



Research Article

THE ROLE OF LASERS IN THE TREATMENT OF POTENTIALLY MALIGNANT DISORDERS OF THE ORAL CAVIT- A REVIEW

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ABSTRACT

The term Laser is the acronym of 'Light Amplification by Stimulated Emission of Radiation'. Lasers have become quite popular over the years due to its unique properties. The first dental laser dates back to 1960 with the introduction of ruby lasers in dentistry by T.H. Maiman. Today, lasers find its application in all the branches of dentistry. Many studies have been conducted on lasers and much literature is available as of today on the application of Lasers in dentistry. The aim of this article is to review the application of lasers in the management of Potentially Malignant Disorders of the oral cavity.

Key words:

Laser, Diode laser, Potentially Malignant Disorders, Dentistry

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INTRODUCTION

LASER which stands for 'Light Amplification by Stimulated Emission of Radiation' is basically a focussed source of electro magnetic radiation or light energy. The three key properties that make Laser unique are its mono chromatism, directional properties and coherence. Laser is a concentrated source that has single wavelength and travels in single direction at a single phase. These properties allow laser light energy to be targeted with high energy and accuracy. <sup>1</sup>The first functioning laser was introduced by Theodore Maiman from Hughes Research Laboratories in Malibu, CA in 1960. He introduced ruby laser which was a solid-state laser with ruby crystal which was used for military purpose. The pioneers in research on the application of lasers in dentistry are Stern and Sognnaes. They started their experiments with Lasers on dental hard tissues in 1964. Today lasers are used for both hard tissue and soft tissue application in dentistry. <sup>2-4</sup>

Albert Einstein in 20<sup>th</sup> century described three mechanisms of photo radiation which are absorption, spontaneous emission and stimulated emission. Schawlow and Towns in 1958 applied these principles in microwave and devised MASER. This laid the foundation for the discovery of laser. <sup>4</sup>Every laser device has three basic components; a laser medium, an optical cavity with one completely reflective mirror on one end and partially transmissive mirror on the opposite end and an external power source. The power source activates the atoms in the laser medium to high energy.

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Atoms that are reexcited emit photons which get amplified while bouncing back between the mirrors. Photons that have the same wavelength and frequency escape through the transmissive mirror and form the laser beam. <sup>5</sup> There are four main interactions that the laser beam has with biological tissues. This is dependent on the wavelength of the laser beam. The four types of interactions are reflection, transmission, scattering and absorption. <sup>6</sup>

Lasers can be of different types based on the laser medium used within the laser device. It can be further classified into hard tissue and soft tissue lasers based on the applications. CO<sub>2</sub> laser, Diode Lasers and Nd:YAG are the chief soft tissue lasers in dentistry. Erbium lasers which include Er:YAG and Er,Cr:YSGG are predominantly used for hard tissue applications. However, Erbium lasers could also be used for soft tissue ablation. <sup>7</sup> Majority of surgical lasers have wavelengths in the infra-red part of the spectrum. Argon laser emits light in the visible spectrum and excimer laser in UV part of the spectrum. The wavelengths of various lasers are as follows. <sup>8</sup>

Solidstate Lasers	GasLasers
Nd:YAG(λ=10,64nm)	CO <sub>2</sub> (λ=10,600nm)
Er:YAG(λ=2940nm)	Argonlaser(λ=458-515nm)
Er:YSGG(λ=2970nm)	Excimerlaser(λ=100-400nm)

Diode laser is a separate entity which uses an upper-luminescent diode as the lasing medium. It emits laser light at wavelengths of 810-980nm. It can emit the waves in continuous or pulsed mode and is hence suitable for soft tissue surgical procedures in the oral cavity. <sup>8</sup>

