LEVERAGING LASER PRECISION: ADVANCEMENTS IN TREATING ORAL MUCOSAL LESIONS

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Abstract

Light Amplification by Stimulated Emission of Radiation – or LASER coined in 1957; by G. Gould [1] is considered one of the greatest inventions of the 20th century. Unlike ordinary light which is nondirectional and not focused, LASERS are monochromatic, collimated, coherent, unidirectional, and efficient. With innovations like photo biomodulation (low-level laser therapy) lasers are not just a substitute for the scalpel or drill anymore, but a strong healing option at the cellular level as well; which is even capable of reversing premalignant oral lesions. This article aims to discuss the basics of laser physics, and its use in the management of some of the prevalent oral soft tissue lesions.

Key words : Dental lasers, Oral mucosal lesions.

INTRODUCTION

From time immemorial light has always been a fascinating subject of scientific study. A laser is a device that emits light through a process of optical amplification based on the stimulated emission of radiation. The theory of lasers was first proposed by Albert Einstein (1916) [2]and made into reality by Theodore H Maiman (1960) when he developed the first laser (ruby laser) [3]. Due to its differential properties, such as monochromaticity, coherence, and directivity, the laser can deposit a large quantity of energy in biological tissues with extreme precision yielding a dry surgical field and better visualization also there is decreased pain, swelling, edema, scarring, and ensures faster healing response

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There are four basic tissue interactions that take place with lasers: *photochemical interaction* - including biostimulation that increases circulation, collagen, and osteoblastic and fibroblastic formation, which initiates healing. Photothermal interaction - includes photoablation, which is the removal of tissue by vaporization and superheating of tissue fluids *(coagulation)*, and photo pyrolysis, which is the burning away of tissue *(vaporization)*. *Photomechanical interaction*-include photo disruption, which is the breaking apart of structures by laser light, and photoacoustic, which is the removal of tissue with shock-wave generation and Photoelectrical interaction includes proto plasmolysis, which is when tissue removed through the formation of electrically charged ions and particles that exist in a semi-gaseous, high-energy state along with plasma.

CLASSIFICATION

Broadly classified into two, according to their power: High power lasers and Low power lasers. In a newer classification that Professor Vipul Kumar Srivastava et al. proposed, dental lasers are divided into two groups based on their clinical usage (Fig 1.1) [4]

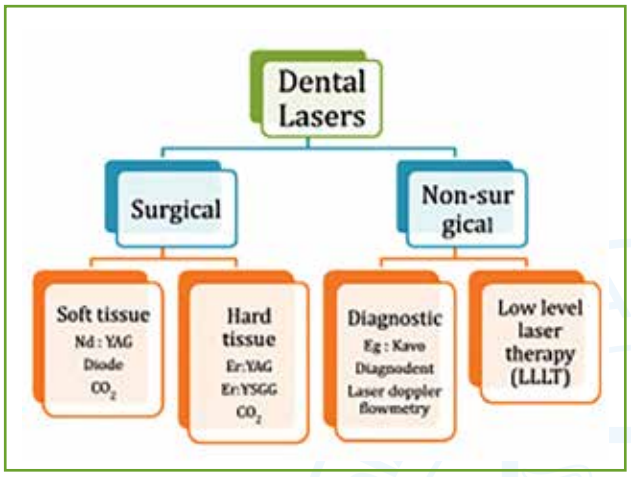

Figure 1.1

Some of the most significant lasers in oral medicine are CO2 lasers, Erbium lasers, Nd:YAG lasers, Argon lasers, Ho:YAG lasers and Diode lasers.

Carbon dioxide laser is the first generation of dental lasers that still offers the clinician a variety of advantages such as minimal bleeding, precise limits for the surgical field, minimal trauma, relative absence of postoperative pain and accelerated healing

The Nd:YAG lasers absorb melanin, water, and dentin as its target tissues and are used in the management of many lesions such as : aphthous ulcers, fibroma, Incision and draining of abscess, biopsies, laser curettage, incision and excision, Frenectomy, etc.

Argon lasers are readily absorbed by hemoglobin and melanin and are useful in treating pigmented lesions and vascular anomalies.

He: Ne lasers allow the dental professional to see where they are aiming the laser and what needs to be accomplished during a procedure in the oral mucosa.

The diode laser is a soft tissue laser, with a cutting depth of less than 0.01 mm. It seals smaller blood and lymphatic vessels, allowing excellent visibility and minimizes the chances of post-operative bleeding and edema.

USES OF LASERS IN ORAL LESIONS

Oral potentially malignant disorders (OPMDs)

Oral potentially malignant disorders (OPMDs) (WHO;2005) is used to describe a number of oral lesions that have malignant potential, such as leukoplakia, erythroplakia, erythroleukoplakia, lichen planus, oral dysplasia, and oral submucous fibrosis (OSF). Several clinical studies of OPMDs with LASER-inclusive treatment modalities, especially co2 laser, diode lasers and LLLTs found to have noteworthy results.

Usually, the laser of choice for oral leukoplakia treatment is the CO2 laser as it is efficient in cutting oral soft tissues and only produces superficial thermal damage, resulting from the intense energy absorption of this particular wavelength (10600nm) by its main chromophore, water, abundant in the oral mucosa. Whenever oral leukoplakia is distributed in areas that are difficult to access with the CO2 articulated arm, a laser with a flexible optical fiber, such as the diode laser (808–980nm), can be used in a contact mode. Significantly reduced postoperative swelling, less hemorrhaging, shorter excision time and less pain were reported when the CO2 laser was used [5]. When the Visual Analogue Scale (VAS) was used for pain analysis Diode laser group reported lesser pain compared to CO2 laser group in the days following surgery. No lesion recurrences were reported in any of the groups [6]
In the case of oral erythroplakia, CO2 laser surgery is found to be effective as long as the lesion is confined to dysplasia of any degree, and that postoperative recurrence is associated with the size or the area (larger than 80 mm2)[7].
In oral lichen planus lesions Low-level laser therapy showed superior results compared to

Non-neoplastic proliferative lesions or soft tissue tumor-like lesions of the oral cavity

Non-neoplastic proliferative lesions or soft tissue tumor-like lesion are tissue enlargements of the oral cavity that result from cell proliferation but are subject to normal control mechanisms that includes a wide range of lesions such as cysts, developmental anomalies, and hyperplasias; based on their etiology.

