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UTILITY OF LASERS IN DENTISTRY: A REVIEW

Orthodontics

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ABSTRACT

Light Amplification by the Stimulated Emission of Radiation, or LASER, is what the phrase refers to. Since, Maiman used a laser in dentistry for the first time in the 1960s, the technology has advanced and is now used for a variety of procedures, including soft tissue and apical surgeries, cavity preparation, caries removal, dental hypersensitivity treatment, etching, composite polymerization, and bleaching. This study of the literature tries to briefly elaborate on laser dentistry applications.

KEYWORDS

LASER, Dentistry, Dental Lasers.

INTRODUCTION:

Light amplification through stimulated emission of radiation is referred to as laser.[1] Light moves at a steady speed in waves. A photon is the name of this energy's building block. Waves of a photon are defined by their amplitude and wavelength. The vertical height of the wave from the zero axis to the peak is its amplitude. The horizontal separation between two adjacent wave components is known as its wavelength.[2]

To simplify and eliminate pain from dental operations, laser technology was used. Due to their low side effects and pain, enhanced visualisation, and enhanced healing, lasers have the ability to supplement or replace conventional treatments. Examples of these properties include bactericidal action, detoxification, hemostasis, and ablation.[3]

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. The laser is applied to hard tissue for a variety of objectives, including cavity preparation, dentinal hypersensitivity, whitening, restorative removal and cure, cavity preparation, and growth modulation. In soft tissue applications, laser is utilised for wound healing, hyperplastic tissue removal to reveal an impacted or partially erupted tooth, photodynamic therapy for malignancies, and photo stimulating herpetic lesions. The laser was found to be a useful instrument for improving the dental procedure's effectiveness, specificity, simplicity, affordability, and comfort. This review of literature aims to elaborate uses of laser in dentistry in brief.

Classification of LASER

According to the wavelength (Nanometres)

- UV (ultraviolet) range – 140 to 400 nm
- VS (visible spectrum) – 400 to 700 nm
- IR (infrared) range – more than 700 nm

Broad classification

Hard laser (for surgical work)

- CO2 lasers (CO2 gas)
- Nd:YAG lasers (Yttrium-aluminium-garnet crystals dotted with neodymium)
- Argon laser (Argon ions)

Soft laser (for Biostimulation and analgesia)

- He-Ne lasers
- Diode lasers

According to the delivery system

- Articulated arm (mirror type)
- Hollow waveguide
- Fiber optic cable

According to type of active medium used

- Gas, solid, semi-conductor or dye lasers

According to operation mode

- Continuous wave lasers
- Pulsed lasers

Components of LASER Device:

Three parts make up the laser cavity that sits at the heart of the laser light: an optical resonator, an active medium, and a pumping mechanism. Chemical elements, compounds, or molecules make up the active medium. Based on their active medium, lasers are given names. a) gas (CO2 laser) (CO2 laser) (b) crystallised rock (Nd: YAG, Er: YAG) d) liquid; c) solid-state semiconductor (diode laser); (not used in dentistry). To inject energy into the active medium, a pumping mechanism is used. Two mirrors on either side of the optical cavity in the (- laser cavity serve as an optical resonator (reflects waves back and forth).[5]

LASER Delivery System:

The laser energy delivery system in a target tissue has compact, flexible fibre optic systems with bare glass fibre for shorter wavelength instruments (such diode, Nd: YAG). The laser wavelength is absorbed by water (such as CO2 or Er: YAG), which prevents it from passing through ordinary glass fibres. As a result, special fibres are made that can transmit the wavelengths, either with a hollow waveguide that is semi-flexible or with articulated arms. The erbium laser uses a water spray to cool the hard tissues.[2]

Application of Laser in Dentistry:

With their significant improvements in clinical applications, lasers are anticipated to set a new standard in dentistry. Lasers can be used in many areas of dentistry since they can treat both hard and soft tissues without direct contact, vibrations, or pain.

