

Low Level Laser Therapy: Boon to Dentistry

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How to citation this article: Dr. Charupriya Rajore, Dr. Furkan Ahmed Khan, Dr. Sruthi Lingasamy, Dr. C. Sreerpradha, Dr. N Priyadarshree, Dr. Shivani Vaishnav, “Low Level Laser Therapy: Boon to Dentistry”, IJMACR- January – February - 2022, Vol – 5, Issue - 1, P. No. 180 – 186.

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Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

LASER is an acronym for “Light Amplification by Stimulated Emission of Radiation” and has been widely used in dentistry for more than 30 years. Low-level laser therapy (LLLT) is a form of laser medicine used in physical therapy, which uses low-level lasers or light-emitting diode to alter cellular functions. Low-level laser therapy has various other names like low-power laser, soft tissue lasers, cold lasers, biostimulation laser, therapeutic laser, and laser acupuncture. In dentistry, LLLT is used in the treatment of recurrent aphthous stomatitis, herpes simplex infections, oral lichen planus, xerostomia, mucositis, paraesthesia, periodontitis, dental hypersensitivity, temporomandibular joint

disorders, and pain during orthodontic tooth movement. The aim of present review of literature is to highlight latest applications of LLLT in the field of dentistry.

Keywords: Laser, LLLT, Dentistry

Introduction

In 1960, the first laser was established into the fields of medicine and dentistry. Then, this science has proceeded quickly. Due to many advantages, lasers are essential for an extensive variety of procedures.¹

Laser is a kind of electromagnetic irradiation source, having particular and exclusive properties. The word LASER is an abbreviation formed by joining the first letter of the words: Light Amplification by Emission of Radiation.² It is considered a great innovation that serves

many fields including medicine, surgery, dentistry, and cosmetics. Laser was used in dentistry for the first time by Maiman during the treatment of carious enamel and dentine.^{3,4} With the current technical advance, many types of laser are introduced, such as argon,⁵ carbondioxide (CO₂),⁶ neodymium-aluminum-garnet (Nd:YAG),⁷ or erbium-yatrium-garnet (Er:YAG), and diode laser.⁸

Nowadays, low-level laser therapy becomes a technique of interest by many researchers because it's many advantageous characteristics. One of these characteristics is its anti-inflammatory action. This treatment has the ability of increasing collagen production, reducing the inflammatory exudation and enhancing revascularization and epithelisation.^{9,10} The aim of present review of literature is to highlight latest applications of LLLT in the field of dentistry.

Low-level laser therapy

Lasers can be categorized as hard tissue lasers and soft tissue lasers, not according to the type of tissue exposed, but depending upon the type of laser-tissue interaction. Laser-tissue interaction is dependent upon wavelength, tissue type, power (incident energy), and time. Wheresoever's, the effect is ablative (essentially photothermic), direct and primary, such lasers are termed 'hard.' Alternatively, where tissue effects are non direct and through secondary (essential biostimulatory), intermediate action, such lasers are termed 'soft'. This group also can be termed low-level lasers, low level laser therapy, low power laser therapy (LPLT), cold laser, biostimulation laser, bioregulation laser, photobiomodulation, photomedicine, medical laser, therapeutic laser, healing laser, nonthermal laser, low-intensity laser, low-reactive laser. The latest name is laser-phototherapy and has been widely accepted.¹¹

Biological effect of LLLT

Low Level Laser therapy is the application of light to a biologic system to promote tissue regeneration, reduce inflammation and relieve pain. Unlike other medical laser procedures, LLLT does not have an ablative or thermal mechanism, but rather a photochemical effect which means the light is absorbed and cause a chemical change. The reason why the technique is termed low level is that the optimum levels of energy density delivered are low and it is not comparable to other forms of laser therapy as practiced for ablation, cutting, and thermal tissue coagulation.^{12,13}

In this treatment technique of using low level lasers, because of the low output power of the laser, wavelength between 630-1300 nm and the deep penetration ability, it easily penetrates up to several centimetres in tissues and reaches the cell chromophores such as mitochondria and effects on them.

