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USE OF LASERS IN ORAL AND MAXILLOFACIAL DISORDERS: A REVIEW

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ABSTRACT

The rapid development of technology has led to the advancement in the characteristics of lasers, which now a days are useful in almost all the field of the dentistry. The lasers are becoming popular among the clinicians due to their potential value in surgical procedures providing surface sterilization, dry surgical field and increased patient acceptance. In the past two decades, researches, experience and knowledge have led to huge interest and demand of lasers in the field of dentistry. This article provides an overview of the current and possible future clinical applications of lasers in oral medicine, including their use in treatment of oral mucosal lesions, orofacial pain, salivary gland pathologies, TMJ disorders and biopsies.

KEYWORDS: Lasers; Lichen Planus; Leukoplakia; Trigeminal Neuralgia.

INTRODUCTION

LASER stands for Light Amplification by Stimulated Emission of Radiation.[1] Theodore Maiman in the year 1960, first developed a deep red colored laser from a ruby crystal.[2] Later in the year 1965, Goldman et al first reported the effect of ruby lasers on enamel and dentin.[3] The characteristic of a laser is dependent on its wave-length (WL), and wave-length affects both the clinical applications and design of laser. The lasers used in medicine and dentistry usually have wavelength ranging from 193 nm to 10600 nm, representing a broad spectrum from ultra-violate to the far infra-red range.[4] After all the research, laser has been

recommended for the treatment of benign oral lesions eg. fibromas, hemangiomas, papillomas, idiopathic gingival hyperplasias or gingival hyperplasia due to side effects of medications, aphthous ulcers, mucosal frenula or tongue ties (ankyloglossia), as well as premalignant lesions such as oral leukoplakias, erythroplakia etc.[5]

Lasers used in oral medicine

Lasers used in dental practice can be classified according to the lasing medium used, such as, gas laser and solid laser; according to tissue applicability, hard tissue and soft tissue lasers; according to the range of wavelength, and of course the risk associated with laser application.

Carbon Dioxide lasers

It has ability for rapid soft tissue removal and hemostasis with shallow depth of penetration, because of high affinity for water.[6]

Neodymium yttrium aluminum garnet laser

It is highly effective surgical laser for cutting and coagulating dental soft tissues, with good hemostasis along with nonsurgical sulcular debridement in periodontal disease control.[7]

Diode lasers

They have a wavelength of 620-900 nm and are used to treat oral soft tissue lesions.[8]

Er:YAG lasers

These lasers are most commonly used for the treatment of hard tissues and skin resurfacing. They have a wavelength of 2944 nm.[8]

Application of lasers in the treatment of oral and maxillofacial disorders

ORO-MUCOSAL PATHOLOGIES

Leukoplakia

In 2005, WHO defined leukoplakia as "white plaques of questionable risk having excluded (other) known diseases or disorders that carry no increased risk for cancer."[9] Leukoplakia is considered to be a common oral premalignant lesion.[10] A number of surgical and non-surgical treatment regimens are prevalent for oral leukoplakia including excision, cryotherapy, laser therapies and therapy with retinoids and vitamin A respectively. Lasers are newer modality in treatment of leukoplakia and different kinds of lasers can be used including neodymium:yttrium-aluminium garnet (Nd:YAG), potassium-titanyl-phosphate (KTP) and argon lasers, the CO2 laser is the most frequently used.[11] Nd:YAG lasers

(wavelength 1,064 nm) are the second most popular lasers for leukoplakia vaporization and intraoral tumor excision. They are recommended for patients with hemorrhage risk due to their higher potency and deep penetration. KTP laser penetrates deeper into the tissue (wavelength 532 nm) and is frequently used to coagulate vascular lesions, thereby surpassed by co_2 lasers.[12] The CO2 laser has been recommended to treat oral leukoplakia.[13] The treatment of OL using CO2 laser can be best obtained by ablation or vaporization of the lesion. Ablation being done at defocused mode (achieved by moving the laser away from the tissue and beyond its focal length), reduces the power and depth of penetration of the laser beam (200-400 lm per pass), limiting the destruction to the epithelium and hence resulting in lesser pain, swelling and even scarring with better regain of elastic property of the tissue.[14]

Fig 1: Leukoplakia.

Lichen planus

Oral lichen planus (OLP) is a chronic autoimmune, mucocutaneous disease of unknown origin which was first described by Wilson in 1869 and can affect the oral mucosa, skin, genital mucosa, scalp, and nails.[15,16] The patients affected with erosive-atrophic lichen-planus which are recalcitrant to conventional treatment are perfect subjects for laser therapy. The most commonly used laser for surgical elimination of OLP is the CO2[17] although the diode[18], Nd:YAG[19] and erbium family lasers[20] can also be used for treatment of OLP the main purpose of removing lichen planus with high power laser directed to relieving of the symptoms. Because of properties such as modulation of the immune system, acceleration of wound healing, and reduction in inflammation and pain, Low Level Laser Therapy (LLLT) have been assumed to be more effective than laser evaporation.[21] Agha-Hosseini et al and Jajarm et al have provided data in this support.[21,22]

Fig 2: Lichen Planus.

