ISSN : 1001-1781
Journal of Clinical Otorhinolaryngology, Head, and Neck Surgery

# PHOTOBIOMODULATION: AN ELXIR IN DENTISTRY

**Dr. Lipika Gopal**
PhD Scholar, Department of Oral and Maxillofacial surgery, Manav Rachna Dental College, FDS, MRIIRS

**Dr. Ashim Aggarwal**
Vice Principal, Head Of Department, Department of Oral and Maxillofacial surgery, Manav Rachna Dental College, FDS, MRIIRS

**Corresponding Author:-**
Dr. Lipika Gopal, PhD Scholar, Department of Oral and Maxillofacial surgery, Manav Rachna Dental College, FDS, MRIIRS

## Abstract
Light with low power output shows defintive therapeutic benefit. Lasers are the devices which uses this beam of monochromatic, collimated light to show the positive healing effect on the tissues which remains true for low level lasers. The therapeutic possibilities in dentistry have increased with the introduction of lasers. Lasers when used at lowest energy power and low dosage shows an effect of biomodulation. The treatment done with these types of lasers are termed as Low Level Laser Therapy or photobiomodulation which has been found to be useful as an effective treatment modality in various fields of dentistry than conventional lasers with high power energy. LLLT accelerates wound healing by stimulating oxidative phosphorylation in mitochondria. Further, the device shows analgesic, anti-inflammatory effects. The following article discusses the laser interaction with tissues. Further it provides an insight to low level lasers and reviews its applications in dentistry.

## Introduction
Our ancestors used heliotherapy, which later changed into actinotherapy and photomedicine, which is where light treatment got its origin. Niels Ryberg Finsen in the late eighteenth century introduced blue and red light for management of diseases in humans particularly *Lupus vulgaris.* For this new development he was accorded with the Nobel Prize in physiology and medicine in 1903 as he introduced evidence that intensive chemical rays emitting from sunlight could result in inhibition of bacteria and stimulates tissues around it.

In 1917, Albert Einstein set down the basis of laser light. He speculated the photoelectric augmentation and demonstrated that it is emission of a stimulated radiation or a single frequency emission. LASER is an abbreviation for 'Light Amplification by the Stimulated Emission of Radiation' . It was publicized in an article by Gordon Gould in 1959[1]. Further, Goldman et al brought in laser in dentistry from where the beginning of laser use evolved in 1965.

Laser light when used at low doses showed enhanced growing of hair at high rate, and also boosts healing of wounds. This was distinguished by Mester et al and was defined as "laser biostimulation"[2].

With this invention a new field of phototherapy came into existence.

This field uses light of low doses for clinical therapy. Subsequently the learning about this field has increased and has matured as this effect can be an inhibitory as well as excite the tissue depending on the use of light parameters[3].This type of light is coherent and low power monochromatic light.

Therefore, "Low level laser therapy" is described as treatment with low dose rate which do not cause a clinically observable tissue structure modification or an elevated temperature immediately[4]. The other terms used are Soft laser, low-intensity laser treatment , Laser phototherapy (LPT), photobiostimulation (PBM), biostimulation (BT), and Mid-laser. These lasers release wavelength which is short consisting of red or infrared laser light with a reduced water immersive power which goes upto a depth of 3 mm - 15 mm in tissues.[5].The types of lasers used for the application of low level laser therapy is wavelengths in the visible and invisible range , pulsed or continuous mode, spectrum in the near infrared, blue and red, and near-infrared wavelengths. "Low Level Laser Therapy" function which ranges between 1 and 75 mW[6]. The first commercially used laser for biostimulation was a 1-mW HeNe laser. Further studies state that as time evolved the most commonly used laser which supplies low level laser light is the GAlAr laser (780 and 830 nm)[4].

**Mechanism of Action**

The principle behind this is application of biostimulative light energy to body cells. The effect of photobiostimulation of laser irradiation shows various changes in a living organisms. These changes include metabolic, physiological, and functional. At cellular level, this laser stimulates the atoms and molecules. The effect of laser on cell depends on chromophores concerned oxidation state along with its wavelength.The photoreceptors present inside the cell (eg, cytochromophores and antenna pigments) absorbs this laser light with low level power and drives it into the mitochondria which further releases energy in the form of ATP. Further which the negatively charged Electrons are passed to oxygen molecule with the help of cytochrome results change in mitochondrial membrane following change and transfer of electron charge. This process results in electrochemical potential activating ATP synthesis pathway with potential upto 300%. As there is an elevation in the level of ATP levels, The RNS and DNA synthesis starts resulting in protein synthesis. Therefore, the intracellular metabolic changes are enhanced which are caused by laser induced biomodulation. These changes elevate the cell division, fibroblast migration and matrix production. matrix production. Also, the stimulation of biological processes depends on the dose of light energy involved[4].

