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REVIEW ARTICLE

Lasers in Dentistry: A Comprehensive Review

Namita Sepolia[1], Aditi Malhotra[2], Monika Negi[3]

[1,3]PG student, Department of Oral Pathology and Forensic Odontology, Bhojia Dental College & Hospital, Baddi (H.P)
[2]Ex Resident, Department of Orthodontics, HPGDC, Shimla (HP.)

ABSTRACT
LASER is a device for generating a high-intensity, ostensibly parallel beam of monochromatic electromagnetic radiation. LASER technology has been recently introduced to the field of dentistry in order to address the diagnostic and therapeutic needs of patients faster and more efficiently. The CO2 laser was the first laser to appear in Dentistry, thanks to its excellent cutting ability, being still a very employed and effective method. Hence; in the present review, we aim to highlight some of the important aspects of LASERS in dentistry.
Key words: Gingivitis, LASER, Oral lesion.

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Corresponding author: Dr. Namita Sepolia, PG student, Department of Oral Pathology and Forensic Odontology, Bhojia Dental College & Hospital, Baddi (H.P), India

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INTRODUCTION

Ever since its introduction since 1960s, Laser in dentistry has led to a continuous research in the various applications of lasers in dental practice. There are two scenarios, on the one hand there are hard lasers, such as, Carbon dioxide (CO2), Neodymium Yttrium Aluminum Garnet (Nd: YAG), and Er:YAG, which offer both hard tissue and soft tissue applications, but have limitations due to high costs and a potential for thermal injury to tooth pulp, whereas, on the other hand in cold or soft lasers, based on the semiconductor diode devices, which are compact, low-cost devices used predominantly for applications, are broadly termed as low-level laser therapy (LLLT) or 'biostimulation.[1- 3]

LASER is an abbreviation formed by joining the first letter of the words: Light Amplification by Emission of Radiation. L refers to Light, A refers to Amplification, S refers to Stimulation, E refers to Emission, and R refers to Radiation.[2, 3]

TYPE OF DENTAL LASERS

Argon laser

The argon laser, the active medium of which is argon gas, produces light at two wavelengths. The 488 nm blue light is commonly used to initiate the polymerization of restorative composite materials. This laser is often used for hemorrhage control in gingival surgery, as well as for detecting cracks and decay on the surface of teeth by using the transillumination technique.[4]

CO2 laser

The active medium of this laser is CO2 gas. The CO2 laser has some advantages, including rapid soft-tissue removal, perfect hemostasis and shallow depth of penetration, which is why it is commonly used for soft-tissue surgery. However, when using a CO2 laser, the tooth structure surrounding the soft-tissue surgery site should be carefully protected. These lasers are not suitable for hard tissue applications.[5]

Erbium lasers

Today, erbium lasers are the most commonly used for dental applications. They exhibit high hydroxyapatite absorbance and the highest water absorbance of any dental laser. Because bone and tooth both contain great amounts of hydroxyapatite and water, erbium lasers can be successfully used in hard tissue removal. For such applications while the water in the tooth evaporates, the surrounding soft-tissues can be removed with a minimal thermal effect on the pulp.[6]

Nd:YAG laser

The Nd:YAG results in long-term hemostasis because of the thick coagulation layer. In addition to surgical applications, it has been used for soft-tissue removal and researchers have also explored its use for non-surgical sulcular debridement. Because Nd: YAG light is only absorbed by dental hard tissue, it can safely be used to perform soft-tissue surgery adjacent to the teeth.[7]

Diode lasers

Diode lasers use a semiconductor as the source for emission. It is not as effective as the argon laser for hemostasis. Because light emitted from diode lasers is poorly absorbed by dental hard tissues, these lasers can be safely used for soft-tissue surgery applications, including gingival recontouring, crown lengthening, removal of hypertrophic tissue and frenectomies close to the enamel, dentine and cement.[8]

CHARACTERISTICS OF LASER LIGHT

Monochromacity - laser light is one specifi c color/ single wavelength unlike ordinary white light which is a sum of many colors of the visible spectrum.

Collimation - refers to the beam having specifi c spatial boundaries which ensures a constant size and shape of the beam emitted from the laser cavity.

