

Dental Lasers on Oral Precancerous Lesions

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ABSTRACT

Dental Lasers on Oral Pre cancerous lesions. Oral precancerous lesions are areas of abnormal tissue in the mouth that have the potential to develop into cancer. Detecting and managing these lesions early is crucial for improving prognosis and maintaining quality of life. Treatment Approaches: For moderate or severe dysplasia (which has a higher risk of becoming cancerous), doctors may remove the lesion and a small margin of healthy tissue, Laser beams can be used for this purpose, providing a minimally invasive approach., Local anesthesia is often used during the procedure, and patients can typically return home the same day. Photodynamic therapy (PDT) using lasers and photosensitizing agents is being investigated for its efficacy in managing oral leukoplakia, a common precancerous condition. We will review on the treatment of oral lichen planus using 980nm diode laser, oral submucous fibrosis treatment with diode laser and oral leukoplakia treatment using diode laser. Early detection and appropriate management play a crucial role in preventing the progression of oral precancerous lesions. Regular dental check-ups and awareness are essential for maintaining oral health.

Keywords: Dental Laser, Oral Pre Cancerous Lesions, Oral Lichen Planus

1. Introduction

Precancerous lesions of the oral mucosa, also known as potentially malignant disorders, are a group of diseases that should be diagnosed early due to their high risk of malignant transformation. Let's delve into some key points about these lesions:

Oral Leukoplakia: This condition presents as white patches on the oral mucosa. Although most leukoplakias are benign, some can progress to cancer. Biopsy confirmation is essential for diagnosis.

Oral Submucous Fibrosis (OSMF): OSMF is characterized by fibrosis and restricted mouth opening. It is associated with betel nut chewing and has a high malignant transformation rate.

Oral Erythroplakia: Erythroplakia appears as red patches in

the mouth. It is less common than leukoplakia but has a higher risk of malignancy.

Oral Lichen Planus: This disorder has six subtypes, including papular, reticular, plaque-like, atrophic, erosive, and bullous. Atrophic and erosive subtypes carry a greater risk of malignant transformation.

Etiological Factors: Tobacco use, alcohol consumption, betel quid chewing (containing areca nut), and solar radiation are frequently implicated as potential causes.

Importance of Early Diagnosis: Detecting these lesions early is crucial. Left untreated, they can progress to severe dysplasia, carcinoma in situ, or squamous cell carcinoma.

Remember, biopsy confirmation is essential for accurate diagnosis, and timely intervention can be lifesaving.

Since its appearance in the dental area, the laser has become a treatment of choice in the removal of lesions in the oral soft tissues, due to the numerous advantages they offer, being one of the most used currently the diode laser.

Among all lasers with generally accepted surgical capabilities, the diode laser is most commonly used for the surgical removal of proliferating lesions and the photocoagulation of venous malformations of the oral cavity. The laser provides several advantages for clinicians, including an absence of intraoperative bleeding and no need for stitches. The laser benefits patients because it reduces postoperative edema and pain, with fast mucosal restoration during healing by second intention.

2. Materials and Methods

A literature review of articles published in PubMed/MEDLINE, Scopus and the Cochrane Library databases between 2007 and 2021 was performed. "Diode laser", "soft tissue", "oral cavity" and "oral surgery" were employed for the search strategy. Only articles published English were selected.

3. Discussion

3.1 Leukoplakia and erythroplakia

Various medical and surgical treatments have been employed to exterminate leukoplakia and erythroplakia, but it is challenging to eradicate these disorders due to the chances of relapse and incomplete elimination. Previous literature suggested topical retinoid as the medical management of leukoplakia, but recurrences have been reported after withdrawal in approximately 50% of the cases¹. Various surgical modalities available for leukoplakia and erythroplakia are laser therapy, cryosurgery and conventional scalpel surgery².

Laser offers many advantages over other conventional methods: lesser post-operative pain, bloodless dry operating field, bactericidal effect, increased patient comfort, lesser chances of scarring, lesser post-operative swelling and minimal local anaesthesia. Moreover, previous studies confirmed that laser surgery had a lesser recurrence rate than scalpel surgery^{3,4}.

