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A Review On Photobiomodulation-"The Laser-Light Therapy"

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ABSTRACT

To execute therapeutic treatments, Photobiomodulation or low-level laser therapy, uses coherent, collimated, monochromatic light radiation. In the world of medicine, a unique mix of lasers and light energy is used for therapeutic purposes. PBM is mostly used for pain management, but it has also been utilised for a variety of other objectives, such as wound healing, tissue bio stimulation, and pain reduction.Alveolitis, anaesthesia, pericoronitis, hypersensitivity dentin, mucositis, and TMJ issues are all treated with photobiomodulation in dentistry. The concept, mechanism of action, and use of photobiomodulation in Periodontics are discussed in this review paper.

Key words: Photobiomodulation, low-level laser therapy, bio stimulation

I.Introduction

Low Level Lasers (LLL), Cold Lasers, Therapeutic Lasers, and Soft Lasers are all terms used to describe photobiomodulation (PBM) lasers. Photobiomodulation is the word used to describe how these devices work. Photons (light energy) are used to control biological activities. Photobiomodulation is a technique that uses light to trigger biological responses from cells and restore normal cell activity.[1]Unlike surgical lasers like Erbium, Carbon Dioxide, Neodymium YAG (Nd.YAG), and surgical diode lasers, which are commonly used in dentistry offices to cut, incise, and remove soft and hard tissues, PBM lasers cannot conduct any surgical treatments. They are non-surgical and mostly used for pain control and palliative care.To execute the treatment, these devices require laser energy, which is typically (but not always) generated by semiconductor diodes with a power output of 0.1W to 0.5W. PBM relies on photon activity to promote chemical changes associated to the mitochondrial respiratory chain, unlike other laser applications that cause ablative and thermal harm.It has a good anti-inflammatory, analgesic action and also improves the biological capacity of the wound bed to achieve optimal healing.[2]

II.Mechanism of action

PBM affects the mitochondria of the cell, primarily Cytochrome c oxidase in the electron transfer chain and porphyrins on the cell membrane. When light photons are absorbed by these receptors, it has been proposed that three things occur by Stimulation of ATP synthesis by activation of the electron transport chain, Transient stimulation of reactive oxygen species, which increases the conversion of ADP to ATP; and a temporary release of nitric oxide from its binding site on Cytochrome c oxidase, which results in an increase in cell respiration differently from other laser applications that result in ablative and thermal injury.Photon activity is used in PBM to promote chemical changes in the mitochondrial respiratory chain. The electron transport chain's terminal enzyme, cytochrome c oxidase (Cox), is responsible for electron transfer from cytochrome c to molecular oxygen. In the red-to-near-infrared region (620–1100 nm), this enzyme operates as a photo acceptor and transducer of light signals.

The interaction between light and this chromophore increases electron transport, mitochondrial membrane potential, and adenosine triphosphate (ATP) production and brings about cellular changes.[3]The clinical effects of PBM are derived not only from direct tissue irradiation, but also from secondary and tertiary effects. PBM's action is aided by factors such as increased lymphatic flow and circulation, stimulation of fibroblasts, osteoblasts, odontoblasts, and endorphins, reduction of nerve depolarization, and control of inflammatory chemicals.[4]

Physiological alterations at the cellular level increased the cell's promotive force, ATP supply, and mitochondrial electrical potential, alkalized the cytoplasm, and activated nucleic acid production. At the cellular level, activation and stimulation of nucleic acid production, as well as increased respiratory processes, improve the cell's electrophysiological properties.

III.Dosage

Dose is measured in joules per square centimetre (J/cm^2) and is a measure of the amount of energy that is conducted into the tissue. The minimal dose response of photobiomodulation requires:[5]Time of Irradiation /cm 2 30 sec – 3-4 min, Power Density of1mW/ cm^2- 100 mW/ cm^2 and Wave length 632-904 nm.