The molecular and cellular mechanisms of LLLT suggest that photons are absorbed by the mitochondria. They stimulate more ATP production and low levels of reactive oxygen species, which then activates transcription factors, such as NF- κ B, to induce many gene transcript products responsible for the beneficial effects of LLLT. ROS are well known to stimulate cellular proliferation of low levels, but inhibit proliferation and kill cells at high levels. Nitric oxide is also involved in LLLT, and may be photo-released from its binding sites in the respiratory chain and elsewhere. It is possible that NO release in low amounts by low dose light may be beneficial.¹⁴

Application of LLLT in Dentistry

LLLT in TMJ Disorder: Temporomandibular disorder (TMD) or craniomandibular disorders is a collective term embracing a number of clinical problems that

involve the masticatory muscles, the temporomandibular joint and associated structures, or both.¹⁵

LLLT use for TMDs is beneficial because of its ease of application, analgesic, anti-inflammatory, and regenerative effects. The anti-inflammatory and analgesic effects of LLLT are probably due to increasing beta-endorphin level in the spinal fluid and increase the urinary excretion of glucocorticoids, which are inhibitors of the synthesis of beta-endorphins. It also increases the pressure pain threshold through a complex electrolytic nerve fiber blocking mechanism and causes a decrease of the release of histamine and acetylcholine and a reduction of the synthesis of bradykinin.¹⁶

LLLT in Management of Oral Lichen Planus

Oral lichen planus (OLP) is a chronic, mucocutaneous disease of unknown origin. It may also occur concurrently or independently and affects the skin and oral mucosa. The most typical oral site for OLP is the buccal mucosa, but any other oral mucosal site can also be affected including labial mucosa, tongue, and gingiva.¹⁷

Low-level power lasers can be used to improve wound repair and reduce the pain that utilizes non-ionizing forms of light origin, broadband light, in the visible and infrared spectrums. There is a so called optical window of the tissue - the greatest depth of the laser beam penetration in the soft tissues and the wavelength being in between 650 and 1200 nm. It can relieve pain, by making a positive effect on the immune response and stimulate lymphatic flow. In addition to the ability of photo biostimulation to stimulate blood circulation, which helps to increase the ability to absorb antibiotics in the body, the Photo bio stimulation modulation (PBM) has many features, including improvement and remodeling of the collagen in the treatment of wounds.¹⁸

LLLT in Mucositis: Mucositis is common finding in the patients who were exposed to chemotherapy and radiotherapy for the treatment of malignancy. When LLLT was applied daily within the oral cavity, it showed significantly decreased in the findings of oral mucositis as well as daily mucositis index. It also resulted in decreased pain scores and decreased xerostomia symptoms whereas their swallowing abilities were improved as compared with non-laser therapy patient.¹⁹

LLLT on Xerostomia

Use of infrared laser shows a significant increase in salivary flow in cases of xerostomia. When a laser with wavelength 904 nm applied to the both parotid and submandibular glands, then the result showed that it was efficient in reducing xerostomia by stimulating these glands.²⁰

LLLT in Aphthous Ulcer

Aphthous ulcers, commonly known as canker sores, are the most common, recurrent lesions that affect the oral cavity. As many as 5-66% of the population may be affected by these ulcerations. Studies have suggested that low-level laser therapy has the potential to treat aphthous ulcer and related lesions. Laser treatment of recurrent aphthous stomatitis is an easy, fast and pain-free procedure. Studies have shown that ulcers treated by laser therapy provide immediate pain relief and fewer recurrences in the future. The main advantage of the LLLT compared to other treatment options is that it can be used for all the causes of the disease both without having any side effects and without the risk of medication overdose.²¹

LLLT in Orthodontics

Increased duration of orthodontic treatment associated with pain and discomfort is the major fear of the

orthodontic patients, especially adults, either to avoid treatment or to seek shorter alternative solutions with compromised results. Low-level laser therapy has the ability to increase the rate of orthodontic tooth movement thereby decreasing the treatment duration. Dakshina CK et al. in his found that the Low-level laser therapy regimen of 980 nm, 2 W power output, 15 J/cm² of energy density in continuous mode application once in a month is effective in increasing the rate of orthodontic tooth movement.²²

