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A Review of Lasers and Their Utilization in Oral Medicine

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ABSTRACT:-

In the 1990s, lasers in dentistry started to become more common. Lasers are utilized in dentistry as a therapeutic instrument or an auxiliary tool. The major objective of employing lasers in dentistry is to eliminate the drawbacks that currently exist with traditional dental treatment methods. The most recent laser technology is used in several dental specialities, including oral surgery, implants, oral medicine, periodontics, paediatrics, and operations. The patient delivery system in dentistry practices has benefited from the usage of lasers since they can perform minimally invasive operations with less discomfort for the patient. The use of lasers in treating oral mucosal lesions is briefly discussed in this article.

Keywords*:* Oral Mucosal Lesions, Dental Lasers, Laser Dentistry

INTRODUCTION: -

Light amplification by stimulated emission of radiation is referred to as LASER.Lasers are powerful beams created by the radiation that a light source emits when it is stimulated to do so. Einstein recognized the promotion of a laser as a natural process caused by the emission of radiation. A laser beam is produced when a beam of light passes through a particular medium and stimulates the atoms therein to transmit light in a particular direction, i.e., in the same direction as the medium by the same wavelength as the original beam. Lasers can make directional, high-intensity beams of light with an effective wavelength by boosting the light's intensity. Three distinctive characteristics of lasers are described by Albert's theory of spontaneous and simulated emission of radiation: monochromatic (all waves have the same

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energy and frequency); coherent (all waves of light are in phases related to one another in speed and time); and collimated (ensuring parallelism of the waves) (low beam divergence).

Laser classification

The active medium of a laser, such as a gas, liquid, solid, or semi-conductor, can be used to categorize lasers in dentistry and determine the type of laser beam that will be emitted. They can invariably be divided into two categories based on the type of laser being used: gas lasers and solid lasers. Additionally, they can be divided into groups based on the wavelengths and risks involved with applying lasers to different types of tissue, such as hard and soft tissue. [4] The helium neon laser was the first gas laser, and it was powered by several infrared and green wavelengths. NdYAG, Er:YAG (erbium-doped yttrium aluminum garnet), and carbon dioxide are all classified as Hard lasers can be applied to both hard and soft tissues, but they have limitations because they are pricey and harm the tooth pulp thermally. Cold lasers, also referred to as soft lasers, are based on the diode device and are inexpensive and portable. Typically, these are referred to as low-level laser therapy (LLLT).

Although the carbon dioxide laser's bulkiness, high price, and destruction of hard tissue are to its drawbacks, it is hydrophilic, has quick soft tissue removal, haemostasis with shallow depth penetration, and has maximal absorbency. The Nd:YAG laser is readily absorbed by pigmented tissue in addition to having good hemostasis, which keeps it highly useful for surgical cutting and coagulation of soft tissue. Additionally, it has been documented that it can be employed in the management of periodontal disease. [4]

The Er,Cr:YSGG (yttrium scandium gallium garnet) laser and the Er:YAG laser are the two wavelengths of the erbium laser. It is the greatest option for treating both hard tissues and soft tissues that contain a large proportion of water due to its high affinity for hydroxyapatite and its high water absorption rate. Haemoglobin and tissue pigment are the main targets of the diode laser's absorption. On the other hand, hydroxyapatite and water do not absorb it well. As a result, it has been employed in herpetic lesions, frenectomies, and the removal of inflammatory and hypertrophic tissue, soft tissue crown lengthening, and aesthetic gingival recontouring. [4]

Due to its direct impact on blood flow and ability to drive cell development, LLLT is absolutely contraindicated in patients with coagulation disorders and cancer. Low-level lasers are considered low-risk devices by the FDA since they are not hazardous. Less than 500 mW is used in the therapeutic laser. [1]

Many different laser wavelengths, including CO2, Argon, Nd YAG, and KTP, are being employed in dentistry, specifically oral surgery. These wavelengths are used in numerous dental specializations, such as caries diagnostics and eradication, light curing of composite, and control of bleeding in vascular lesions. Additionally, they have been employed in soft tissue treatments such as gingivectomy, gingivoplasty, and excision of tumors, excision of

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biopsies, and second stage recovery of implants, as well as the activation of tooth bleaching solutions. [1]

Process of Action

An energy source, an active lasing medium, and two or more mirrors make up the laser. The hollow wave guide, focusing lenses, cooling system, fiberoptic cable, and dental laser all work together to direct light toward the target tissue. [4]The action is supported by the Amdt-Schutz principle. This indicates that if the stimulus is increased or decreased above the optimal dose, the effect will be diminished or non-existent. The best dose will produce the best result. As a result, the bio stimulating effect of LLLT can be created by exposing tissues to the ideal dose in a non-contact mode. Additionally, LLLT causes tissues to store sub-thermal energy, which affects the sub-cellular component. The use of LLLT also activates a variety of cells, including lymphocytes and mast cells, which lead to changes in capillary hydrostatic pressure, which result in oedema absorption and intermediary metabolite removal. Even it can boost fibroblast and epithelial cell mitosis and collagen production.Additionally, by stifling nociceptive signals, it can have an analgesic effect. [1]The lasers used in surgery emit light at precise wavelengths that directly affect the tissue, causing it to coagulate and vaporize as well as to speed up the body's normal healing process. In addition to surgical lasers, other laser types can also be employed as bio stimulators. [1] There are several wavelengths that fall within the following categories:

1. the UV spectrum (ultra-spectrum 400-700 nm)
2. the infrared spectrum (from the 700 nm range to the microwave spectrum);
3. the VIS spectrum (visible spectrum 400-700 nm)

The wavelength of the laser, which transforms electromagnetic energy into thermal energy, depends on its design and intended medical use.