**Effects of laser**

"Low level laser therapy" leads to relaxation of soft vascular muscles, vasodilation and local blood circulation. These changes help in fastening tissue repair as it provides superior immune cell migration to the tissues and blood flow.Ozawa et al. documented that "Low level laser therapy" considerably reduces the rise in plasminogen activity brought on by mechanical tensile tension in human periodontal ligament cells. Latent collagenase, the enzyme that

cleaves collagen fibres, can be activated by plasminogen activity which modulates the inflammatory process[7].Also, "Low Level Laser Therapy" effects the PGE2 synthesis by inhibiting it thereby, further having an effect on periodontal inflammatory process.With regard to the ability of lasers with the different wavelengths such as 940nm, 820nm and 660nm to cause mast cell release of antimicrobial cytotoxic vesicles and the subsequent release of tumour necrosis factor (TNF) causing inflammation, which speeds up leucocyte dispersion in the tissue, the current evidence is quite strong[4].

The main principles of application for many clinical disorders become evident when one comprehends the fundamental cellular actions of the lasers and the desired therapy goal of lowering inflammation, expediting the healing process, and giving pain relief.

In a systematic review, as a single or combined therapy, low-level laser appears to benefit treatment of various neuropathic orofacial pain of neuropathic origin entities such occipital neuralgia, burning mouth syndrome and trigeminal neuralgia[8].

Numerous mechanisms, including effects on formation of Prostaglandin(PG). Also prostaglandin type G and type H2 conversion into prostaglandin type 2 increases. Glucocorticoids urinary secretion increases along with higher pain threshold in nerve fibres combined with the level of beta-endorphins in CSF. It leads to a rise in serotonin urinary secretion and histamine secretion and a lower bradykinin synthesis[9,10]

The effectiveness of "Low Level Laser Therapy" producing wavelength of 890 nm and 660 nm , which was suggested to lessen the discomfort in the muscles of mastication, was examined by Shirani et al. The subjects were treated biweekly for 3 weeks. Further the pain control was evaluated pre and post mangement in both the groups. Photobiomodulation resulted to provide with better results on comparison between two groups. Therefore, this therapy was a successful method of pain management for MPDS patients[11].

Helium-Neon Low intensity lasers or diode lasers have been shown to be beneficial in reducing inflammation and generating analgesia in vesicle-related locations. The idea behind the beneficial effects of laser radiation in Herpes Simplex Labialis treatment is that it can promote the growth of blood circulation within the regenerative tissue, which in combination with products causing physiological and chemical reaction secreted into inflamed tissue assist the interpretation of the benefits of laser radiation[12].

In a literature review and metaanalysis, Bensadoun RJ, Nair RG recorded the efficacy of biobodulation by laser light for blocking and mangement of mucositis.They suggested using red or infrared low-level laser therapy (LLLT) with a diode output of 10–100 mW, a dose of 2-3 J/cm2 for preventions and a dose of 4 J/cm2 for therapeutic impact.

Additionally, they suggested applying "Low Level Laser Therapy" to a specific area rather than in a scanning motion[13].

According to published research, "Low Level Laser Therapy" is an effective way to treat acute sinusitis exacerbations by reducing pain and inflammation. In a study with 65 sinusitis-afflicted kids between the ages of 6 and 15, " Low Level Laser Therapy" was used, and it was discovered to increase microcirculation, lessen oedema, and decrease the frequency of sinusitis relapses[14].

In addition to other scaling, root planing, curettage, or surgical treatment, the antiinflammatory impact of "low level laser therapy" slows or stops the deterioation of tissues in the

periodontium and reduces prominence assisting in environmental health. Further studies showed that bacterial elimination and better healing results with the use of diode laser for the treatment. A. actenomycetemcomitans bacteria were significantly reduced, as demonstrated by Moritz et al. (1997), and periodontal metrics were improved[15]. If low level powers are applied to the surgical site, there may be less post-operative discomfort and swelling. Also, Any difficulties may be reduced by post-extraction irradiation with about 2 J/cm2, in a non-contact method, for about a minute.The impact has been attributed to interfering with endorphin production stimulation and/or pain impulse mediation interference[12].

The laser energy activates the cytochromes and porphirins, which, in turn, encourages an increase in cellular activity by boosting the levels of ATP, ALP, and calcium release. According to certain studies, nondifferentiated mesenchymal cells may be bio-modulated positively to become osteoblasts, which would then more quickly transform into osteocytes[16]. Studies on experimental fracture healing and bone defects have shown that stimulation with " Low level laser therapy" can improve bone repair[17].

**Merits**

1. Bacterial decontamination of periodontal pockets and root canal systems.
2. Aids in hemostasis, which creates a clear working environment.
3. Repair of hrad tissues is simpler and more comfortable for the patients.
4. No suturing required
5. Reduces post-operative pain and discomfort.
6. Enahanced wound healing
7. Increased accuracy in surgical procedures.
8. Minimizes bleeding during the procedure.
9. Depending on the clinical procedure, minimizes or eliminates the need of local anesthesia.

**De-merits**

1. Highly technique sensitive
2. Scattered and reflected laser beams possess a massive health hazard.
3. Contraindicated in cancerous lesions.
4. Expensive equipment.

**Conclusion**

All the specialities in dentistry are utilising the therapeutic advantages of LLLT. In conclusion, the precise and precise term for this useful and significant use of light is photobiomodulation treatment. If the doctor receives the appropriate training and implements the essential safety precautions, LLLT can show to be a useful therapy option for a variety of oral diseases. The different wavelength and techniques utilised in the management of the lesions decides the result of the treatment done.Further studies are required to be done to enhance literature on LLLT use and the different wavelengths which can be used in low doses of light.

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