WHO in 2005 defined potentially malignant disorder as oral cavity disease "where there is a risk of malignancy being present in a lesion or condition either during the time of initial diagnosis or at a future date." This can be further subdivided as premalignant lesion and premalignant conditions. Premalignant lesion is a benign lesion with morphologically altered tissue, which has a greater than normal risk of transformation to malignancy. Premalignant condition is defined as a disease or patient's habit that does not necessarily alter the clinical appearance of local tissues but is associated with a greater than normal risk of precancerous lesion or can later develop in that tissue.<sup>9</sup> The primary objective of treatment of premalignant lesion is to remove the potentially neoplastic cells as they are prone to recurrence and/or malignant transformation.<sup>10</sup>

The lesions are to be excised with clear margins. The various modalities for surgical management include scalpel excision, electro-cautery, cryo surgery and laser surgery. Gold standard method for management for high risk per-malignant lesion is excision and laser ablation. Laser assisted excision and vapourisation are superior in efficiency and tolerability, when compared to conventional scalpel excision. The transmission of laser energy to cells initially causes warming, at above 100°C causes coagulation, and with further increase in temperature causes protein denaturation, vaporization and carbonization.<sup>10</sup>

Laser is employed in the treatment of leukoplakia, lichen planus, Oral sub mucous fibrosis and also for the management of lesions such as traumatic fibroma and aphthous ulcers. Owing to the least effect during Laser surgery maintaining a clean operative field is easier. In addition, laser enables the accurate removal of the lesion and hence the damage to the adjacent tissue, inflammation and post-operative pain are minimal. Laser surgery causes limited contraction of the tissues and hence excellent wound healing and satisfactory mobility of the oral mucosa are achievable.<sup>11</sup>

#### **Lasers in the treatment of potentially malignant disorders**

**Leukoplakia** can be defined as a lesion which has a white patch or plaque on the oral mucosa that can not be removed by scraping and can not be classified clinically or microscopically as any other disease.<sup>11</sup> Lasers can be employed for the excision or vaporisation of the leukoplakia. A systematic review by Alfonso *et al.* In 2016 concluded that CO<sub>2</sub> lasers are excellent in the management of oral leukoplakia.<sup>12</sup> Felix *et al.* in 1988 used CO<sub>2</sub> laser for the purpose of cure and palliation in 29 patients. He reported 97% 3 year local control of the lesion after one or two procedures, initial recurrence rate of 10.8% and malignant transformation of 2.6%. The wound healing was excellent and few complications could be countered. His study supported the use of laser surgery over conventional methods for treatment of leukoplakia.<sup>13</sup> Ishii *et al.* in 2003 used varieties of lasers including CO<sub>2</sub> Laser, Nd:YAG laser and KTP laser for the purpose of excision and vaporisation. They reported recurrence rate of 29.3% and malignant transformation of 1.2%.<sup>11</sup> Singhal *et al.* in 2016 used CO<sub>2</sub> Lasers in the management of oral leukoplakia. There was a recurrence rate of 9.10% and malignant transformation of 2.27% during the follow up.<sup>14</sup> Vatsa *et al.* in 2016 employed diode laser for ablation of leukoplakia in 10 patients and found favourable results with less bleeding and pain. One year follow up showed no evidence of recurrence.<sup>15</sup> Yangetal in 2015

used CO<sub>2</sub> lasers for excision of erythroplakia. Post-operative recurrence rate was found to be 16.7%.<sup>16</sup>

Based on the existing evidence it can be concluded that CO<sub>2</sub> lasers, Nd:YAG lasers and diode lasers can be used for the treatment of leukoplakia. The lesion can be excised or vaporised with the assistance of lasers. The treatment can be done in a blood-free field, with minimal damage to the surrounding tissue and rapid healing with minimal or no loss of function. Homogenous leukoplakia reveals excellent response where as there is high chance of recurrence and malignant transformation with verrucous leukoplakia and erythro-leukoplakia.<sup>15,17-20</sup>

