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Review Article

USE OF LASER IN THE TREATMENT OF COMMON ORAL PREMALIGNANT LESIONS AND CONDITIONS - A REVIEW

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Abstract

Various procedures are performed for the treatment of oral pre-malignant lesions. These include surgical excision, electrocoagulation, cryosurgery, laser surgery, the local use of corticoids and administration of vitamin A. The introduction of lasers to the biomedical field has truly given a technological boost to the way clinicians perform a number of procedures. Soft tissue lasers have become popular among the clinicians due to their potential value in surgical procedures providing surface sterilization, dry surgical field, and increased patient acceptance. Management of premalignant lesions of the oral cavity such as leukoplakia and erythroplakia is challenging. 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 presents a review on the use of lasers in the management of oral premalignant lesions.

Keywords: Premalignant lesions, lasers, leukoplakia, ablation, CO_2 laser.

Introduction

The term "Premalignant" "Precancer" or "Potentially Malignant Lesions" have been used in the literature to broadly describe clinical presentations that may have a potential to turn malignant.

A Precancerous Lesion is a morphologically altered tissue in which cancer is more likely to occur than its apparently normal counterpart. These include lesions like leukoplakia, erythroplakia etc.

A Precancerous Condition is a generalized state of the body associated with a significantly increased risk of cancer. Submucous fibrosis, lichen planus etc. are examples of these conditions.

Various studies done on the incidence of head and neck squamous cell carcinoma showed that more than 500,000

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new cases of head and neck squamous cell cancer arise annually worldwide, making it the sixth most common cancer.[1] Of these, oral cavity malignancies account for 14% and lead to upward of 7000 deaths per year.[2] From a genetic perspective, the progression of oral squamous cell carcinoma (SCC) comprises of a distinct pattern and timing of genetic alterations along a continuation of malignant transformation.[3]

The main objective in the treatment of precancerous lesions of the oral cavity is to remove potentially neoplastic cells due to the possibility of recurrence and/or malignant transformation from those cells.

With the introduction of lasers in 1917, with the theory of "Stimulated Emission" put forward by Albert Einstein, stating that photons could "stimulate" the emission of another photon that would possess identical properties to the first. Townes and Schawlow worked on this study together which led to the development of light amplification by stimulated emission of radiation (LASER).[4]

Use of laser system in dentistry is rapidly improving. Lasers are being used as a niche tool as a direct replacement for conventional approaches like a scalpel, blades, electrosurgery, dental handpiece. Lasers can be divided on the basis of the energy of the beam and the wavelength of the emitted radiation (table 1).

Table 1:- classification of lasers[5]

Gas Lasers	Argon
	CO_2
Liquid Lasers	Dyes
Solid lasers	Nd: YAG
	Diode
	Er: YAG
Semiconductor	Silicone lasers
Excimers	Argon-F
	Xenon-F

Laser surgery has many advantages for both the surgeon and the patient. It can control hemorrhage while the surgeon has excellent visibility during operation and enables shortening of the operative time. Patients do not require a special method to stop bleeding after surgery. In addition, there is minimal damage to adjacent tissue, thus reducing acute inflammatory reactions and postoperative pain, swelling, edema or infections. Sealing of blood and lymphatic vessels diminishes the risk of disseminating neoplastic cells in the treatment of malignant lesions, and sealing of the nerve endings reduces postoperative pain.[6]

Laser surgery results in the excellent healing process because of the limited scarring and contraction, and there is satisfactory mobility of the soft tissues. However, laser surgery has some disadvantages. The major disadvantage being that the biopsy should be obtained using other methods, preoperatively or at the time of laser treatment. Epithelial regeneration after laser surgery is delayed, and the wound healing process takes longer to re-epithelialize when compared to conventional surgery. The last disadvantage is safety precautions, namely, the use of eye-glasses is required to protect both the patient and the medical staff.[7]

Management of Oral Premalignant Lesions (OPLs)

Various treatment modalities have been described for OPLs. They can broadly be divided into surgical and non-surgical treatments. The non-surgical treatments include photodynamic therapy and topical or

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systemic medical treatment using carotenoids, retinoids, bleomycin, etc. Various treatment procedures for precancerous lesions in the oral cavity have been reported: excision surgery, electrocoagulation, cryosurgery, laser surgery, the local use of corticoids and administration of vitamin A. The gold standard for management of the clinically evident high-grade premalignant disease is excision or laser ablation. However, moderate and low-grade pre-malignancy may be treated with observation as well as ablation.[9]

Various Methods of Management of OPLs Using Laser

Surgical Resection without Reconstruction

Surgical resection is performed in the office or the operating room depending on the size of the lesion and access.[10] En bloc excision facilitates complete pathologic evaluation and accurate assessment of margins to exclude invasive disease. However, surgical resection without reconstruction of large defects, especially in the floor of the mouth may cause functional impairment.[11] There is significant pain associated with a large deep healing wound. Furthermore, leukoplakia has a tendency to recur even after excision, either within the surgical field or at the edges of resection.[12] Thus, excision may be too radical in many cases of OPLs. Many techniques are present for surgical excision including various lasers. The CO2 laser causes minimal charring providing clean surgical margins for accurate assessment. However, its hemostatic ability is poorer than hemoglobin avid lasers, hence, electrocautery is routinely employed as an adjunct.[13]

Vaporization

Vaporization of OPLs involves the surface application of laser energy for ablation. This technique is found to be suitable for larger, shallower OPLs and is also especially useful in difficult to access areas. It allows treatment of the lesion while ablating superficially. Prior to vaporization representative biopsies have to be taken as there is no surgical specimen to examine for evidence of deep invasion. Also, the surgical bed created after vaporization will have to heal by secondary intention. Both laser excision and vaporization are better-known tools than electrocautery treatment in terms of post-operative pain and wound contracture. However, it has potential demerits such as scarring, tethering, and secondary bleeding as it leaves an exposed wound. Areas where resection is not possible such as gingival leukoplakia and other more extensive lesions benefit from laser vaporization. The CO2 laser is the management option due to its properties like minimal thermal damage to underlying tissue, least char, and thus allowing the most accurate assessment of depth.[13]

Laser Treatment of OPLs

The lasers commonly used are classified into visible and non-visible (infrared) wavelengths.[14] With the availability of portable and more cost-effective lasers, outpatient office-based laser treatment is evolving as the therapy of choice for OPLs.