LASER in Restorative Dentistry

LASER as a Diagnostic tool:

Argon and diode lasers are frequently utilised for the diagnosis and measurement of dental cavities utilising diagnostic. Additionally, subgingival calculus detection and evaluating pulpal blood flow using Laser Doppler Flowmetry also require diode lasers. Additionally, helium-neon lasers are used to scan the phosphor plates of digital radiography. Spectroscopic analysis and confocal cytometric imaging of soft and hard tissues both use Nd, Er: YAG.[6]

LASER in Caries Prevention:

Numerous in vitro and preliminary in vivo studies have demonstrated that argon laser irradiation offers some protection against the onset and progression of enamel caries. Similar findings from studies using various argon laser delivery methods indicate that this type of laser is efficient in lowering the susceptibility of sound enamel and white spot lesions to caries.[7,8] Recent in vitro experiments using argon laser irradiation in conjunction with topical acidulated phosphate fluoride therapy shown a reduction in lesion depth in primary tooth surfaces (APF). The CO2 laser has also been applied to cavity avoidance. Research demonstrates that CO2 laser irradiation improves enamel's ability to withstand acids.[9,10]

LASER Assisted Crown Lengthening:
Lasers have an advantage in crown lengthening regard as they cut only at the tip and can be held parallel to long axis of the tooth to remove bone immediately adjacent to cementum without damaging it. Clinical scenarios where crown lengthening methods are specified within esthetic zone, need attention to attain esthetic results.[11,12]

LASER in Prosthodontics
Removal of Ceramic Veneers:
The use of lasers when removing veneers allows the practitioner to avoid cutting out the bonded elements, it also improves the patient's comfort and reduces the time in chair-side. The energy emitted by the laser passes through the ceramic while remaining unchanged, then absorbed by the water molecules present in the bonding agent. The detachment is made at the junction of the silane and the resin, the underlying tooth does not suffer any trauma during this operation.[13]

Management of Soft Tissues around Abutment:
As argon laser is absorbed in hemoglobin, it enhances hemostasis, coagulation, and vaporize the oral tissues. Gingivectomy, gingivoplasty (i.e.,) removal and contouring of soft tissues around abutment tooth are best done using Ar Laser. The management of soft tissues around abutment provides better finish line, adequate crown length. Also enhances troughing and accurate impression can be made of which excellent results of the fixed prosthesis can be achieved.[14]

Modification of Soft Tissues around Laminates:
Modification of soft tissue around laminates: The removal and re-contouring of gingival tissues cover can be easily efficient with the argon laser. The laser can be used as a primary surgical instrument to detach excessive gingival tissue, whether diseased, secondary to drug therapy or orthodontic treatment. The laser will detach tissue and supply hemostasis and tissues join the wound.[12]

LASER in Periodontics
Laser-assisted new attachment procedure (LANAP):
According to preliminary data, LANAP can be linked to periodontal regeneration of the damaged root surface in people as well as new connective tissue attachment mediated via the cementum.[15]

Surgical Procedure:
Numerous investigations revealed improved visibility, a relatively dry operating field, and enhanced coagulation. By reducing bacteraemia, swelling, edema, and scarring, laser therapy improves tissue surface sterilisation. When performing gingivectomies and gingivoplasties, laser technology works well. Laser ablation has been acknowledged as an efficient, pleasant, and dependable method of gingival depigmentation. In 1994, Finkbeiner made the case that argon lasers are preferable to traditional tissue closure techniques for soft tissue welding and soldering. Currently, lasers are used for a variety of operations, including operculectomy, free gingival graft procedures, crown lengthening, and frenectomy.[16]

LASER in Orthodontics
LASER Debonding:
By weakening the adhesive resin material used to bond the brackets, laser energy allows for the use of less force during the removal procedure. Particularly when removing ceramic brackets using an erbium-doped yttrium aluminium garnet (Er:YAG) laser scanning technique that required lower shear bond strength than traditional methods and showed adhesive remnant index (ARI) scores between 2 and 3, debonding operations with laser application are especially effective in ceramic brackets that have high adhesion with enamel way. Through the processes of thermal softening, thermal ablation, and photoablation, laser energy can dissolve adhesive from the surface of teeth. The action of thermal softening allows for the removal of ceramic brackets using an Er:YAG laser.[18,19]