**Actinic cheilitis** is another potentially malignant disorder that presents usually in the lower lip due to chronic exposure to sunlight. Vermilionectomy, cryo surgery with liquid nitrogen, electrodesiccation and curettage, chemocautery, dermabrasion or topical application of medications such as retinoic acid are employed in the management of this. Roberts *et al.* in 1988 and Laurence *et al.* in 1985, in their studies used CO<sub>2</sub> lasers for the vaporisation of the lesion and reported superior cosmetic outcome with minimal functional compromise.<sup>21,22</sup> Brian *et al.* in 1990 conducted a similar study during which he encountered mild hypertrophic scar which was treated with intralesional steroid injections. The author reported that Laser is simple, inexpensive and effective therapy for actinic cheilitis.<sup>23</sup> Raymond *et al.* in 1997 performed an extensive treatment review of the therapeutic modalities for actinic cheilitis. The review concluded that laser should be employed for extensive lesions and CO<sub>2</sub> lasers yield an improved cosmetic outcome when compared to scalpel vermilionectomy.<sup>24</sup>

**Oral lichen planus** is a chronic inflammatory mucocutaneous, presumably autoimmune disease. Manju *et al.* in 2004 and Katja *et al.* in 2003 employed use of Low dose Excimer 308 nm Laser for the treatment of lichen planus. This study revealed favourable outcome.<sup>25,26</sup> Jajaram *et al.* in 2011 compared the efficacy of low intensity diode laser of 630 nm wave length with corticosteroids. The authors reported that low intensity laser therapy is as effective as corticosteroid in the treatment of erosive and atrophic form of lichen planus.<sup>27</sup> Further, the systematic review by Al-Mawer *et al.* in 2017 and Systematic review and meta-analysis by Jajaram *et al.* In 2018 suggested that low level laser therapy is a suitable alternative to conventional treatment with corticosteroid in the treatment of Oral Lichen Planus. The complications associated with pharmacological treatment are bypassed by this modality of treatment.<sup>28,29</sup>

**Oral Submucous Fibrosis (OSMF)** is a chronic insidious debilitating disease which is associated with progressive fibrosis of the connective tissue of the oral cavity which leads to trismus. Zainab *et al.* In 2014 used ErCr: YSGG laser for fibrotomy in 16 moderate OSMF cases. Laser fibrotomy was combined with cessation of habits, topical steroids and oral physiotherapy. There was mean improvement of 17.5 mm mouth opening in 1 year.<sup>30</sup> Ramanupam *et al.* In 2014 used diode lasers for fibrotomy in 5 patients with an average mouth opening of 20mm. The treatment could be completed in under 20 minutes without any complications. 3 months follow up revealed no recurrence of the bands.<sup>31</sup> Utkarsha *et al.* in 2014 used diode lasers for fibrotomy in 50 cases of oral submucous fibrosis. The experimental study concluded that significant mouth opening could be achieved through Laser assisted fibrotomy with minimal morbidity.<sup>32</sup> There had been no

systematic review sormeta-analysis is that evaluates the efficacy of laser for OSMF. This may probably be because of the lack of comparative studies where in lasers are compared with conventional calpelfibro to my. However, the exist in gevid encesuggests that this can be used as a tool which can yield satisfactory results.

## CONCLUSION

The existing evidence suggests that LASER Saree ffcientin surgical managemen to fOr al Potentially Malignant Disorders such asleukoplakia, erythroplakia, actiniccheilitis, lichenplanus and OSMF. It may effectivel yarrest the progress and malignant transformation of such lesions. There is much variation between different authors on the type, wavelength and intensity of laser used for procedures. The major advantage so flasers are blood less operative field, excellent wound healing with minimal post-operative pain and in flammation. However, the cost of the machinery and lack of awareness about Laserbiopsy may be there as on why it is not being used widely by all practitioners. A thorough hunder standing of the efficiency and ease in the usage of LASERS may remove this in hibitions and make it an effectivealer native to scalpel surgery.

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