Water Avid Infrared Lasers

The CO2 laser produces coherent laser energy at the 10,600 nm wavelength in the infrared spectrum and does not have a particularly preferred chromophore of absorption. It shows good absorption by water – both intracellular and extracellular. It creates rapid heating of target tissues causing cells to explode creating a zone of tissue vaporization and a surrounding zone of thermal damage which theoretically seals lymphatics and blood vessels. When used in the focused mode it acts as an excisional instrument ensuring precise surgical margin with minimal char. This also helps in the accurate assessment of surgical margins.

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Furthermore, it can be used for surface ablation in defocused mode. The CO2 laser has historically been the workhorse in OMFS laser surgeries. In the past years, the use of the laser has been limited owing to its high cost, bulk, and difficulty in using in poorly accessible areas. However, technological advancements have up to an extent successfully overcome these limitations. The introduction of scanning CO2 laser may offer potential benefits due to the ability to control precisely the depth of vaporization thereby extending its use to the treatment of large area OPLs.[14]

Other lasers in this range include Nd: YAG, Holmium: YAG, and Erbium: YAG, which are based on yttrium aluminum garnet crystals doped with either neodymium, holmium or erbium. The Nd: YAG was developed in 1973 and emits light of 1064 nm wavelength. Its penetration power is much deeper than the other lasers described and has a thermal damage area well beyond the depth of normal epithelium. These lasers are not routinely used for treating OPLs.[15]

Haemoglobin Avid Lasers

A more recent development in OMFS has been the introduction of hemoglobin avid lasers. The chromophore for these lasers is hemoglobin, and thus they exert effect specifically upon the vasculature.[16]

The oxygenated and deoxygenated hemoglobin have a relative optical absorption peak between 520 and 550 nm and lower absorption peaks at 750 nm and 940 nm. The Aura XP and the Varilite are examples for lasers of this type. They are both potassium-titanyl-phosphate (KTP) lasers, yielding visible green light at 532 nm. It is produced by passing an Nd: YAG laser beam (1064 nm) through a KTP crystal, thus halving its wavelength to 532 nm.[17] Its usefulness in OPLs lies in its ability to ablate the underlying vasculature feeding the lesion while preserving a biological dressing of overlying mucosa.[18] At higher energy levels, these lasers can also be used in an ablation setting although the KTP causes more charring when compared with water absorbed lasers, and superficial char may need to be removed manually. Both have fiber-based energy delivery system, allowing easy access to all areas of the oral cavity.[19]

Laser use in OPLs

Leukoplakia

Leukoplakia is the most common premalignant lesion of the oral mucosa. Treatment for this lesion includes scalpel excision, electrocautery, cryosurgery, laser surgery, and medications. The lesions are removed with laser and heal by new healthy epithelium. Small lesions can be treated by carbon dioxide laser with a margin of 3 mm.[4]

Fausto Chiesa et al (1986) treated 92 leukoplakias by CO_2 laser surgery. Felix WK Chu et al (1988) used a CO_2 laser to treat 29 leukoplakia patients and follow up was done for 3-10 years. The results supported CO_2 laser over conventional modes of treatment in relation to precision of tissue removal, minimal damage to adjacent tissue, immediate hemostatic effect, excellent wound healing and effective destruction of abnormal mucosal tissue minimizing recurrences.[21]Treatment can be performed under local anesthesia on an outpatient basis and the recurrence rate is low compared with the recurrence rate after surgical excision.

Erythroplakia:

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

Oral Lichen Planus

Oral lichen planus is a common mucocutaneous disease characterized by

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white striations, papules or plaques on the buccal mucosa, tongue, and gingivae.

Vander He et al (2008) treated 21 oral lichen planus patients with CO2 laser evaporation in the period of 1973-2003. During follow up of 1-18 years (mean 8 years) 85% of patients were found to be free of pain while 15% experienced painful recurrence after treatment. Hence, they 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 the first choice in patients suffering from painful oral lichen planus.[22]

Oral Submucous Fibrosis

Jawahar R et al - used a diode laser to treat trismus in oral submucous fibrosis patients. They concluded that the 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 the Asian population as it required less hospital stay and less follow up as compared to other surgical methods.[23]

Nayak DR et al used KTP-532 laser to treat 9 oral submucous fibrosis patients. Their study indicated that adequate release of oral submucous fibrosis can be achieved by using a KTP-532 laser release procedure, with minimal morbidity and satisfactory results. [23]

Mohan Kameshwaran et al treated 15 patients by lysis of the fibrotic bands with a soft tissue laser and adjunctive treatment. Excellent results over a 12 month follow up.[24]

Conclusion

Treatment of premalignant lesions with laser therapy is a reliable technique which is associated with low complications and morbidity rates and can be practiced on a routine basis. As premalignant lesions have the tendency of recurrence and malignant transformation rates, regular follow-up and patient education to eliminate the risk factors are recommended.

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