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RESEARCH ARTICLE

LOW LEVEL LASER THERAPY IN PERIODONTICS –A REVIEW

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Abstract

Periodontal disorders are a group of inflammatory conditions that induce degeneration of the Periodontium and damage the supporting components of the teeth, including gingiva, periodontal ligament, cementum, and alveolar bone, leading to tooth loss. According to WHO, approximately 10-15% of the world's population suffers from severe periodontal diseases. Periodontal disease pathophysiology is linked to microbial biofilm development,dental plaque, and host cell immunogenicity. The severity of this condition is determined by risk factors and stage of development. Low-Level Laser Therapy (LLLT) is a light source treatment that generates light of a single wavelength. The low-level lasers do not cause temperature elevation within the tissue, but rather produce their effects from photo bio stimulation effect within the tissues.Low-level laser is capable of reducing inflammation and appearance of MMP8 (Matrix Metallopeptidase8) following scaling. LLLT apart from pain reduction is also known to help in repair process and thus subsequently accelerating the wound-healing process. The primary goal of this article is to offer a holistic update on periodontal disease in terms of its occurrence ,stages, pathogenesis, diagnosis, therapy, and management.

Introduction:-

Periodontal disease also known as **gum disease**, is a set of inflammatory conditions affecting the tissues surrounding the teeth. In its early stage, called gingivitis, the gums become swollen and red and may bleed. It is considered the main cause of tooth loss for adults worldwide. In its more serious form, called **periodontitis**, the gums can pull away from the tooth, bone can be lost, and the teeth may loosen or fall out. Bad breath may also occur.[1]

Periodontal disease is generally due to bacteria in the mouth infecting the tissue around the teeth. Factors that increase the risk of disease include smoking, diabetes, HIV/AIDS, family history, and certain medications

Albert Einstein was the first to explain the fundamental theory of lasers (1). Maiman invented the first equipment for creating laser beams based on Einstein's theory (2).

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For more than three decades, low-level laser therapy, often known as "Soft Laser Therapy," has been used in medicine. Low-level laser has an influence due to its non-heating actions [3], which stimulate fibroblast reproduction; and it has been demonstrated in in-vivo and in-vitro investigations that low-level laser is capable of speeding up the repair process. [4]

History

The first laser built by Maiman[5] was a pulsed ruby laser, which was displayed at a press conference at the Hughes Aircraft Laboratory in Los Angeles on July 7, 1960. (A solid-state laser using a single, rod-shaped ruby crystal). It emitted 694 nm pulsed light.In the mid-1960s, the ruby laser was also the first to be employed in biostimulatory research. The HeNe (Helium-Neon) laser, a gas laser emitting at 632.8 nm with a power output of 1 to 5 mW, was one of its descendants. Leon Goldman was the first to report on laser exposure to critical human teeth in 1965. He used two pulses of a ruby laser and found that there was no harm to the tooth and that the operation was safe . Endre Mester was the first to use photobiomodulation in 1967 .[6,7]