A comparative study between diode laser, CO2 laser and cryotherapy showed that diode laser and CO2 laser had better clinical outcomes of parameters, such as pain, oedema and slough

formation than cryosurgery in the management of leukoplakia. Pain was significantly higher in CO2 laser and surgery group as compared with diode laser group over a period of 2 weeks. Pain was evaluated with the help of VAS, while oedema was evaluated by comparing the wound area with the anatomical area of the opposite side for the presence or absence of asymmetry⁵.

A regular follow-up is mandatory for these cases to evaluate any recurrences. According to the 'recurrence phenomenon', the adjacent clinically normal peripheral epithelial tissues contain abundant active cells in the basal cell layer. These active cells might proliferate in the future to cause recurrences. It is commonly acknowledged that 'field cancerisation' or the so-called 'field change' of cancer plays a significant role in the occurrence of dysplastic cells close to the oral squamous cell carcinomas and other OPMDs. It also explains the events of recurrence following complete laser vaporisation⁵. Laser ablation has more chances of recurrences compared to excision cases⁴.

Previous studies of leukoplakia treated with laser by^{6,7} showed a recurrence rate of 29.3% and 17.5%, respectively, while a meta-analysis by⁸ concluded that the overall recurrence rate was 16.5%. Herein, we observed a recurrence rate of 19.48% (15/77 lesions). The recurrence rate was higher for laser ablation compared to laser excision. Moreover, the gingival lesion showed a maximum recurrence rate (50%) compared to the other sites.

Laser ablation has a high recurrence rate possibly related to incomplete deep removal, as described above. Gingiva had the highest recurrences as laser excision was not performed in any case due to the limited thickness available. Recurrences may also be related to patient's gender, non-cooperation to quit the habit, dysplastic activity, location of the lesion and the presence of lesion for a prolonged period³.

When comparing the diode laser with other lasers in the management of leukoplakia, diode laser seems to have significantly lesser postoperative pain than CO2 laser over 2 weeks⁵ and better bleeding control and patient satisfaction than Er, Cr: YSGG laser⁹. Very few studies are available, focused on the comparison of diode laser with other lasers in the management of leukoplakia; thus, the author recommends future studies in this aspect (**Table 1**).

Table 1: The comparison between laser ablation and laser excision.

Laser ablation/laser evaporation	Laser excision
It is the removal of lesion superficially	It is the removal of lesion deeply, consider an excisional biopsy
Indications	Indications
Leukoplakia without dysplasia	Leukoplakia with dysplasia of any grade
Homogeneous leukoplakia	Non-homogeneous leukoplakia
Large areas where excision could cause discomfort	
Specially indicated in gingival leukoplakia	
Advantages	Advantages
It has limited post-operative discomfort and lesser pain	Tissue removed can be sent for histological examinations
Can be performed in larger lesions	Chances of recurrences are lesser than laser ablation
Can be used in multiple lesions	Difficult for larger lesions
Faster healing	
Reduced scarring and better preservation of tissue's elastic property	
Can be repeated even if new lesions arise near the primary lesion	
Disadvantages	Disadvantages
Tissue cannot be sent for pathological examination. Hence, cannot determine the histology of the lesion	Excising large lesions can cause functional problems
High chances of recurrence	Compared to ablation it has a high chance of tissue scarring

3.2 Oral Lichen Planus

OLP is a chronic inflammatory¹⁰ disease characterised by relapses and remissions. It is a cell-mediated immune condition of unknown aetiology, in which T lymphocytes accumulate beneath the epithelium of the oral mucosa and increase the rate of differentiation of the stratified squamous epithelium, resulting in hyperkeratosis and erythema with or without ulceration.

The T cells kill the target cell either by synthesis and extracellular release of cytotoxic proteins as perforin and granzymes, producing pores in the target cell membrane and so kill cell by osmotic lysis, or by stimulating the target cell, through mechanisms that are not well understood to undergo apoptosis¹¹.

