Low Level Laser or Photobiomodulation in Dentistry

Vipul Srivastava[1], Shally Mahajan[2]

Professor[1],
MDS
Endodontics & Conservative Dentistry,
Advanced Proficiency in Laser Dentistry (ALD, USA)
Masters in Laser Dentistry (Vienna)
Vipul13@gmail.com
Private Practitioner,
32 Pearls Multispecialty Dental Clinic,
Lucknow

Professor[2],
Department of Dentistry,
Dr. RMLIMS
drshally23@gmail.com

Abstract :

The introduction of laser light as a source of amplified, stimulated emission of radiation, gave clinicians and researchers a chance and opportunity to obtain and use these high-powered light on biological tissues to create a new perspective for its application in healing and tissue regeneration. The use of laser light at power levels (specific wavelengths and power) have been documented to be capable of protein denaturation, water vaporisation and tissue ablation. The purpose of this article is to explain the mechanisms of action and to explore the uses of this group of lasers in general dental practice.

Keywords: Photobiomodulation, Mucositis, trigeminal neuralgia, mucositis

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INTRODUCTION

Over the centuries, various therapeutic effects of sunlight have been recognised in treating a wide range of diseases like dementia, psoriasis, neonatal jaundice, tendinopathies, nerve injuries, osteoarthritis, & wound healing vitamin D deficiency, lupus vulgaris & acne. They used heliotherapy that is the treatment which involves exposure to sun and other natural light. [1,2]

In the year 1960, Endre Mester and National Aeronautics and Space Administration (NASA) researchers introduced the effect of PBM in accelerating the healing process and used it for enhancing the healing processes in space. They used the light to treat patients with open wounds where conventional therapies had failed, reporting success rates of 85%. [3,4]

In medicine and dentistry, lasers used in phototherapy and included in photobiomodulation (PBM) are low-level lasers (class III) which are defined with an output power of 500 mW, and there are also high-level lasers (class IV) with a power output of 500 mW or more. The wide range of diode laser wavelength (450-1064 nm) & Nd:Yag lasers (1064nm), have shown to have a deep penetrating potential in tissue and they can be used to control or eradicate the disease, provide relief of pain which shall lead to the restoration of form and function.

Mechanism of Action

Low-level laser therapy (photobiostimulation) involves the use of visible red and near-infrared light with tissue in order to stimulate and improve healing, as well as reduce pain. The mechanism of action of LLLT was first proposed by Karu et al in 1981. [5]

Light energy is absorbed within living tissue by the chromophores (cellular photoreceptors). The incident electromagnetic energy is absorbed by cytochrome C oxidase which is present in the mitochondria, and that leads to the increased production of ATP (adenosine tri-phosphate), release of nitrous oxide,

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Increased ATP (adenosine tri-phosphate) production in the cell, further stimulates the production of fibroblasts, triggering the immuno-logical chain reaction which stimulates mast cell and macrophages and also an increased procollagen synthesis which promotes wound healing. The release of nitrous oxide helps in local micro-circulation through vasodilation and activation of the respiratory chain.

In a nutshell, the stimulatory effects of LLLT include the following:

- Proliferation of macrophages, lymphocytes and fibroblasts [6,7,8]
- Proliferation of endothelial cells[7]
- Proliferation of keratinocytes
- Release of growth factors and other cytokines[9]
- Transformation of fibroblasts into myofibroblasts and Collagen synthesis [9,10].

In addition, there is evidence to support the analgesic effects of LLLT, through an enhanced synthesis of endorphins and bradykinins, decreased c-fibre activity and altered pain threshold. Other research suggests a therapeutic analgesic effect, through the release of serotonin and acetylcholine centrally, and histamine and prostaglandins peripherally, with the use of LLLT.

Clinical Applications in Dental Practice

The primary use of LLLT is to stimulate the inherent cellular and biochemical pathways associated with resolution and healing.

