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Review Article

Application of Laser in Dentistry: A Brief Review

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ABSTRACT:
Field of dentistry is a dynamic field and the search for better materials, systems, and innovation is everlasting. Laser today has turned out to be a response to numerous such journeys. Since 1960s, When Maiman used it for the first time in dentistry, laser have evolved their way in the field, where they are been used for several procedures like caries removal, cavity preparations, dental hypersensitivity treatment, etching, composite polymerization, bleaching, canal sterilization, soft tissue and apical surgeries. This review of literature aims to elaborate uses of laser in dentistry in brief.
Keywords: Laser, Dental Laser, Dental application

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INTRODUCTION

The past decade has seen an explosion of research work in the application of laser technology to general dental practice and the parallel emergence of organization to support laser dentistry with an international focus.[1]

Once regarded as complex technology with limited uses in clinical dentistry, there is growing awareness of the usefulness of laser in the armamentarium of modern dental practice, where they can be used as an adjunct or alternative to traditional approaches.[2]

LASER is an acronym for light amplification by stimulated emission of radiation. Lasers are heat producing devices converting electromagnetic energy into thermal energy.[3] Laser is a special light source that has a high power and better quality of beam compared to the other light sources.[4] Laser today has turned out to be a response to numerous such journeys.[5] The use of laser in dental procedures popularized amid the 1960s. In dentistry, unlike other fields of medicine and surgery, laser is considered an adjunctive to deliver precise tissue management to achieve hard and soft tissue procedures.[6] This review of literature aims to elaborate uses of laser in dentistry in brief.

HISTORY

Theoretically, laser light production was developed some 90 years ago and first used on extracted tooth about 47 years ago. In 1900, first pulsed Nd: YAG laser was released as to have better interaction with dental hard tissues.[6,7] The term LASER is an acronym for 'Light Amplification by the Stimulated Emission of Radiation' and was first introduced to the public in 1959, in an article by a Columbia University graduate student, Gordon Gould. In 1961, a laser generated

from crystals of yttrium-aluminum-garnet treated with 1-3% neodymium (Nd: YAG) was developed. In 1962, the argon laser was developed, whereas, the ruby laser became the first medical laser to coagulate retinal lesions, when it was used in 1963. In 1964, Patel at Bell Laboratories developed the CO2 laser. Nowadays diode lasers are being extensively used in the field of dentistry. [8, 9]

PRINCIPLE OF LASER

Dental lasers use the energy generated by atomic electron shifts, producing coherent monochromatic electromagnetic radiation between the ultraviolet and the far IR section of the electromagnetic spectrum, producing both visible and invisible lights with particular wavelength and colour, which act on the particular tissue site to attain the desired effect. The basic principle involved in laser action is quantum nature of light and stimulated emission. Lasers produce heat that converts electromagnetic energy into thermal energy. Emitted laser has three characteristic features: monochromatic, coherent, and collimated.[6, 10, 11, 12]

TYPES OF LASER

Dental lasers are named depending on the dynamic medium that is empowered. The medium can be a liquid (colour) or a gas (e.g., argon and carbon dioxide), a solid state crystal rod, for example, neodymium: YAG (Nd:YAG), Erbium:YAG (Er:YAG) or a semiconductor (diode lasers).[13]

CLINICAL APPLICATION OF LASER IN DENTISTRY

Lasers are expected to make a benchmark in dentistry with its major advancements in clinical applications. Hard and soft tissues can be treated using lasers without direct contact, vibrations, and pain; thus, it can be utilized in many divisions of dentistry.

LASER AS A DIAGNOSTIC TOOL

Argon and diode laser are popularly used for detection and quantifying of dental caries using diagnodent. Further, diode lasers are used for detection of subgingival calculus, and testing pulpal blood flow via Laser Doppler Flowmetry. Helium-neon lasers also and their use for scanning phosphor plates of digital radiographs. Nd, Er: YAG are also utilised in spectroscopic analysis and confocal cytometric imaging of soft and hard tissues.[14]

LASER IN CARIES PREVENTION

Several in vitro and initial in vivo studies have shown that argon laser irradiation provides a certain degree of protection against enamel caries initiation and progression. Studies with different argon laser delivery systems showed similar results, i.e., that this type of laser is effective in reducing caries susceptibility of sound enamel and white spot lesions.[15,16] More recent in vitro studies showed reductions in lesion depth in primary tooth surfaces using argon laser irradiation combined with topical acidulated phosphate fluoride treatment (APF). The CO2 laser has also been used for caries prevention. Investigations show the beneficial effect of CO2 laser irradiation on the acid resistance of enamel.[17,18]

LASER IN CARIES REMOVAL

Carious material contains a higher water content compared with surrounding healthy dental hard tissues. Consequently, the ablation efficiency of caries is greater than for healthy tissues. There is a possible selectivity in the removal of carious material using the Er: YAG laser because of the different energy requirement to ablate carious and sound tissues leaving those healthy tissues minimally affected.[19]

LASER ASSISTED ETCHING

It has been evaluated as an alternative to acid etching of enamel and dentine. Enamel and dentine surfaces etched with (Er, Cr: YSGG) lasers show micro-irregularities and no smear layer. Adhesion to dental hard tissues after Er: YAG laser etching is inferior to that obtained after conventional acid etching.[20,21]

