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Role of lasers in oral medicine

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Abstract

Laser is a special light source that has a higher power and better quality of beam compared to the other light sources. The word 'LASER' is not a new term for science and technology. The introduction of lasers to the biomedical field has truly given a technological boost to the way clinicians perform a number of procedures.

Lasers in dentistry began to gain popularity in the 1990s. Lasers in dentistry are used as a treatment tool or as an adjunct tool. By using the laser in the field of dentistry, the main goal is to overcome the disadvantages, which are currently being experienced in conventional dental treatment procedures. Many specialties in dentistry including oral surgery, implants, oral medicine, periodontics, pediatrics, and operative use the current new laser technology.

The ability of lasers to provide minimally invasive procedures with less discomfort to the patient has been useful in the patient delivery system in dental practice. Soft tissue 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.

Oral premalignant lesions of the oral cavity such as leukoplakia and erythroplakia remain a diagnostic and treatment challenge. They have a potential for malignant transformation. Management of such lesions includes observation, excision, ablation, or topical medical therapies. The gold standard for management of the clinically evident high-grade premalignant disease is excision or laser ablation.

Laser treatment has been a well-established modality for management of premalignant lesions and has potential advantages over surgical excision. This article describes in brief on the uses of lasers in oral medicine and radiology.

Keywords: Oral medicine, laser therapy, soft tissue lesions.

Introduction

LASER is an acronym of light amplification by stimulated emission of radiation.Lasers are intense beams produced by stimulated emission of radiation

from a light source. Einstein identified that a laser is promoted by the emission of radiation as a natural process. Laser play a valuable role in field of dentistry. This acronym describes the lasing principle.

It has been harnessed for practical use in wide range of industries, ranking among the most significant laser applications are those in medicine and dentistry. Dental procedures performed today with the laser are so effective.[1]

"Heliotherapy" was the practice followed by our ancestors, following which the development of action therapy and photomedicine took place. The award of the Nobel Prize to Finsen in 1903 for the development of the carbon arc lamp with lenses and filters for the treatment of diseases (especially lupus vulgaris) was a major milestone in the development of lasers for medical use.[2]

In the early 1960s, it was noted the use of medical lasers in dental applications had limited application. In the early decades, the physicians realized that the light allowed them to observe many things such as skin color and wounds, and it helps them in choosing the most effective therapeutic course of action. This led researchers to explore the specific applications of lasers in the medical and dental fields.

In oral medicine, lasers dispositive can offer important advantages, especially on the treatment of certain lesions. These advantages includes a higher precision on tissue excision, disinfection of the surgical area, reduction of edema and physical scarf, without a necessity or decreasing the quantity of suture, hemostasis and reduction or elimination of postoperative pain.[3]

The majors lasers of high power are recommended for oral surgeries in soft tissue are the Nd:YAG and CO2. Both can be used on frenectomy, lesion ablation, removal of the gingival operculum, incisional and excisional biopsy, gingivectomy and gingivoplasty. Despite the literature, mention the superiority of laser in comparison with the conventional surgery, this requires a complementary study that proves its effectiveness and applicability on the oral cavity lesions,[4]

The aim of this study was to evaluate the use of laser in the department of oral medicine for various disorders like leuko plakia, mucositis, pyogenic granuloma, burning mouth syndrome, hemangioma, fibrous hyper plasia, mucocele, papilloma and frenectomy.

Classification

Lasers in dentistry can be classified according to various factors, including the lasers active medium such as gas, liquid, solid and semi-conductor, which specifies the type of laser beam that will be emitted (Table 1). Invariably they can be also classified according to the lasing medium used as a gas laser and a solid laser. Furthermore, they can be classified according to tissue applicability in hard and soft tissue lasers or according to the wavelengths and the risk associated with laser application.

A host of intraoral lesion can be treated with lasers. The importance of using laser for biopsy and vaporization of extensive, diffuse mucosal lesions lie in the incomparable speed, efficacy and overall tolerability as compared to other surgical modalities.[5]

Table 1: Lasers and their application

Lasers	Applications
Carbondioxide lasers	Superficial lesions, resurfacing of the skin and removal of sialoliths. Premalignant lesions like leukoplakia, sublingual keratosis. Apthous ulcers Herpetic lesions Coagulation of bleeding areas