Various uses of Low Level Laser Therapy in day to day clinical dentistry include the following (Figures 1-7):

- Dentine hypersensitivity
- Orthodontic Treatment[11]
- Bone Remodelling
- Erosion
- Stimulatory effect on root development
- Periodontal Pocket Disinfection/Periodontitis
- Peri-Implantitis
- Post Surgery Healing: Post-Extraction Socket/Post-Trauma Sites
- Viral Infections: Herpes Labialis, Herpes Simplex
- Neuropathy: Trigeminal Neuralgia, Bells Palsy, Paraesthesia
- Apthous / Traumatic Ulceration
- Edema And Sinusitis
- Gag Reflex/ Nausea
- Temporomandibular Disorders
- Post-Oncology: Mucositis, Dermatitis / Post Surgical Pain

Safety Measures & Contraindications:

LLLT can prove to be an effective treatment modality for various dental ailments. Although till date low level laser therapy have not been found to report side effects or cause any harm to the patients being operated, safety measures are to be considered with every use. These therapeutic or low power lasers based on potential to cause damage usually belong to Class III or Class IV.[12] There are no absolute contraindications to the application of LLLT, however, a proper case history need to be documented in patients with pregnancies, malignancies and coagulation disorders as they have to be handled with utmost care and caution. The risk of retina (eye)injury must be considered, especially for high-output lasers in the invisible range. Protective safety glasses with specific wavelength goggles, specific for the wavelength, must be used for the patient , the dental professional and assisting staff. The use of non relflecting mirrors and surfaces is a mandate while using lasers along with non inflammable products to be used in the operatory.

Figure 1 : LLLT in Hypersentivity

Figure 2: LLLT in TMJ disorders

Figure 3: LLLT in Periodontitis

Figure 4: LLLT in Post operative swelling after a traumatic extraction

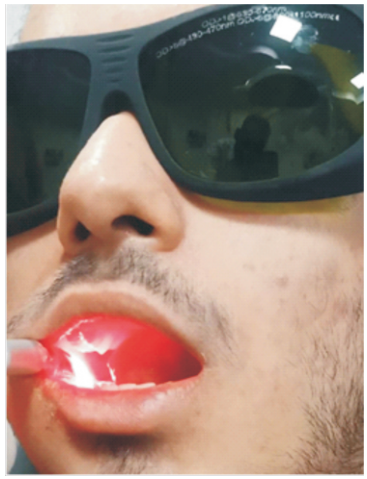

Figure 5: Healing of Extraction socket

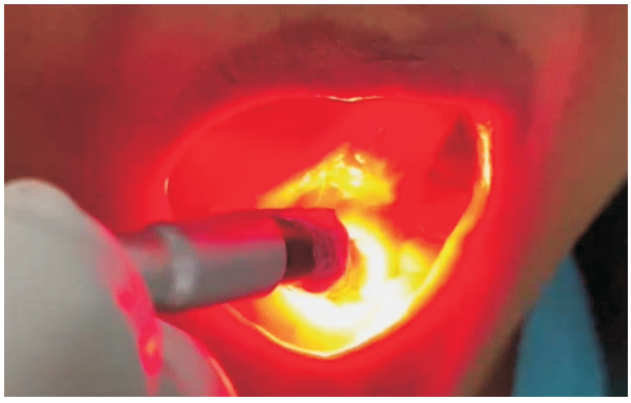

Figure 6 : LLLT for treating Mucositis

Figure 7 : LLLT for treatment of Sinusitis (intraoral)

CONCLUSION

Besides the immediate analgesic effect and coagulating effects, the laser therapy if used with correct parameters, may stimulate the normal physiological cellular functions. Future research might result in several more potential applications of LLLT in dentistry. At the same time, the research focusing on stem cells and their properties should be initiated which can further contribute to the better understanding of the repair and regeneration mechanisms, based on properties of stem cells such as self-renewal and ability of multilineage differentiation.

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