Despite numerous existing remedies, there are many treatment failures. One of the current approaches to the management of OLP includes diode laser therapy, a promising modality with minimum side-effects.

Clinical applications of the low-level laser therapy (LLLT) started to appear in the 1980s and became the most popular lasers which are relatively inexpensive diode units^{12,13}.

The GaAs (gallium arsenide; 904 nm) diode laser and the GaAlAs (gallium aluminium arsenide; 780–890 nm)¹¹.

They have significant neuropharmacological effects on the synthesis, release and metabolism of a range of neurochemicals, including serotonin and acetylcholine at the central level and histamine and prostaglandin at the peripheral level¹⁴.

The pain influence has also been explained by the LLLT effect on enhanced synthesis of endorphin, decreased C-fibre activity, bradykinin and altered pain threshold.

It causes vasodilation and increases local blood flow which brings in oxygen and makes a greater movement of immune cells into the tissue¹⁵.

Diode is a solid active medium laser, manufactured from semiconductor crystals using some combination of aluminium or indium, gallium and arsenic. The available wavelengths for dental use range from about 800 nm for the active medium containing aluminium to 980 nm for the active medium composed of indium. All of the diode wavelengths are highly absorbed by pigmented tissue and are deeply penetrating¹⁶.

The principle of using diode is to supply direct biostimulative light energy to the body's cells. Cellular photoreceptors (eg, cytochromophores and antenna pigments) can absorb diode laser light and pass it on to mitochondria, which promptly produce the cell's fuel, ATP. It may have significant neuropharmacological effects on the synthesis, release and metabolism of a range of neurochemicals, including serotonin and acetylcholine at the central level and histamine and prostaglandin at the peripheral level. It has effect on enhanced synthesis of endorphin, decreased C-fibre activity, bradykinin and altered pain threshold¹⁷.

3.2.1. Treatment with diode laser is non-invasive and non-pharmaceutical

Earlier studies conducted by Soliman et al in 2005 on 25 patients of OLP using diode laser (980 nm) observed marked clinical improvement in 64% patients with complete remission of symptoms, with recurrence observed in 12% of patients after 3 months. Cafaro et al in 2010 conducted a study on 13 patients

of OLP using 904 nm pulsed infrared laser and observed that all patients reported a complete resolution of symptoms at the end of the laser sessions. Jajarm et al in 2011 conducted a comparative pilot study of low-intensity laser (LIL) versus topical corticosteroids in the treatment of erosive atrophic OLP and observed that LIL therapy (LILT) was as effective as topical corticosteroids but LILT did not exhibit unwanted side effects. The results of earlier studies that used excimer lasers were not satisfactory. Passeron et al used excimer lasers (308 nm) on four patients with OLP. Kollner et al also studied the effect of excimer lasers on eight patients with OLP, and only one patient responded completely after 12 sessions. In a study by Trehan et al, an excimer laser was used in eight patients with OLP who had previously failed to respond to traditional treatment and five patients improved more than 75%.

3.3 Oral Submucous fibrosis

Among various debilitating aspects of OSF^{18,19}, trismus due to fibrosis remains the main challenge for the clinicians and researchers. The OSF-related trismus hampers self-cleansing activity of the stiff oral tissues; thereby increasing the contact of betel nut and tobacco carcinogens with the tissues and thus increases the probability of malignant transformation. Recently²⁰, also suggested stiff and rigid oral tissues in OSF patients as initiator and promoter of carcinogenesis. Therefore, the treatment of OSF patients should primarily be directed towards improving the MO and increasing flexibility of the oral mucosa. This definitely augments the chewing ability, swallowing, oral hygiene care, speech, nutritional status; and thus further helps in achieving better Oral health related quality of life in this population.