	Removal of granulation tissues Excision of epulis Inflammatory hyperplasias Mucoceles and ranulas Pigmented lesions
Nd:YAG	Pigmented lesions. Sialoliths, verrucous carcinoma
Ho:YAG	Excisional Biopsy
Er:YAG	Hard tissues and skin resurfacing
Argon lasers	Vascular anomalies
Diode lasers	Vascular soft tissue lesions
He-Ne	Radiation mucositis
Low level laser	Herpes lesions, Apthous ulcers, Denture sores
Helium – Cadmium	Fluorescence examination

Mechanism of action

The laser consists of an energy source, an active lasing medium, and two or more mirrors. In the dental laser, the light reaches the target tissue via the fiberoptic cable, hollow wave guide, focusing lenses, and cooling system. The Amdt–Schutz principle is the basis for the action. This means that the increase or decrease of the stimulus beyond the optimal dose will lead to weakening or absence of the effect.[6]

There are two types of beams used in dentistry, which are the visible beam like the argon laser and the invisible beam in the infrared range like the carbon dioxide laser, erbium substituted yttrium aluminium garnet, erbium chromium doped yttrium, scandium gallium garnet holmium, yttrium aluminium garnet, and gallium arsenide. There are many properties of the laser beam, especially the wavelength and optical features of the specific target tissue, which show the type and the extent of the interaction that might occur.

The lasers used for surgical purposes emit light at specific wavelengths which have direct effects on the tissue not only on the coagulation and vaporization but also on the natural healing process of the cells. There are other kinds of lasers other than surgical lasers that are used as bio stimulators.[7]

There are different wavelengths which can be classified into:

- The UV range (ultra-spectrum 400-700 nm)
- The IR range (infrared spectrum 700 nm to microwaves spectrum)
- The VIS range (visible spectrum 400-700 nm)
- The laser converts the electromagnetic energy to thermal energy and the wavelength depends on both design and clinical application.

Lasers in oral medicine

Mucositis

The oral mucositis is an inflammatory response of the oral mucous, being a secondary detrimental effect to treatments with anti-neoplastic drugs or usage of ionizing radiation, on neoplastic diseases of head and neck. Many research states that it is possible claim that the laser therapy, when applied on patients undergoing to oncotherapy, is efficient on the control of Oral Mucositis on advanced degrees, demonstrating the importance of prevention imposed by the oral mucositis degree ≥3, which can even lead to the non-adherence and consequently interruption of the treatment.[8]

Hemangioma

The hemangiomas are the mesenchymal tumors formed by blood vessels, which exhibit an increase on the cellular proliferation11. It grows quickly, regress slowly, and never reappear. All the three phases of the life cycle of an hemangioma are characterized by a single set of markers and biological processes, which are:

- Proliferative phase (0 to 1 year of age),

- Involution phase (1 to 5 years of age), and
- Involute phase (>5 years of age)

However, the spontaneous involution can be incomplete and around 15% to 20% of the residual lesions can remain. A total of 65,3 % of the affected patients is children and approximately 20% of the patients have multiple lesions. On average, 80% of the lesions are localized on the head and neck regions and the mucous membranes are involved in 10 % of the cases.

For the endoluminal sclerosis for hemangiomas on the orofacil the combined use of intralesional diode laser with radiofrequency, with a rate of success of 90%, with few post-operative complications. Thus, the intralesional laser photocoagulation should be considered an excellent to other modalities well established for the treatment of oral hemangioma.

According to literature review, Nd: YAG therapy is quick, secure and relatively easy to learn besides does not causes bleeding. The post-operative discomfort is minimum, as the potential of occurring scars. Therefore, for theses authors, the Nd: YAG lasers are the choice of approach on the treatment of vascular lesions of the mucous.[9,10,11]

Leukoplakia

Leukoplakia is a common mucous pathology with power of 0,1- 17 % of risk of malignant transformation. Etiology of the leukoplakia still is not clearly established. Smoking, alcohol abuse, mechanic injuries, infection by Candida albicans and the different locations of galvanic potential are reported as most important casual factors. As its etiology cannot be established, the treatment is difficult and shows insufficient efficiency. However, the possibilities of treatment include the resection of the lesion, cryotherapy, use of laser, as well as administration of vitamin A and retinoids.

The usage of CO2 laser has turned the base of the treatment of leukoplakia and pre-cancerous lesions all over the world and has demonstrated efficiency and with low morbidity, and can be better obtained by ablation or vaporization of the lesion. The CO2 laser replaces the conventional scalpel in terms of better intra-operative bleeding and reduction on the formation of scars, however, in relation to the post-operative pain and edema after the excision the laser has not shown a statistically significant difference than the scalpel.[12]

Pyogenic granuloma

Pyogenic granuloma is a mucocutaneous benign lesion relatively common. The term is a mistake once the lesion does not contain pus and it is not granulomatous. The most common intraoral site is the gum margin, but the lesions have been reported on the palate, oral mucous, tongue and lips.