GINGIVAL RE-CONTOURING AND CROWN LENGTHENING

Diode laser had emerged as a rescue from painful conventional gingival surgeries, where laser is associated with less pain, discomfort and bleeding. Moreover, healing is rapid and without healing marks.[22]

LASER ASSISTED FRENECTOMY

A frenum can be defined as a fold of mucous membrane that appends the check and the lips to the alveolar mucosa, the gingiva, and the underlying periosteum. Sometimes, abnormality in this frenum may lead various problems such as midline diastema, trauma, and poor oral hygiene. This leads to the surgical removal of the frenum which is known as Frenectomy. The laser is one surgical tool that provides a bloodless field, clear and simple technique, no need of suture, and with the excellent postsurgical healing of the tissue. Erbium laser is mostly used with simultaneous water spray. 30–40 Hz of frequencies is commonly used.[23,24]

LASER IN ORAL APHTHOUS STOMATITIS

Amongst one of the highly painful oral conditions, oral aphthous stomatitis is characterized by the presence of painful oral ulcers with a strong history of recurrence. Low-level laser treatment has proved to be extremely potent considering instant relief of pain as well as subsequent reduction of the size of the ulcers. A study done using the diode laser has shown remarkable improvement when used with less than 1 megawatts power and a wavelength of 810 nm.[25,26]

LASER ASSISTED PULPOTOMY

Lasers have been used for carrying out pulpotomy procedures in primary teeth, as they maintain a sterile environment and reduce inflammation. It was first applied for pulpotomy procedure by Shoji *et al*. using dog's teeth, wherein no detectable damage was observed in the radicular portion of the remaining pulps tissue. Lasers, also, possess hemostatic, antimicrobial, and cell-stimulating properties with added advantages of an improved wound healing and no mechanical damage on the remaining pulp tissue. For the said reasons, laser irradiation was suggested as a promising alternative to the conventional pharmacotherapeutic strategies.[28]

LASERS IN ANALGESIA

The pulsed Nd:YAG laser is widely used for analgesia in endodontics. Its wavelengths interfere with the sodium pump mechanism, change cell membrane permeability, alter temporarily the endings of sensory neurons, and block depolarization of C and A fibers of the nerves.[29]

LASER IN DIRECT PULP CAPPING AND PULP AMPUTATION

Lasers can be used for haemostasis and cavity disinfection during pulp capping and amputation. Yazdanfar et al. (2015) used diode lasers during pulp capping and found that this technique was more effective than the conventional one. Similarly, the erbium chromium laser was also found to be more successful Lasers can also be used to decrease dentin permeability insensitive teeth with no pulp exposure (Stabholz et al., 2004).[30,31]

EXPOSURE OF UNERUPTED AND PARTIALLY ERUPTED TEETH

An impacted or partially erupted tooth can be exposed for bonding by conservative tissue removal, allowing for reasonable positioning of a bracket or button. It has the advantage of no bleeding, and an attachment can be placed immediately, and moreover, it is not painful at all.[22]

LASER IN ORTHODONTICS

In orthodontic practice, lasers have many common applications, including acceleration of tooth movement, bone remodeling, enamel etching prior to bonding, debonding of ceramic brackets and pain reduction after orthodontic force and prevention of enamel demineralization. Soft-tissue applications such as frenectomies, gingival contouring and crown lengthening can also be achieved using the dental lasers.[32]

Lasers have been used in both acid etching and de-bonding of brackets. Lasers have shown efficiency for de-bonding, with a decrease in the adhesive remnant index and a relatively small increase in pulp temperature. In particular, application of Nd: YAG and CO2 lasers have shown satisfying results and minimal side effects from the increase in pulp temperature.[33]

Laser can help in the manipulatation of soft tissue like exposure of teeth in submucosal inclusion to expose the clinical crown for disimpaction of the tooth, Distal gingival resection at the mandibular molars region for the eruption of 2nd molars in the arch. There procedure is rapid and almost bloodless field can be obtained.

Laser can employed for joining metal frameworks, crystals of YAG, with added neodymium are used to emit laser beams. The advantages of laser-welding are -no solder, and hence no corrosion at the joint, smaller focus and an argon shielding atmosphere which prevents the oxidation around the welding zone.[33]

LASER SAFETY

While most dental lasers are relatively simple to use, certain precautions should be taken to ensure their safe and effective operation First and foremost being, wearing protective eyewear, that of specific wavelength. This protection should be done by anyone in the vicinity of the laser, i.e. operator, patient, assistant and any family member, if near.50 Any accidental exposures may be prevented by putting warning signs on the doors, minimizing the reflective surfaces, limiting access to surgical environment, and ensuring good working condition of laser. The room should be well ventilated for escape of vapours while tissue ablation which may be poisonous to people present in surgical room.[14]

CONCLUSION

Laser based technology holds greater promise in the coming future and thus emphasizes on a combination of diagnostic and therapeutic laser technique. Over the past few decades use of laser in all dental speciality as grown dramatically. Ongoing research showing the many benefits of laser therapy; Because of its many advantages the professional has started accepting them as alternatives to traditional therapies.

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