbook. 2013;13(5): 1-5.

3)Pendyala C, Tiwari RVC, Dixit H, Augustine V, Baruah Q, Baruah K. Contemporary Apprise on LASERS and its Applications in Dentistry. Int J Oral Health Med Res 2017;4(2):47-51

4)Parker S. Introduction and history of lasers and laser light production. BDJ 2007; 202 (1)

5)L. J. Walsh: The current status of low-level laser therapy in dentistry. Part 1. Soft tissue applications. Australian Dental Journal 1997; 42:4

6)Susmit Sneha et al: laser in oral mucosal lesions- an innovative tool. Journal of oral medicine, oral surgery, oral pathology and oral radiology,2017;3(2):103-106 Doi:10.1823/2395-6194.2017.0023

7)Bouneko J M et al. The efficacy of laser therapy in the treatment of wounds: a meta-analysis of the literature. Proc. Third Congress World Assn for Laser Therapy, Athens, Greece, May 10-13 2000; p 79

8)Dubinksy RM, Kabani H, El-Chami Z. Practice parameter: treatment of postherpetic neuralgia: An evidence-based report of the quality standards subcommittee of the American Academy of Neurology. Neurology. 2004;63(6):959-965.
9)Reshma J Abraham: Laser Management of Introral Soft Tissue Lesions – A Review of Literature. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 13, Issue 1 Ver. X. (Feb. 2014), PP 59-64
10)NarjissAkerzoul and SalihaChbicheb: Low laser therapy as an effective treatment of recurrent aphtous ulcers: a clinicalcasereportingtwolocations.PanAfrMedJ. 2018;30:205. Doi: 10.11604/pamj.2018.30.205.15779PMCID: PMC 6294968 PMID: 30574224
11)Giuseppe Alessandro Scardina et al: Photo biomodulation Therapy in the Management of Burning Mouth Syndrome: Morphological Variations in the Capillary Bed. Dent. J. 2020, 8, 99; doi:10.3390/dj8030099
12.Alexiades-Armenakas MR, Geronemus RG. Laser-mediated photodynamic therapy of actinic cheilitis. J Drugs Dermatol 2004;3(5):548-551
13)Qianming Chen, Hongxia Dan: Photodynamic therapy guidelines for the management of oral leucoplakia International Journal of Oral Science (2019) 11:14
14)Zainab Chaudhry et al: The Efficacy of Er Cr: YSGG Laser Fibrotomy in Management of Moderate Oral Submucous Fibrosis: A Preliminary Study. J Maxillofac Oral Surg. 2014 Sep; 13(3): 286–294. Doi: 10.1007/s12663-013-0511-x
15)Amira Besbes et al: Recurrent Oral Mucocele Management with Diode Laser - A case report. Hindawi Case Reports in Dentistry Volume 2020, Article ID 8855759, 5 pages https://doi.org/10.1155/2020/8855759
16)Anette Stájer et al: Utility of Photodynamic Therapy in Dentistry: Current Concepts. Dent. J. 2020, 8, 43; doi:10.3390/dj8020043
17)Marwan El Mobadder et al: Photo biomodulation Therapy in the Treatment of Oral Mucositis, Dysgeusia and Oral Dryness as Side-Effects of Headand Neck Radiotherapy in a Cancer Patient: A Case Report. Dent. J. 2018, 6, 64; Doi:10.3390/dj6040064
18)Paulo Andre Goncalves de Carvalho et al: Three photo biomodulation protocols in the prevention/ treatment of radiotherapy- induced oral mucositis.
19)Armida MM. Laser therapy and its applications in dentistry. Pract Odontol.1989;10:916.
20)Stabholz A, Zeltser R, Sela M, Peretz B, Moshonov J, Ziskind D, Stabholz A. The use of lasers in dentistry: principles of operation and clinical applications. Compend Contin Educ Dent. 2003 Dec;24(12):935-48; quiz 949. PMID: 14733160.
21)Meenakshi Boddun et al: Laser hazards and safety in dental practice: A Review DOI: 10.15761/OHC.1000189
22)Beer F, Strabl M, Wernisch J, Laser safety (1995) In: Moritz A, editor, Oral laser application. 2nd Ed. New York: Raven Press 465-478
23)DiVito EE, Benjamin SD, LeBeau J. Advances in laser dentistry: expanding beyond periodontal care. Compend Contin Educ Dent. 2014 Nov-Dec;35(10):734-5. PMID: 25742677.
24)Sanjeev Kumar Verma et al. Laser in dentistry: An innovative tool in modern dental practice. Natl J Maxillofac Surg. 2012 Jul-Dec; 3(2): 124–132.
Doi: 10.4103/0975-5950.111342, PMCID: PMC3700144, PMID: 23833485.