Dose estimation

The given energy will be converted to mWxseconds, where 100 mW x 10 seconds equals 1000 mJ, or 1 J, in order to determine the dose. By dividing the energy by the irradiation area, the dose is computed. The depth of the treatment target site is taken into account, as is an optimal power density to initiate biological effects such that the low output will not be entirely compensated by long exposure. The target tissues and the type of tissues must be taken into account even while employing the laser probe. For instance, fat and mucosa allow the laser light to pass through more readily than muscle. Additionally, haemoglobin and pigments are powerful absorbers, thus the dosage must be increased. By applying pressure and bringing the laser closer to the target, the penetration can be accelerated. [9]

High dosages of laser energy are used to treat acute disorders that include inflammation and oedema, and they may need to be treated more frequently to be resolved. Patients are treated

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conservatively while dealing with chronic diseases like paraesthesia and discomfort; the laser is applied once or twice a week.The second day will still be affected by the first day's LLLT effects, in addition to a long-term build-up of inhibitory levels. In chronic illnesses, a flare-up occurs in a patient who is responding well when the ailment enters an acute phase, triggering the start of the healing process. The recommended number of sessions for LLLT varies. A single session of therapy may be sufficient in some circumstances, but in most cases, numerous sessions are needed. [1]

Lasers' effects

Lasers were first used in dentistry in clinical experiments in 1964. The first medical professionals to employ medical lasers intraorally to perform surgical procedures in the soft tissue were otolaryngologists, periodontists, and oral surgeons. The floor of the mouth, the tongue, and other areas with frequent bleeding are suitable candidates for laser surgery because it offers good access and control. [3]There are numerous dental LLLT indications. The trauma to arteries or nerves that can sometimes be brought on by a needle puncture has been positively impacted by anesthesia. Before the injection, LLLT can be given directly to the superficial mucosa, producing an excellent aesthetic result. However, it cannot be applied to the hard palate. The lymphatic system is necessary for oedema, which is brought on by an accelerated inflammatory response.Oedema will be lessened if LLLT is given directly to the lymph nodes.

The wavelengths of electromagnetic radiation range from microscopic gamma rays, with a wavelength of around 10-12 m, to thousands of meters for radio waves. The contemporary dental laser instruments are all non-ionizing radiation devices with emission wavelengths ranging from 488 nm to 10 600 nm. This must be distinguished from ionizing radiation, the impact of which on DNA has been demonstrated to be mutagenic. Dental lasers emit thermal radiation and heat. Some dental lasers produce visible light. For instance, when the frequency is doubled, argon lasers emit both blue and green light at a frequency of 514 nm. Low level lasers emit light at a wavelength of 635 nm for photobiomodulation and at a wavelength of 655 nm for caries detection. Of the two primary instruments that emit visible light, the Nd:YAGemits mostly the green light at a wavelength of 532 nm. With one exception—the low-level laser in the range of 810 nm—other laser devices that are utilized for soft and hard tissue surgery emit the laser in the middle, near infrared part of the electromagnetic spectrum. An active medium made of aluminum, gallium, and arsenate is used in surgical diode lasers with a wavelength of 800-830 nm; it is also utilized in diode lasers with a wavelength of 980 nm and 1064 nm. Nd-YAG lasers use YAG, which are yttrium scandium, gallium, and garnet crystals doped with erbium and chromium; however, Er;YAG uses erbium as the doping agent at a wavelength of 2940 nm and carbon dioxide at a wavelength of 10 600 nm. [10]

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Oral mucosal lesions treated with laser

There is no known etiology for the condition known as lichen planus. The pathogenesis is mostly carried out by T-lymphocytes. It comes in two varieties: keratotic, which are white lesions with no symptoms and no need for treatment, and non-keratotic, which are red lesions that need to be treated to relieve their symptoms and lessen their cancerous effects. There are many ways to do this, including corticosteroids, photochemotherapy, lasers, and surgery. With relatively little adverse effects, LLLT was developed specifically for treating the erosive lichen planus type. A low-level laser also creates two different kinds of effects: primary and secondary. Vasodilation, lymphatic drainage, cellular activity and metabolism, improved blood flow, activation of fibroblast and neutrophils, and increase of pain threshold are its primary side effects. The accumulation of prostaglandin, immunoglobulin, lymphocytes, and beta-endorphin in the tissue encephalin is the secondary effect. As a result, this will lessen immunological response, pain, soreness, and inflammation. [10]