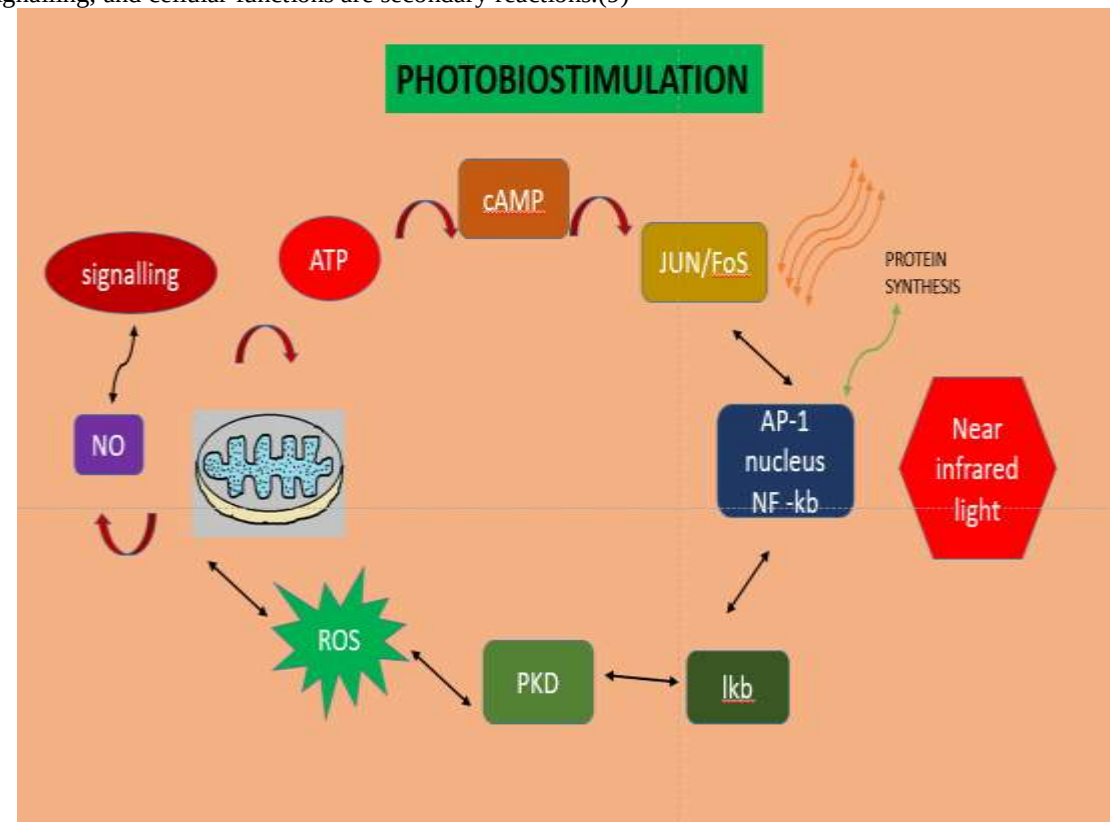
Principle

A biphasic dose response means that no tissue reaction will take place when low level laser light is delivered at a wavelength and dose that are too low. It can block a tissue response if used at a dose that is too high. There is an ideal dose (time and interval) at which a maximal reaction is obtained for a given bio stimulus. Studies on wound healing have demonstrated this, showing that the optimal dose accelerated healing whereas too low a dose had no effect and too high a dose prolonged healing. [8]

Mechanism Of Action

The mechanisms of low level laser therapy are complex, but essentially rely upon the absorption of particular visible red and near infrared wave lengths in photoreceptors within sub-cellular components, particularly the electron transport chain within .the membranes of mitochondria, Karu et al 1989,

1. Photon absorption causes shift in the molecular configuration of the photo acceptor, accompanying with an associated alteration in the molecular signal of the cell.
2. The alterations in photoacceptor function are the primary reactions and subsequent alterations in cellular signalling, and cellular functions are secondary reactions.(9)



Low Level Laser Therapy In Periodontics

LLLT and Inflammation

Low-level laser is capable of reducing inflammation and appearance of MMP8 (Matrix Metallopeptidase8) following scaling. It can also prevent plasminogen increased activity, and prostaglandin synthesis.Lasers with wavelength of 670nm along with typical periodontal treatment result in betterment of treatment outcomes, as well as stability in treatment time.[10]

LLLT and Repair

Low-level laser therapy may promote vasodilation, enhanced local blood circulation, and soft vascular muscle relaxation. This arterial dilatation is responsible for increased blood perfusion as well as immune cell migration to the tissues, both of which might expedite recovery.[11] Low-level laser stimulation stimulates and accelerates lymphocyte reproduction. Low-level laser stimulation increases fibroblast reproduction and maturation, fibroblast conversion to myofibroblast, decreases E2 prostaglandin synthesis, and increases fibroblast growth factor (bFGF). The crucial point here is that such effects on the epidermis, buccal, and gingival mucosa can be seen at low laser doses, whereas high doses limit fibroblast reproduction and growth factor release.[12]

LLLT and Dentin Hypersensitivity

Laser technology has been widely for treating DH since the mid-1980s though results were divergent.[12] Different lasers He-Ne, neodymium or erbium doped yttrium-aluminium garnet, CO_2, and diodes (GaAlAs) have used for treating DH and is mostly depended on the action of lasers on dentinal tubules.

Low-level laser therapy (LLLT) has been explored widely in treating DH. Its action is due to its analgesic, bio stimulatory, and anti-inflammatory properties also regulates the cellular metabolism which makes it effective.[14] LLLT has also been further used in treating aphthous, endodontic intervention, and after surgeries.

LLLT and Wound Healing

LLLT apart from pain reduction is also known to help in repair process and accelerating the wound-healing process. Low-level lasers are known to have a stimulatory effect on cells at low dosage and a suppressive effect on cells at high dosage. Mechanism by which low-level laser accelerates the healing process is by stimulating the mitochondrion to increase ATP production to increase the reactive oxygen species, which in turn influences redox signalling, affecting intercellular homeostasis of the proliferation of cells.[15] LLLT also has an effect on the microcirculation, which reduces oedema by changing the capillary hydrostatic pressure.[16] The ideal dose of LLLT leads to the formation of new endothelium and blood vessels that will help in granulation tissue formation and accelerated healing.