Oral submucous fibrosis

Oral submucous fibrosis is a premalignant condition affecting the submucosal layer of oral mucous membrane. The common etiology is the habit of betelnut chewing, which is highly prevalent in Indian subcontinent. The main clinical symptoms are trismus, dysphagia, xerostomia, and burning mouth.[23] A wide range of treatment modalities are available for treatment of OSMF, which include, intralesional injection with corticosteroids, placental extracts, treatment using turmeric, aloe vera gels, gamma interferon, or surgical excision of fibrotic bands. The newest modality for treatment include use of laser therapy. The most commonly used lasers for this purpose are diode lasers. Diode laser has diversity of favorable features like good hemostatic properties and flexibility of the probe which makes it accessible in the limited access; especially in trismus.[24] The healing in these procedures is rapid without any grafts because the incision given through the fibers is precise with minimal damage to the adjacent tissue.[25]

Fig 3: Oral Submucous Fibrosis.

ORO-FACIAL PAIN

Trigeminal neuralgia

TN is mainly a periodic, unilateral, sharp, and electric shock like pain which affects trigeminal nerve branches.[26] Standard first line treatment is pharmacological, usually with

carbamazepine.[27] Other drugs including lamotrigine, phenytoin, gabapentin, oxcarbazepine, topiramate, baclofen, and clonazepam. The newer approach in the treatment of TN include LLLT, it has been tried to relieve pain in TN patients. Studies have shown an increase in the nerve function and capacity for myelin production using LLLT. Growth of axons can also be promoted using LLLT in injured nerves, which was observed in animal models. Studies are going on to compare the effect of laser with placebo irradiation or medicinal or surgical treatment modalities have been tried.[26]

Myofacial Pain

Myofacial pain dysfunction syndrome (MPDS) is the most common reason for pain and limited masticatory system function. Low level laser therapy has been found useful in treating myofascial pain. Several studies have shown that use of 830 nm wavelength laser in several appointments can reduce or eliminate myofacial pain.[28] Shirani et al. evaluated the efficacy of a LLLT producing 660 nm and 890 nm wavelengths and concluded LLLT was effective in reducing pain in MPDS patients.[29]

Temporomandibular joint disorder pain

TMD are about a variety of clinical problems originating from TMJ,masticatory muscles, and surrounding tissues.[30] The cause of pain in the orofacial region which does not from dental arches is mostly the TMD.[31] Low level laser therapy is the recommended treatment of choice because of diversified laser parameters and lack of dosage consensus. The actions making it compatible with for TMD treatment include analgesic, anti-inflammatory and simulative effects.[32] The low level laser therapy ranging between 830nm and 904nm reduce pain and improve total vertical opening.[33]

Salivary gland pathologies

Sialolithiasis

It is the most common disease of the salivary glands. It is characterized by the development of calcifications (sialoliths) that accumulate within the salivary gland parenchyma and associated ductal systems. Most of the sialoliths are found in the submandibular gland.[34] Based on the fact that sialolith should be removed with the minimally invasive method various type of lasers have been used for the treatment of sialolithiasis, including carbon dioxide, diode, Ho:Yag and Nd:YAG lasers.[35] Among these diode laser has been reported to be more advantageous. It has a greater absorption by hemoglobin, oxyhemoglobin and melanin, thereby making its penetration depth smaller than neodymium: yttrium-aluminum-

garnet (Nd-YAG) laser. Owing to the smaller penetration in blood rich tissues diode laser is accepted to be safe in the adjacent tissues.[36]

Mucocele

Mucocele is commonly occurring lesion in oral mucosa containing mucin that may result from alteration in minor salivary gland.[37] The treatment of choice is surgical excision of the mucocele. Lasers are a newer approach and diode laser is considered a good cutting device for oral mucosa.[38] When compared to other lasers like argon, neodymium:yttrium‑aluminum‑garnet (Nd:YAG) and carbon dioxide lasers, the diode laser shares similar feature that is intensely absorbed in hemoglobin, results in elevating the temperature and thus promoting coagulation and carbonization of soft tissues, such as the oral mucosa and resulting in minimum discomfort and scarring.[39]

Fig 4: Mucocele.

CONCLUSION

Lasers are promising tools in field of dentistry, it's noninvasive nature and greater patient compliance and comfort, have increased modern practitioner's interest in it. Over the past few years, the use of lasers to treat oral and maxillofacial lesions has grown remarkably. Proper training and knowledge is required for its application in the field. Lasers have a lot of potential and greater role, than now realized.

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