Because of the chronic, progressive and insidious nature, OSF-related trismus does not regress either spontaneously or with the cessation of betel quid chewing. The management of OSF over the past decades has been varied and largely ineffective. Medical management with various options is inadequate in reducing trismus and other OSF-related symptoms.⁹ The potential complications of post-surgical fibrosis leading to recurrence and donor-site morbidity downcast the outcomes of surgical approaches²¹. Local physiotherapy including hot rinses, short wave diathermy did not evoke satisfactory results²². However, LT provides clinicians and researchers a new minimally invasive, cost- and time-effective treatment option for OSF patients. As it produces immediate trismus relief with uneventful healing, LT enhances patients satisfaction and help motivate them for continuation of further treatment^{23,24}. More importantly, being delivered through a flexible cable, lasers can be targeted to relatively difficult-to-access areas with ease and safety. Despite of all these advantages, the literature on role of lasers in OSF treatment is still lacking. Therefore, there was a dire need of evaluating the influence of LT for management of OSF patients.

Rationale for the use of LT for surgical fibrotomy in OSF is photo-thermal action which results in disruption of the tissue by sufficient deposition of heat to vaporize the tissue²⁵. Interestingly, the laser energy is absorbed selectively in the target tissues and results in a direct tissue cut (cold cut) or cause tissue rupture due to vaporization of water within a cell (thermo-mechanical tissue ablation). This mechanism limits the collagen damage up to 5 µm (approximately 2 cell widths) sparing the extracellular collagen matrix.

Laser fibrotomy can be performed on a dental chair or a minor operating room under LA; thus, is less time consuming. Moreover, the procedure is without any associated risk of GA and cost-effective as it cuts extra financial burden of hospital administration and post-operative care on patients. Thus, it is quite conceivable that laser fibrotomy under LA can serve as an effective and affordable treatment option for OSF patients in Asian countries where majority of the patients belong to lower socio-economic strata 34.

The site and type of incision of the laser fibrotomy can influence the resultant increase in^{26,27} observed significant results in reducing trismus by using ‘Inverted Y shape’ incision in retromolar region and buccal mucosa²⁸ accomplished excellent outcomes with the help of ‘multiple parallel’ incisions. However, this is supported by the fact that they have excised fibrous bands in the soft palate and anterior faucial pillars in addition to retromolar region and buccal mucosa under GA²⁸. Three studies worked on ‘linear’ incision and reported relatively less effective outcomes as compared to those of other included studies²⁹⁻³¹.

Apart from relieving trismus, it is essential to therapeutically target other OSF-related symptoms to achieve successful outcome goals in OSF management and improve the OHRQoL of patients. The burning sensation was found to be significantly decreased in two studies^{30,31} in addition to increased cheek flexibility and tongue protrusion as reported by¹⁹ It is important to note that rigorous daily oral physiotherapy should always be used adjuvant to laser fibrotomy in order to sustain the resultant increased MO^{27-29,32}. We believe that patient counseling and motivation plays a crucial role to increase their compliance and in regard to habit cessation. All the studies included in this review implemented oral physiotherapy after laser fibrotomy and achieved good outcomes for longer time. Medicaments including antioxidants, corticosteroids and hyaluronidase are vitally important supplements and plays pivotal role in the success of OSF treatment. Six studies included in the present review have advised antioxidants/steroids in addition to LT^{23,26,28,30-32}. Due to non-inclusion of appropriate control groups in the included studies, the degree of MO attributed to these adjunct therapies (physiotherapy and medicine) cannot be expressed. Moreover, appropriate randomization of the samples is warranted in the future research.

The present systematic review identified three different lasers that were used for management of OSF. The noteworthy finding of this systematic review was lasers can provide a promising and better means for relieving trismus and probably OSF-related other symptoms in moderate stages of the disease as they are minimally invasive, well tolerated, time- and cost-effective with sustainable outcomes and lesser morbidity. The observations of this review can help enhance awareness among the healthcare professionals and clinicians about various lasers and probably will also be a part of their practice.

4. Conclusion

Lasers, especially Diode lasers, contribute to excellent treatment with minimally invasive surgical procedures. They offer many advantages in the treatment of patients with various types of oral mucosal lesions and maxillofacial disorders. It is conceivable that lasers will play an increasingly important role in dentistry.

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6. Declaration of Competing Interest

None declared.

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