LLLT and Frenectomy

The combination of a high-power laser surgical operation and the use of a low-power laser with an infrared wavelength has been scientifically proven to be effective in frenectomy . Low-power laser has bio modulatory effects, operating directly in the mitochondria of cells, speeding cellular metabolism and, as a result, providing benefits to persons. [17] A low-power laser utilised with appropriate parameters aids in the healing process and prevents the formation of pain or oedema. [16] The lingual frenectomy was effective when the lingual frenulum recovered after 14 days, reinserting itself in the likely proper anatomic position. The patient reported no pain or oedema following the surgery, confirming the efficiency of the low-power laser.

LLLT and Gingivectomy

LLLT application may speed gingivectomy wound healing by increasing human keratinocyte motility and promoting early epithelialization, increasing fibroblast proliferation and matrix production, and enhancing neovascularization. It has also been demonstrated that LLLT increases the expression of fibroblast growth factors by macrophages and fibroblasts. [18] Another effect of LLLT on wound healing is an increase in revascularization rate, which is known to have a major influence on successful wound healing following periodontal surgery. [19]

LLLT and Flap Surgery

Ozturan, et al. conducted a study on Coronally advanced flap adjunct with low intensity laser therapy. Primary wound healing is of major importance in the outcome of regenerative therapy. Primary healing was evaluated using the Early Wound Healing Index, where the margin of the wound is evaluated using a five-point score. It showed complete closure of the flap without the formation of a fibrin line in the interproximal area at two weeks after

surgery. This helps to achieve faster revascularization and facilitates primary intention healing.The effects of LLLT in periodontal ligament cells have shown that LLLT can potentially stimulate the production bFGF, which helps in proliferation and differentiation of fibroblasts.

Advantages Of LLLT

1. Minimally invasive technique with least collateral damage to normal cells enhances results and superior healing
2. Exceedingly efficient broad spectrum of action, since one photosensitizer can act on bacteria, virus, fungi, yeasts, and parasitic protozoa
3. Efficacy independent of the antibiotic resistance pattern of the given microbial strain
4. The therapy also causes no adverse effects such as ulcers, sloughing or charring of oral tissues
5. Lesser chance of recurrence of malignancy
6. Economical to use.

Disadvantages Of LLLT

1. Instruments are relatively high
2. Technique sensitive,most dental instruments are having both side cutting and end cutting .but lasers are exclusively end cutting.
3. Inability to remove over hanging metallic restoration.

Discussion:-

Periodontitis is one of the most common diseases of the attachment apparatus of the tooth. It is the major cause of tooth loss in the later part of life.

On the basis of histopathological findings, Obradovi et al. [21] demonstrated that when patients with periodontal disease were treated with LLLT (670 nm) in conjunction with conventional periodontal treatment, healing was improved as well as collagenisation and homogenization in gingival lamina propria.

Lasers have been recognised as an auxiliary or alternative method in periodontal and peri-implant therapy. Soft tissue surgery is one of the most prevalent applications for lasers. These treatments are typically performed with CO2, Nd:YAG, diode, Er:YAG, and Er,Cr:YAG lasers. In terms of easy ablation, decontamination, and hemostasis, as well as decreased intraoperative and postoperative pain, laser therapies have been demonstrated to be superior to traditional mechanical procedures in soft tissue care. Laser or laser-assisted pocket therapy is expected to emerge as an innovative periodontal technology technique. The Er:YAG laser offers the best potential for root surface debridement, such as calculus removal and decontamination.

Theodoro et al.[20] employed LLLT photodynamic treatment in patients with chronic periodontitis. They concluded that there was a substantial difference in periodontal bacteria in patients treated with both conventional and laser periodontal therapy versus simply conventional therapy. Other researchers determined that LLLT is an effective adjunct therapy to nonsurgical periodontal therapies because it promotes periodontal repair.

Sobouti et al(21) showed faster and painless wound healing by Diode low-level laser after gingivectomy in patients with fixed orthodontics for aesthetic purposes in comparison with those for whom surgical knife was used.

Conclusion:-

The beneficial effect of LLLT is due to the laser's unspecific stimulatory action, which enhances collagen production, enzyme activity, micro- and lymph-circulation, fibroblast proliferation, decreases local hypoxia, has an anti-inflammatory effect, and reduces pain. There is compelling evidence that the increased cell metabolic activities observed during LLLT are the result of photoreceptor activation within the mitochondrial electron transport chain. Future trials of new LLLT applications in dentistry should use standardised, validated outcomes and look into how wavelength, treatment time, dosage, and application site affect the efficacy of the LLLT protocol used.

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