Coherency - means that the light waves produced in the instrument are all in phase with one another and have identical wave shapes, i.e. all the peaks and valleys are equivalent.

Efficiency - at very low average power levels lasers can produce the required energy to perform their specific function, e.g. 2 watts of Nd: YAG laser light provides the thermal energy to precisely incise a gingival papilla.[9- 11]

LASER THERAPY IN DECREASING DENTIN HYPERSENSITIVITY

Dentin hypersensitivity happens as a short and sharp pain from naked dentin in response to various stimuli. To treat dentin hypersensitivity, different anti sensitivity substances are used. In more complicated cases like reversible pulpitis, it is possible to use laser energy to help. Low level laser irradiation of cervix and apex region of sensitive teeth can be an appropriate treatment to eliminate sensitivity.[12, 13]

LASER THERAPY IN TREATING GINGIVAL INFLAMMATION

Low power laser irradiation may have both a local and general anti-inflammatory effect. The following are some of the characteristics of this therapy: it induces an increase in nonspecific protection factors such as the complement system, interferon, and others; reduces interstitial and intracellular swelling by improving blood circulation in the damaged tissue, often resulting in less pain at the site of injury; decreases in the levels of histamine and serotonin, which are mediators in the inflammation process and also have vasodilation effects; decreases in the porousness of blood vessels, preventing alteration-exudative processes, thereby preventing swelling.[14]

The anti-inflammatory effects of low power laser irradiation are observed by a decrease in the number of clinical signs of inflammation, lower acute-phase protein levels, and decrease in circulating immune complexes. In dentistry, low power laser therapy has mainly been used for pain relief in oral mucous membranes, dentin hypersensitivity, and other conditions requiring an analgesic and anti-inflammatory response. Its effects on periodontal therapy are known and have been recognized in *in vitro* and clinical studies; however, they still need further exploration.[15, 16]

SOFT TISSUE APPLICATIONS OF LASER

In literature, laser has been recommended for the treatment of benign oral lesions, e.g. 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.[14]

Isolated areas of transient tissue hypertrophy can easily be excised with the diode laser without specialist referral. The diode laser is also very useful for a number of isolated applications, such as, removing tissue that has overgrown mini-screws, springs, and appliances, as well as for replacing a tissue punch if needed, when placing mini-screws in the unattached gingiva.[13, 14]

Laser provides an opportunity for safe treatment of periodontal disease in children without causing allergic reactions or bacterial resistance. All wavelengths of laser enable gingivectomy, gingivoplasty and operculectomy without the need for local anesthesia and without bleeding. Enhancement of tooth eruption, elimination of abnormal gingival lesions due to improper tooth movements, treatment of drug-induced gingival hyperplasia, resection of fibroma, aphthous lesions, herpes labialis, mucocele and pyogenic granuloma and also esthetic procedures are among other applications of lasers.[17]

Er:YAG laser can be used for frenectomy in infants with tight maxillary frenums or for upper and lower frenectomy in infants with severe ankyloglossia. CO2 laser can be used for surgical resection of vascular tumors in the oral cavity

and gingival enlargement due to the use of cyclosporine. This laser has the advantages of disinfection and coagulation in comparison with surgical scalpel.[18]

The superiority of the diode laser in relation to the conventional scalpel offers no doubts. D'Arcangelo *et al.* and Amaral *et al.* compared both techniques concluding that diode laser offers numerous advantages compared to the conventional scalpel as a lower intraoperative bleeding, a lower swelling of the area, better coagulation and scarring, no need of suture, reduction of surgical time and lesser degree of postsurgical pain. In addition, the laser instantly disinfects the surgical wound, and lesser further mechanical trauma is also confirmed by Bakhtiari *et al.* study. On the other hand, Jin *et al.* reported that diode laser produced greater tissue damage compared to the conventional scalpel and the Er Cr: YSGG laser.[19- 22]

CONCLUSION

In today's scenario, LASER is being currently used in numerous areas of the medical field with excellent results. However; at the same time, Laser light depending on wavelength, power or output energy can be dangerous for body tissues, particularly eyes and skin. Laser light is not only dangerous when directly encountering tissues but also after reflection from reflective materials. Hence; studies are recommended in future for better exploration of application of LASERS in Dentistry.

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