Postoperative Pain Reduction:
It is common knowledge that discomfort following surgery develops 2-4 days after orthodontic force has been applied. There is currently no clear understanding of how much force is used and how painful it is. Numerous researchers have found that the use of LLLT has an analgesic impact in a variety of therapeutic and clinical settings.[20]

LASER in Pediatric Dentistry
Pulpotomy:
As they maintain a sterile environment and decrease inflammation, lasers have been employed for pulpotomy treatments in primary teeth. It was first used for pulpotomy surgery on dog teeth by Shoji et al., who reported that there was no discernible harm to the residual pulp tissue's radicular region. Additionally, lasers have the advantages of improved wound healing and no mechanical harm to the residual pulp tissue in addition to their hemostatic, antibacterial, and cell-stimulating qualities. The aforementioned factors led to the recommendation of laser irradiation as a promising substitute for the established pharmacotherapeutic approaches.
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Exposure of unerupted and partially erupted teeth:
By carefully removing tissue, an impacted or partially erupted tooth can be made exposed for bonding, enabling appropriate bracket or button positioning. It has the benefit of being completely painless, there is no bleeding, and an attachment can be inserted right away.

LASER in Management of Oro-Mucosal Lesion
Management of Aphthous Ulcer:
The most frequent recurrent lesions that afflict the oral cavity are aphthous ulcers, also referred to as canker sores. These ulcerations could affect 5 to 66% of the population. Low-level laser therapy may be able to treat aphthous ulcers and associated lesions, according to studies. Recurrent aphthous stomatitis can be treated with a laser in a quick, painless, and simple manner. According to studies, laser therapy for ulcers reduces future recurrences and provides instant pain relief. The key benefit of LLLT over other forms of treatment is that it may be used to treat all types of illness causes without causing any negative side effects or increasing the danger of drug overdose.[21]

Management of Oral Lichen Planus:
The cause of the chronic mucocutaneous condition known as oral lichen planus (OLP) remains unknown. The skin and oral mucosa are both impacted, either simultaneously or independently. The buccal mucosa is the oral site most frequently affected by OLP, however the labial mucosa, tongue, and gingiva can also be impacted.[22]

By utilising non-ionizing kinds of light, such as broadband light, in the visible and infrared spectrums, low-level power lasers can enhance wound healing and lessen pain. There is something known as an optical window of the tissue, where the soft tissues are where the laser beam penetrates the deepest and where the wavelength is between 650 and 1200 nm. By having a good impact on the immune system and promoting lymphatic movement, it helps reduce pain. The Photo Bio Stimulation Modulation (PBM) has many features, including the improvement and remodelling of the collagen in the treatment of wounds, in addition to the ability of photo biostimulation to stimulate blood circulation, which helps to increase the ability of antibiotics to be absorbed in the body.[23]

LASER Safety:
Although the majority of dental lasers are quite simple to use, certain safety measures should be followed to guarantee their reliable and efficient operation. [95] Anyone near the laser while it is in use must wear protective glasses. This comprises the patient, the doctor, any assistance at the patient's side, and any onlookers like relatives or friends. Every piece of protective eyewear worn must be wavelength specific. Additionally, the use of warning signs placed outside the nominal hazard zone, limiting access to the operating room, reducing the reflective surfaces, and making sure the laser is in good working order with all manufacturer safeguards in place can prevent accidental exposure to the non-target tissue.

High volume suction should be utilised to remove any vapour plume formed during tissue ablation to prevent exposure to pathogenic pathogens, and standard infection protocols should be adhered to. A dedicated Laser Safety Officer should be assigned to each office to oversee the proper use of the laser, organise staff training, monitor the use of safety goggles, and be knowledgeable about the relevant laws.[24,25]

CONCLUSION:
Throughout many years of research up to the present, laser technology has demonstrated a high state of refinement for hard tissue application and soft tissue surgery, and more advancements are yet possible. Being non-invasive, laser technology is a godsend in dentistry. Future efforts should concentrate on combining laser approaches for both diagnosis and treatment. Over the next ten years, it may be anticipated that laser technology will play a crucial role in modern dentistry procedures.

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