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Low Level Laser Therapy in Periodontics – A Review

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ABSTRACT

Low level laser therapy also known as 'Soft Laser Therapy' have been in use for more than three decades in the field of health system. Laser has a property to enhance biostimulation which induces metabolic change in the intracellular leading to rapid rate of cell division, proliferation rate, fibroblast migration and production of matrix. There are plenty of application for low level laser therapy that included in the treatment of mucositis, oral lichen planus, aphthous ulcers, hard tissue applications, dentinal hypersensitivity (dh), temporomandibular disorders, sterilization of hard tissues, bone implant interphase pain to reduce inflammation, reduce pain and so on

Keywords: Low level laser therapy, biostimulation, photo biomodulation, dental application

1. Introduction

Mester with his colleagues first introduced low -level laser treatment which was also termed as 'Soft Laser Therapy' and have been have been in use for more than three decades in the field of health system.[1] The low level laser has a quite complex mechanism of action in which the red or infra-red light has a low wavelength and low absorption power in water with depth of penetration of 3mm to 15 mm into soft and hard tissues which plays a major role in respiratory chain the electron transfer of the mitochondrial membrane. Light absorbed in respiratory chain components results in its activation and NADH oxidation which causes mitochondrial change and cellular cytoplasm revival. This electron transfer chain enhance ATP leading to increase in electrical potential of mitochondrial membrane to activate and synthesis nucleus which result in increase driving force to the cells.[2]

2. MECHANISM OF ACTION

2.1 Biostimulatory Effect

Laser has a property of biostimulation that irradiates and cause changes in structural, biochemical and functional of living microorganisms. It vitalize cell by increase production of adenosine triphosphate (ATP) inducing intracellular metabolic changes that faster cell division, rate of proliferation, fibroblast migration and production of matrix. Helium neon (HeNe) laser was first commercialized laser for biostimulative effect that is less than 1 mW, but due to its need for the optic fibers and the power option is low 5 – 25 mW its use are limited. To overcome this limitation the indium-gallium-aluminum-phosphide laser was introduced, that are diode producing red laser, range of 600-700 nm. Gallium-aluminum-arsenide laser was most frequently used dental laser for LLLT with the range of 780-830 nm, and 10 -500 Mw power range. Diode lasers has advantage of smaller size, with better battery operation, handy and portable.[3]

2.2 Primary Reactions After Light Absorption

In 1981 proposed first mechanism of action of LLLT which was the singlet oxygen hypothesis. In this hypothesis, singlet oxygen are produced by porphyrins molecule absorption of laser light and stimulates RNA and DNA synthesis rate.[4] In this hypothesis, when certain chromatophores are photoexcitation of cytochrome c oxidase molecule that influences the redox state of electron flow in the molecule. NO hypothesis are latest proposed hypothesis in which laser are irradiated and activates flow of electron into cytochrome c molecule oxidase which could be reversed by partial inhibition of the catalytic centre of NO. Activation of superoxide anion activates respiratory chain which was proposed in 1993.[3]

2.3 Secondary Reactions After Light Absorption (Cellular Signalling)

Cellular signalling pathways and mitochondrial retrograde signalling are the two secondary reactions that occur after light absorption in LLLT. The mitochondrial retrograde signalling cells communication occurs from mitochondria of cells to nucleus which influence on many cellular activities. Cytochrome C oxidase absorbs the light and increases the potential of mitochondrial membrane in releasing ATP and reactive oxygen species, that inturn increase availability of energy and signal transduction. Therefore for a cell overall redox state was represented as net balance between stable and unstable

reducing and oxidizing equivalents.[3]

3. APPLICATIONS OF LOW-LEVEL LASER IN DENTISTRY:

3.1 Soft Tissue Applications

a. Periodontitis

Periodontitis which is an inflammatory disease of the supporting tissues of the teeth, in which LLLT was found to improve healing, collagenization and homogenization of periodontium when LLLT was used along with conventional periodontal therapy.[5] Theodoro et al. used photodynamic therapy in patients with chronic periodontitis and found a significant reduction in periodontal pathogens than in patients who were treated with conventional periodontal therapy. As periodontal healing was enhanced by LLLT, it is considered to be potent when used a adjuvant therapy to non-surgical periodontal treatments.[6]

b. Herpes simplex infections:

LLLT also has a beneficial effect on Herpes simplex infection healing. In 1999 a study was done by Schindl et al in which one group of patients received LLLT therapy for every day for 2 weeks results showed average healing time was 37.5 weeks in patients who received placebo and 3 weeks in patients treated with LLLT. Therefore LLLT when used in treatment of herpes simplex infection showed significant increase in healing and recurrence of lesion was also prevented. [7]

c. Mucositis:

Patients who undergo chemotherapy and radiotherapy for malignancy has a common sequela of mucositis, when LLLT was applied on daily basis in the oral cavity there is a significant reduction in mucositis occurrence, significant reduction in pain score, xerostomia and its symptom occurrence was decreased and improved in ability of swallowing.[8]

d.Oral lichen planus:

LLLT when applied to lichen planus shows significant reduction in pain and the size of the lesions which was equal effective as topical corticosteroids.

e. Aphthous ulcers:

LLLT therapy when applied on aphthous ulcer decrease pain and functional complications, produces faster healingthan medication which was usually used with no side effects.[9]

f. Xerostomia:

When LLLT is used in patients with xerostomia showed significant increases in flow of salivary, also when applied on parotid and submandibular glands stimulates salivary secretion and decrease xerostomia occurrence. [10]

3.2 HARD TISSUE APPLICATIONS

a. Dentinal hypersensitivity (DH):

LLLT reduces dentinal hypersensitivity by changing network of neural transmission present within dental pulp. When Ga-Al-As lasers are used showed desensitization of hypersensitive at approximately 90% in cervical dentine.[11]

b. Temporomandibular disorders:

When LLLT in patients with myofascial pain dysfunction syndrome showed a significant improvement in the movement of mandibular.[12]

c. Sterilization of hard tissues

For destruction of bacteria high-power lasers has a best effect, where as low power lasers when coupled with dyes penetrate into the bacterial cell wall and destroy bacteria at less power without damaging pulp, dentin and periodontal ligament. Term lethal laser photosensitization (LLP) denotes laser radiation process which was emitted from low power laser device and exerts lethal effect on bacterial cells by activation of dye therefore these LLP have a significant role in the root canal sterilization and dental caries management.[8]

d. Bone implant interphase

Success of the implant completely depends on osseo-integration, LLLT has a favorable effect on healing of bone and enhance attachment of titanium implants to alveolar bone.[13]

4. APPLICATIONS OF LOW LEVEL LASER IN PERIODONTOLOGY

4.1 ANTI INFLAMMATORY EFFECT OF LOW LEVEL LASER TREATMENT

Low-level laser when applied as a adjuvant to scaling has a capable of reduction in inflammation, MMP8 (Matrix Metallopeptidase8), decrease plasminogen activity, and synthesis of prostaglandin.[14]

4.2 IMPACT OF LOW LEVEL LASER ON REPAIR

Low-level laser enhance healing as a result of vasodilation, increasing local blood circulation and relaxing vascular muscle which inturn causes increase blood perfusion, and migration of cell into tissue to boost the immunity. Lasers also stimulates degranulation of mast cell to release pre-inflammatory cells such as TNF-α cell to stimulate the diffusion of leucocytes cells into tissue.[15]

4.3 IMPACT OF LOW LEVEL LASER THERAPY ON PAIN:

The exact mechanism of pain control by low level laser was still unknown, but some of mechanisms are by stabilizing the double membrane lipid and its proteins, which increases ATP production and the enhance revival system. As inflammatory process are modified by LLLT, it reduces the pain which results due to inflammation. Therefore LLLT has been prescribed within the first 72 hours following the operation in case of acute pain.[16]

4.4 LOW LEVEL LASER THERAPY AND GINGIVECTOMY:

When LLLT was applied gingivectomy results in improved and faster repair and epithelialization.[17]

4.5 PERIODONTAL FLAPS AND LOW LEVEL LASER:

When 810nm Diode laser was applied along with Modifed Widmann Flap would reduce postoperative pain and post-op edema.[18]

4.6 FREE GINGIVAL GRAFT AND LOW LEVEL LASER:

Low-level laser when applied in area from where free gingival graft was harvested, reduces biochemical markers, oxidative stress, and edema by which it relieve pain. The anti-pain effect of low-level laser with a high radiation density in the first 72 hours post-op may be more effective, and the lower laser doses have to be continued for faster pain relief.[18]

CONCLUSON

LLLT has been used in various fields of dentistry both hard and soft tissues of the oral cavity and has many beneficial activity when used as a adjuvant therapy.

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