LLLT in Dentinal 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 a study Gerschman et al. used low level laser with 830 nm to decrease sensitivity in the dentinal region of teeth and repeated treatment in three time intervals. The most reduction of sensitivity was observed after the first treatment session. Also evidence has been presented on decrease of dental hypersensitivity immediately after beginning of treatment with He-Ne laser and lasted till 3 months after treatment and all teeth remained vital as well.²³

LLLT in Pulpotomy

Pulpotomy is a pulp therapy modality that has the advantage of preserving the vitality of the primary pulp until the time of normal exfoliation. Many agents and techniques have been implicated for the pulpotomy procedure, with formocresol being the standard.²⁴

Few studies examined LLLT's clinical and radiographic impact on primary teeth pulps using different types of laser, with varying wavelengths and energy dosages, resulting in conflicting evidence of LLLT's influence on the mechanism of pulp tissue repair. In 2010,

Golapayegani et al., compared LLLT and formocresol and found that LLLT can be used successfully as a substitute to formocresol.²⁵

LLLT in Wound Healing

Low-level laser therapy has been shown to exert reliable effects on the acceleration of wound healing process. Laser therapy result in better wound healing by the following mechanisms on the 3 phases of primary inflammation, proliferative and remodeling phases.

- Increased synthesis of RNA, DNA and proteins
- Angiogenesis and neovascularization
- Accelerated epithelialization

Two studies were carried out on rats to test the effects of LLLT on the healing of skin wounds by secondary intention. Daily application of LLLT following operation, stimulated collagen synthesis and increased the strength of the wound scar. Increasing the laser power density up to 9.3 J/cm² had slowed down the reparative process.^{26,27}

Bone Implant Interphase

Bone implant interphase is a topic of concern to the clinician because success of the implant completely depends on osseointegration. Khadra et al. from their study concluded that LLLT might have a favourable effect on healing and attachment of titanium implants with the alveolar bone.²⁸

LLLT in Periodontics

Chronic periodontal inflammation results in the destruction of periodontal ligament and leads to the loss of supporting periodontal tissues. Low-level laser therapy is reported to reduce gingival inflammation and expression of metalloproteinase when used after scaling and root planning.

Amorim et al. used LLLT on gingivectomy wounds in 20 patients using a 685-nm laser with a power of 50 mW

and energy density of 4 J/cm². The authors observed a significant improvement in clinical parameters evaluated in the laser group at 21 and 28 days post-surgery compared to the control sites. They postulated that the improvement is likely to be derived from higher collagen production leading to a better remodeling of connective tissue and a reduction of the probing depth, the latter in turn aiding oral hygiene and synergistically contributing to limiting inflammation.²⁹

Contraindication of LLLT²

1. It is not prescribed in patients with pacemakers, or used with precaution
2. Laser should not be used in the uterus region in pregnant women
3. Shouldn't be used in epileptic patients or with frequency less than 800Hz
4. Shouldn't be used in patients with antecedent of arrhythmia or chest pain
5. Shouldn't be used on glands, e.g. thyroid gland
6. Laser therapy should be avoid on tumorous tissues or benign tumors with malignant tendency.
7. Prescription of laser therapy is forbidden in patients with lupus or patients treated with substances sensible to light.

Conclusion

LLLT is also known as "soft laser therapy" and bio-stimulation. The use of LLLT in health care has been documented in the literature for more than three decades. Numerous studies have documented that LLLT is effective for some specific applications in dentistry. Low-level laser therapy offers an attractive, painless, and non-invasive therapeutic way to modulate inflammation in dentistry. Low-level laser therapy is a useful adjunctive treatment modality in various fields of dentistry. It has positive effects on both hard and soft

tissues of the oral cavity and less antagonistic effects. Usefulness of the LLLT should also be discovered with respect to the wavelength, duration of treatment, and the site of application. Efforts should be focused toward inspecting the accurate dose required for therapeutic effects in order to achieve standardization of treatment protocols.

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