An overview on Photobiomodulation in Temporomandibular Joint Dysfunction

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Abstract

Photobiomodulation, also known as low-level laser therapy, is the application of red and near-infrared light to promote healing, pain relief, and inflammation reduction. This brief review focuses on the detailed physiology of how this device works and its use in temporomandibular joint dysfunction. Photobiomodulation acts at the cellular level, stimulating the mitochondrial respiratory chain in cytochrome c oxidase and increasing ATP and mitochondrial membrane potential, allowing cells to regenerate and repair themselves. By acting on inflammatory mediators, it promotes tissue healing and reduces inflammation. This anti-inflammatory and healing property can be used to treat a variety of skin, joint, and soft tissue conditions. Photobiomodulation has also been shown to provide significant pain relief when compared to other treatment options. This therapy employs the use of light emitting diodes. In studies focusing on its use in the temporomandibular joint, it has been shown to be effective in reducing pain in joint-related conditions such as degenerative arthritis or myopathic pain by promoting metabolic action.

Keywords: Photobiomodulation, temporomandibular dysfunction (TMD), inflammation, pain.

INTRODUCTION

Photobiomodulation has made significant progress in gaining acceptance from biomedical science authorities, and it continues to do so(1). It is a non-invasive treatment, this has been shown to be useful for intervening temporomandibular dysfunction related agony in several trials(2).

Photobiomodulation, being a nonthermal light, can induce metabolic changes in cells and tissues, including as cellular respiration, vascularization, and fibroblastic differentiation. Because of its anti-inflammatory and analgesic effects, as well as its rejuvenating effects, all these are requisite for its therapeutic benefit. Photo biomodulation is a feasible therapeutic option for musculoskeletal issues(2).

It has been shown in vitro and in vivo to promote cell proliferation and growth in a variety of cell types, so this can be used efficiently in wound healing. It's the process by which chromophores absorb nonionizing optical energy in the visible spectrum region to cause photophysical and photochemical changes without causing thermal damage. It comprises the use of light from a variety of sources, including as light emitting diodes and broadband light, to induce physiological and therapeutic effects.(3)

Photobiomodulation is a resource that promotes anti-inflammatory and analgesic action by allowing a greater production of Adenosine Triphosphate through a modulatory process, as well as a positive effect on protein synthesis and cell proliferation, restoring homeostasis in cells or organisms in a state of suppression or disease, so can be used in arthritic joint conditions

Low-level lasers and light emitting diodes operating in the red and near-infrared parts of the electromagnetic spectrum have been utilised to treat a variety of injuries to the tendons, muscles, joints, and nerves, with promising results in tissue repair,
inflammation, and pain relief. Furthermore, research released in the last decade has shown that PBMT can reduce fatigue, diminish signs of exercise-induced muscle damage, increase exercise performance, and even improve muscular adaptations to resistance training programmes. And according to the studies optimise the subjects' performance, a combination approach of photobiomodulation therapy applied 6 hours and shortly before resistance training.(4)

photobiomodulation method of action: -

Low-level laser treatment is another name for photobiomodulation, induces tissues by direct irradiation with Light with profoundly penetrating different wavelengths from 630 nm to 1300 nm that is also absorbed. The lack of general adoption of photobiomodulation is primarily owing to a lack of understanding of mechanisms of action. However, significant information has been acquired in this field in recent years. It has anti-inflammatory and analgesic properties The amount of energy produced in PBMT is a soft substance that has no effect on skin temperature. Edema, prostaglandin E2 (PGE2), and cyclooxygenase (COX) levels are reduced by using a laser that enhances lymphatic flow.(5).

Unit IV of the mitochondrial respiratory chain i.e., cytochrome c oxidase which absorbs emission in near-infrared range containing heme as well as copper centers, is one of the most important chromophores. Photons displace inhibiting nitric oxide via enzyme, boosting adenosine triphosphate (ATP) synthesis, electron transport, mitochondrial membrane potential, according to the most widely accepted explanation (4). ATP provides the energy required for a cell to operate and repair itself, which can be thought of as the cell's gasoline(6).

This has shown to promote tissue healing, angiogenesis, and pain and inflammation reduction, and encourage the production of new muscle fibers. Long term usage of photobiomodulation is thought to be risk-free(7).

A general reduction in inflammation is one of the most repeatable results of photobiomodulation, which is especially essential for joint problems, traumatic injuries, lung disorders, and brain disorders (7).

Photobiomodulation therapies using light-emitting diodes is based on the fact that at specific physiologically active wavelengths, light-emitting diodes have shown to have therapeutic potential at the molecular levels and are a viable substitute to lasers as a photon source, among other advantages(8).

Increased osmotic resistance, normalisation of membrane permeability, decreased free radical oxidation and concentration of intermediate products of lipid peroxidation, reduced phospholipase A2 membrane activity, and normalisation of the viscoelastic properties of RBCs were all observed in various studies after exposure to PBM.(9)

Light-mediated calcium ion channel activation, such as transient receptor potential (TRP), can be demonstrated to induce significant changes in intracellular calcium. TRP channels are engaged in a range of actions, but the majority of them are involved in heat sensing and thermoregulation.(10-25)

Over the last decade, there has been a surge in curiosity in employing photobiomodulation of laser to alleviate pain in different conditions and reduce inflammation. Low laser have ability to assist in symptomatic relief in pain and promoting considerable decrease in pain after application, 2 major benefits of this treatment are non-invasive method and low-cost procedure.

Use of photobiomodulation in temporomandibular dysfunction

Photo biomodulation technique is found to be useful in following TMJ related conditions.

- Myopathic Pain
- TMJ Osteoarthritis and Degenerative Joint Disease
- Intracapsular issues cause joint pain and related muscle.
- Trigeminal neuralgia and Neuropathic Pain
Procedure: - Treat the joint with the teeth together, then open the patient enough to allow the condyle to translate out of the joint, allowing the structures inside the joint to be treated more precisely. Because it is pain control, an 8 J/cm² dosage can be used to suppress it(6).

Photobiomodulation improves vascularization and oxygen distribution in hypoxic cells via promoting metabolic action via stimulation of the cellular respiratory chain inside mitochondria. Improved ATP creation can consequence into muscle relaxation along with increased blood microcirculation, which can speed up the clearance of catabolism products from tissues; there was a considerable reduction in pain among TMD patients(26-39).

Summary and future perspective

Photo biomodulation therapy, as mentioned earlier in this section, can be used to decrease discomfort and inflammation in a variety of musculoskeletal conditions, including temporomandibular dysfunction. The effect of photo biomodulation treatment on TMJ dysfunction has been investigated in a number of research. Though the exact mechanism of photobiomodulation is unknown, it has been discovered to be a fantastic non-invasive alternative for treating pain associated with joint disorders. Because of its analgesic, anti-inflammatory, and regenerative benefits, as well as the fact that it is a noninvasive procedure, photo biomodulation may be a viable choice for the treatment of musculoskeletal problems, according to the studies. By acting on the cellular level, this also reduces the need for surgery in joint-related or joint-disc-related conditions by reducing inflammation and the source of pain. Because it is a non-invasive technique, it may be a huge help in ensuring the effectiveness of the therapy, especially in situations when complications from other disorders can make surgery difficult. Still, research is being conducted to determine the correct mechanism of this photo biomodulation (low laser) therapy and its application in various conditions. Due to a lack of understanding of the device and therapy, it is still utilised less frequently than other treatment modalities such as therapeutic ultrasound, TENS, and so on. Although this device is not now accessible as a locally utilised invasive technique, it may be a valuable treatment modality.

REFERENCES