Inflammatory fibrous hyperplasia (IFH) or epulis fissuratum is a tissue growth in the oral cavity caused by low-intensity chronic trauma, usually from ill-fitting dentures or even parafunctional habits. The treatment of choice is conventionally surgical excision, but CO2 laser is a reliable alternative [8]

Drug-induced gingival enlargement: The treatment is generally targeted at drug substitution and effective control of local inflammatory factors such as plaque and calculus. When these measures fail to resolve the enlargement, surgical intervention is recommended. The use of high-power lasers for gingivectomy has proven to be effective in reducing gingival enlargement, providing a fast postoperative hemostasis [9] These treatment modalities, although effective, do not necessarily prevent the recurrence of the lesions.

Pyogenic granuloma (PG): is a common tumor-like growth of the oral cavity. The pathogenesis of PG is still debated. Clinical appearances range from a sessile lesion to an elevated mass and are generally soft, painless, and deep red to reddish-purple in color. Being a non-neoplastic growth, excisional therapy is the treatment of choice, surgical excision reported to have greater recurrence rate. the Nd:YAG laser, CO2 lasers, high power diode laser[10]and laser photocoagulation[11] are other reported methods.

Cancer treatment-induced oral mucositis

Oral mucositis is a frequent and painful debilitating side effect of non-surgical oncotherapy. It occurs frequently on the non-keratinized mucosa, such as that of the buccal mucosa, labial mucosa, lateral/ventral tongue, and floor of the mouth. It starts within 7 days of the onset of radiotherapy and after chemotherapy, it starts within a day. In the most recent update of the MASCC/ISOO guidelines, low-level laser therapy (LLLT) has been elevated to the level of a recommended therapy [12] Low Level Laser Therapy (LLLT) or photo biomodulation (PBM) is the application of red and near infra-red light(600nm-1000nm) over injuries or lesions to improve wound and soft tissue healing, reduce inflammation and to give relief to both acute and chronic pain. It is a non-invasive, pain-free and safe therapy with no associated adverse effects. LLLT is found to accelerate the healing rate of oral mucositis and also able to control inflammation and maintain mucosa integrity Its mechanism of action also leads to the blocking of the ascending pain pathway and stimulation of the descending pain pathway which increases the release of natural endogenous analgesics like serotonin, beta-endorphin which reduces pain or even block nociception. Assortment of studies by various clinicians have demonstrated improved analgesia with PBM.

Recurrent aphthous ulcers

The recurrent aphthous ulcer (RAU) is the most common ulcerative lesion found in the oral cavity. It is characterized by the appearance of single or multiple ulcerative lesions in the oral mucosa; typically painful, recurrent, small, round, or ovoid with circumscribed margins and erythematous haloes. RAU has three clinical presentations: minor aphthous ulcers, major aphthous ulcers, and herpetiform ulcers. Conventionally managed by local corticosteroids, antiseptic, and antibacterial drugs used singly or in various combinations, none of them has been shown to be effective in preventing or even decreasing the incidence of lesions. Low-level laser therapy (LLLT)on the other hand has shown excellent results in the treatment and prevention of RAU. Low power, non-thermal, single-session CO2 laser irradiation effectively

reduces pain in RAU immediately with no visible side effects [13] RAU can be prevented by treatments that promote the inhibition of endogenous TNF-α, such as thalidomide and pentoxifylline and the same effect can be achieved by laser irradiation, with no side effects. LLLT can be also used when the patient has no RAU manifestations; as LLLT stimulates the immune system and increases the resistance of the mucosa to ulcer formation.

Oral mucocele

Oral mucoceles are common, benign lesions of minor salivary glands characterized by single or multiple nodules that are generally asymptomatic. Generally, mucocele lesions are single, spherical, fluctuant, and painless bluish swellings Several clinical reports have described protocols for the application of laser irradiation in the excision of oral mucoceles where the large majority have used high-power CO2 lasers for excision or vaporization of the lesions [14] Nd:YAG, Er:Cr:YSGG, and diode lasers are also found to be effective.

Neuralgicpain

It is a neuropathic disorder of the trigeminal nerve characterized by sudden sharp, shooting, lancinating pain attacks lasting several seconds to several minutes, and localized to one or two branches of the trigeminal nerve. Although treatment with LLLT has been utilized as an adjuvant therapy for this disorder,12 the mechanism of action of the laser light is not well understood. Laser irradiation probably inhibits neural activity in both humans and animals by slowing the conduction velocity in peripheral nerves. Visible and near-infrared laser irradiation is found to be able to cause neural impairment, particularly in small diameter Aδ and C fibers, which convey nociceptive stimuli that are very relevant to pain[15] so that other important peripheral neural disorders that occur in the oral and maxillofacial area could also be treated with LLLT.

CONCLUSION:

Over the past few decades, laser dentistry has been steadily evolving from a niche novel technology to an integral part of everyday dental practice; ensuring better patient comfort and good clinical outcomes. Making it accessible and equitable for all will revolutionize oral health care.

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