The lesion appears as a non-neoplasic growth, the choosen treatment being the excisional therapy, but some alternatives approaches, such as cryosurgery, the excision by ND: YAG injection of corticoid or ethanol, and sclerotherapy with sodium tetradecyl sulfate has also been reported as efficient. The diode laser has shown excellent results on cutaneous pyogenic granuloma with minimum pigments and textural complications.[13]

Apthous ulcer

Aphthous ulcers are painful and often recurrent. Laser treatment of aphthous ulcers is an alternative to temporary palliative pharmacologic therapy. The laser provides relief of pain and inflammation, with normal wound healing of this uncomfortable and potentially recurrent oral lesion. Lasers when used in defocused mode removes exposed nerve endings. The lesion can be rendered insensitive at low wattage within 4 minutes or less. Healing time is reduced markedly.

It is best to treat aphthous ulcers within the first 48 hours. 400 micron tip is used for small lesions. The laser defocused mode 5-6mm away from the lesion and advanced towards the periphery 2mm away. Continual movement from the periphery to the centre is done.15-20 seconds period is given between the laser allowing the tissue to cool. The area, a wet gloved finger to determine if there is reduced pain felt. 2nd and 3rd pass need to be done to completely reduce the pain. After every application of laser, the area should be palpated to check for reduced pain.[14]

Oral lichen planus

Oral lichen planus is a common mucocutaneous disease. It was first described by Wilson in 1869. It can be bilateral white striations, papules or plaques on the buccal mucosa, tongue and gingivae. Various research concluded that in patients whose condition is unresponsive to topical corticosteroids, CO2 laser evaporation can cause long-term remission of symptoms and may even be the treatment of first choice in patients suffering from painful oral lichen planus.[15]

Oral sub mucosal fibrosis

Laser is used to reduce the trismus in OSMF patients. Numerous research concluded that Diode laser is a less expensive and alternative method in group III and group IVA cases in whom bilateral temporalis myotomy and coronoidectomy are considered to be the only solution. Also this technique had less morbidity and was suitable for Asian population as it required less hospital stay and less follow up as compared to other surgical methods. Adequate release of oral submucous fibrosis can be achieved by using a KTP-532 laser release procedure, with minimal morbidity and satisfactory results.[16]

Other conditions in oral medicine

Erythroplakia can be managed by surgical excision and CO2 laser. It is important to excise the lesion widely rather than deeply due to superficial nature of dysplastic and in situ lesions.

Smokeless tobacco induced white lesions are induced by the chronic usage of smokeless tobacco. These lesion are treated by carbon dioxide lasers.

Verrucous carcinoma is also a malignant lesion.Treated by carbon dioxide and Nd:YAG contact laser using excisional technique including the base of lesion with wide margins.

Oral Papillomatosis can be treated with a carbon dioxide laser or an Nd:YAG

Sialolithiasis is the disease of the salivary glands. Most of the sialoliths are found in the submandibular gland. Various types of lasers have been employed to treat sialolithiasis, including carbon dioxide, diode, and Nd:YAG lasers.

Laser treatment can be done to remove mucoceles. The mucocele treate with the gland tissue using Laser HF.This laser uses high frequency technology which helps in precision cutting and reduces the risk of necrosis. Re-epithelialization takes about 2-3 weeks.

Frictional keratosis, as the term suggests results from chronic low-grade friction derived mechanically either from cheek biting, ill-fitting denture or sharp cusps of the teeth. The lesion is characterized by white in colour appearance of patch. The lesion is non scrap able. These lesions can be treated with soft laser therapy. Small questionable lesions can be excised by using carbon dioxide laser with a 0.2mm spot size. It is applied perpendicular to the elliptical outline around the lesion.

Wound healing is a complex process with local and systemic responses and involves several types of cells, enzymes, growth factors and other substances. In studies of fibroblast responses to lasers, increased cell division and increased collagen production have been reported. However, it is possible that low level laser therapy

effects on wound healing depend not only on the total dose of irradiation but also on the irradiation time and the irradiation mode.[17,18,19,20]

Conclusion

The application of laser treatment in maxillofacial medicine has potential implications for quicker treatment and faster healing. The soft tissue laser is a state of the art tool that creates predictable aesthetics results within general dental practice. Lasers have significantly contributed to dental clinical practice in the 21st century and they will play a very important role in the dental practice in the coming future.

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