The most painful oral lesion, oral mucositis, requires narcotic analgesics and can lower quality of life. Chemotherapeutic regimen, type of cancer, patient age, neutrophil counts, and adoption of oral hygiene practices are all factors that can affect the development of oral mucositis. The oncologic therapy has a number of side effects, including oropharyngeal mucositis, ulcerations, alopecia, thrombocytopenia, and neutropenia. When combined with poor oral hygiene, pre-existing intraoral lesions, a weakened immune system, and high levels of pro-inflammatory cytokines, the disease gets worse. The nonkeratinized tissues, the lateral borders of the tongue, and the floor of the mouth are the tissues that are most affected, so many therapeutic and preventive measures, including analgesics, cryotherapy, antibiotics, growth factors for anti-inflammatory drugs, and biological mucosal protectants, should be taken into consideration. The use of LLLT has demonstrated a considerable decrease in oral mucositis pain as well as a speedier healing of the oral lesions. [7, 8] Combining low-intensity and high-intensity lasers for Fordyce granule excision has improved cosmetic outcomes, sped up recovery, and decreased postoperative pain and inflammation. [9]

CONCLUSION:-

The use of laser therapy in maxillofacial medicine may have an impact on the speed of healing and treatment. The soft tissue laser is a cutting-edge device that delivers reliable cosmetic outcomes in general dentistry. Lasers have made a significant contribution to dental clinical practice in the twenty-first century and will continue to do so in the foreseeable future.

REFERENCE:-

1. Fu JY, Masferrer JL, Seibert K, Raz A, Needleman P. The induction and suppression of prostaglandin H2 synthase (cyclooxygenase) in human monocytes. J BiolChem 1990;265:16737-

ISSN PRINT 2319 1775 Online 2320 7876

Research paper **© 2012 IJFANS. All Rights Reserved,** UGC CARE Listed (Group -I) Journal Volume 11, S Iss 4 ,2022

2. Pairet M, Engelhardt G. Distinct isoforms (COX-1, COX-2) of cyclooxygenase, possible physiologic and therapeutic implications. FundamClinPharmacol 1996;10:1-17.

3. Simon AM, Manigrasso MB, O'Connor JP. Cyclooxygenase-2 function is essential for bone fracture healing. J Bone Miner Res 2002;17:963-76.

4. Komhoff M, Grone HJ, Klein T, Seyberth HW, Nusing RM. Localization of cyclooxygenase-1 and -2 in adult and fetal human kidney: implication for renal function. Am J Physiol 1997; 272(4 Pt 2):F460-8.

5. Samad TA, Moore KA, Sapirstein A, Billet S, Allchorne A, Poole S, Bonventre JV, Woolf CJ. Interleukin-1beta-mediated induction of COX-2 in the CNS contributes to inflammatory pain hypersensitivity. Nature 2001;410(6827):471-5

6. Desjardins PJ, Grossman EH, Kuss ME, Talwalker S, Dhadda S, Baum D, et al. The injectable cyclooxygenase-2-specific inhibitor parecoxib sodium has analgesic efficacy when administered preoperatively. AnesthAnalg 2001;93(3):721-7.

7. Riendeau D, Percival MD, Brideau C, Charleson S, Dube D, Ethier D, et al. Etoricoxib (MK-0663): preclinical profile and comparison with other agents that selectively inhibit cyclooxygenase-2. J PharmacolExpTher 2001;296(2):558-66.

8. Cochrane DJ, Jarvis B, Keating GM. Etoricoxib. Drugs 2002; 62(18):2637-51.

9. Stichtenoth DO, Frolich JC. The second generation of COX-2 inhibitors: what advantages do the newest offer? Drugs 2003; 63(1):33-45.

10. Brune K, Neubert A. Pharmacokinetic and pharmacodynamic aspects of the ideal COX-2 inhibitor: a pharmacologist's perspective. ClinExpRheumatol 2001;19(6 Suppl 25):S51-7.

11. Scheiman JM. Outcomes studies of the gastrointestinal safety of cyclooxygenase-2 inhibitors. Cleve Clin J Med 2002;69(Suppl 1):SI40-6.

12. Harris RC Jr. Cyclooxygenase-2 inhibition and renal physiology. Am J Cardiol 2002 Mar 21;89(6A):10D-7D.

13. US Food and Drug Administration. Celebrex capsules (celecoxib) NDA 20-998/S-009 Medical Officer Review

14. US Food and Drug Administration. NDA 21-042, s007, Vioxx gastrointestinal safety-Medical Officer Review. Available at: http://www.fda.gov/ohrms/dockets/ac/01/briefing/ 3677b2-03-med.doc. Accessed June 2002.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, S Iss 4 ,2022

15. Schafer AI. Effects of nonsteroidal anti-inflammatory therapy on platelets. Am J Med 1999;106(Suppl 5B):25S-36S