IV.Application of Photobiomodulation in Periodontics:

After a surgical procedure, photobiomodulation (PBM) can be used. The periodontal ligament is damaged and alveolar bone is lost after a long period of periodontal inflammation. When used after scaling and SRP, photobiomodulation (PBM) reduces gingival inflammation and MMP-8 expression (root planing). For comprehensive therapy, at least four sessions are required at the recommended dosage.[6]

In bone regeneration

PBM has a considerable influence on osteocytes and bone marrow cells, according to scientific research and investigations. PBM can have an impact on bone regeneration, which is an important case. After suturing, PBM is utilised during the healing period at the surgical site. It has been stated that for a significant result, frequent irradiation (2-3 times/week for at least 2 weeks) is required.[7]

In Wound Healing

PBM can help with oedema and healing. In addition, infrared lasers can be useful in these situations. Because the area is oedematous, laser therapy is usually utilised to treat ulcers caused by stretched denture borders and to remove overextended acrylic flanges to create a pain-free state. Tenderness and oedema are reduced by laser irradiation.

In Inflammatory conditions

Photobiomodulation (PBM) has tremendous role in reducing inflammation and course of the inflammatory process is shortened by using irradiation at appropriate recommended dose.[8] This dose for inflammation reduction is recommended as 8 to 12 J/cm^2.

V.Photobiomodulation after Implants

It has been observed that a single large dose of PBM given after implant implantation can reduce post-operative pain, swelling, and oedema situations. Following that, repeated treatments at a lower dose can stimulate osteoblast growth.It has been documented in various surgical notes that use of PBM at the range 1.5 to 3 J/cm2 can enhance activity of cells interactions with an implant, thus enhancing tissue curing and eventual implant achievement.[9]

VI.Literature

Snehal Dalvi et al,[10] in a systematic review studied the effectiveness of photobiomodulation as an adjunct to non-surgical periodontal therapy in the management of periodontitis. It was found that photobiomodulation was effective as an adjunct to non-surgical periodontal therapy. Mohammed Al-Rabiah et al,[11]conducted a randomised controlled trial to explore the influence of photobiomodulation (PBM) as an adjunct to scaling and root planing (SRP) for treating periodontitis among gutka chewers. The results of the study showed significant reduction in the plaque index scores and bleeding on probing in the gutka chewers and thus it was concluded that photobiomodulation was more effect with SRP than SRP alone.Nídia Castro dos Santos et al,[12] investigated the local effect of photobiomodulation (PBM) for the treatment of periodontal pockets in patients withperiodontitis and type 2 diabetes.Photobiomodulation was found to be more effective in reducing the percentage of periodontal pockets at 6 months in patients with type 2 Diabetes Mellitus

Francesca Angerio et al,[13]evaluated the levels of bradykinin, VEGF, and EGF biomarkers in gingival crevicular fluid and comparison of Photobiomodulation with conventional techniques in periodontitis. It was found that photobiomodulation had beneficial effects in the early phases of the healing process playing a role in modulation of Bradykinin, EGF, and VEGF in gingival crevicular fluid levels in subjects treated with scaling and root planing alone with photobiomodulation.Jacek Matys et al,[14]evaluate the stabilization (primary and secondary) and bonedensity in peri-implant zone after photobiomodulation using a 635 nm diode laser. The implants treated with 635nm diode laser showed better stability after 2nd and 4th week of photobiomodulation.

VII.Advantages

In photobiomodulation, laser strength and mode sight may be efficiently regulated, and the application period can be chosen. Because there is no touch system, it is aseptic and atraumatic. Photobiomodulation is a quick, painless, and precise therapeutic method with a brief and quick treatment interval. In addition, photobiomodulation has an analgesic and antiphlogistic effect.

VIII.Disadvantages

In photobiomodulation, sometimes, split devices are essential to get beam on the specified area under treatment.[15] In addition, the therapeutic outcomes are hard to manage by objective parameters some times.

IX.Contraindications

Photobiomodulation is contraindicated in case of malignancies, as it promotes cell growth and pregnancy and Irradiation over the thyroid gland.

X.Conclusion

Photobiomodulation is a newly emerging field in dentistry and Periodontics that combines light energy along with laser for therapeutic benefits. Its wide application in the field of medicine and dentistry, photobiomodulation is well establishing its efficacy in the upcoming days and future.

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