

An overview on Photobiomodulation in Temporomandibular Joint Dysfunction

Neha Arya¹, Mitushi Deshmukh^{2*}

¹Department of Musculoskeletal Physiotherapy, Ravi Nair Physiotherapy College, Datta Meghe Institute of Medical Science, SawangiMeghe, Wardha, Maharashtra, India

²Assistant Professor, Department of Musculoskeletal Physiotherapy, Ravi Nair Physiotherapy College, Datta Meghe Institute of Medical Sciences (DU), Sawangi Meghe, Wardha, Maharashtra, India

Email: mitushideshmukh11@gmail.com

DOI: 10.47750/pnr.2022.13.S06.388

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: Photo biomodulation, 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 to 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 photo biomodulation is thought to be risk-free(7).

A general reduction in inflammation is one of the most repeatable results of photo biomodulation, 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 therapy, continuous research and outcomes may embark to the treatment's usage of this device due to its positive results. In today's rapidly evolving technological world, this technique has the potential to be a valuable treatment modality.

REFERENCES

1. Hamblin MR. Photobiomodulation or low-level laser therapy. *J Biophotonics*. 2016 Dec;9(11-12):1122-4.
2. Tunér J, Hosseinpour S, Fekrazad R. Photobiomodulation in Temporomandibular Disorders. *Photobiomodulation Photomed Laser Surg*. 2019 Dec;37(12):826-36.
3. Photobiomodulation Therapy on Physiological and Performance... : The Journal of Strength & Conditioning Research [Internet]. [cited 2022 Apr 22]. Available from: https://journals.lww.com/nsca-jscr/FullText/2018/10000/Photobiomodulation_Therapy_on_Physiological_and.14.aspx
4. Rossato M, Dellagrana RA, Sakugawa RL, Lazzari CD, Baroni BM, Diefenthaler F. Time Response of Photobiomodulation Therapy on Muscular Fatigue in Humans. *J Strength Cond Res*. 2018 Nov;32(11):3285-93.
5. Management of TMD Symptoms with Photobiomodulation Therapy - ProQuest [Internet]. [cited 2022 Apr 16]. Available from: <https://www.proquest.com/openview/4a12e0c89291832516787169ab2bfd4/1?pq-origsite=gscholar&cbl=41679>
6. Gerry Ross DDS. How to treat facial pain with photobiomodulation/low-level laser therapy. *Dent Prod Rep* [Internet]. 2019 Oct 29 [cited 2022 Apr 16];53(11). Available from: <https://www.dentalproductsreport.com/view/how-treat-facial-pain-photobiomodulationlow-level-laser-therapy>
7. Tsuk S, Lev YH, Fox O, Carasso R, Dunsky A. Does Photobiomodulation Therapy Enhance Maximal Muscle Strength and Muscle Recovery? *J Hum Kinet*. 2020 Jul 7;73(1):135-44.
8. Kumar AN, Jadhav V, Jawalekar R, Akhare P, Atram H, Jaiswal E, et al. Light Emitting Diode Mediated Photobiomodulation Therapy in Orthodontics - A Review of Contemporary Literature. *J Evol Med Dent Sci* [Internet]. 2021 Aug 9 [cited 2022 Apr 19];10(32):2672-80. Available from: <https://go.gale.com/ps/i.do?p=HRCA&sw=w&issn=22784748&v=2.1&it=r&id=GALE%7CA673736913&sid=googleScholar&linkaccess=abs>
9. Liebert A, Pang V, Caagby D, Arshnikova L, Kiat H. Narrative Review of Russian, Ukrainian and English-Language Publications Investigating the Effects of Photobiomodulation on Red Blood Cell Physiology. *Photobiomodulation Photomed Laser Surg*. 2022 Feb;40(2):98-111.
10. Hamblin MR. Shining light on the head: Photobiomodulation for brain disorders. *BBA Clin*. 2016 Dec 1;6:113-24.
11. Nirmal, Apoorva, Gajendra Agrawal, Sunil Kumar, Sourya Acharya, Akshay Dafal, and Dwivedi Bhushan. "Echocardiographic Assessment of Cardiac Function in Liver Cirrhosis: A Cross-Sectional Study." *JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH*, 2021. <https://doi.org/10.7860/JCDR/2021/45792.14881>.
12. Nisargandha, Milind Abhimanyu, and Shweta Dadarao Parwe. "Evaluation of Spermatogenic Action in the Management of Oligospermia." *International Journal of Pharma and Bio Sciences* 11, no. 2 (April 15, 2021): 218-23. <https://doi.org/10.22376/ijpbs/lpr.2021.11.2.P218-223>.
13. "[No Title Found]." *INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH* 12, no. 1 (n.d.).
14. Padmane, Ekta, and Samruddhi Gujar. "Case Report on Hydatid Cysts with Hydropneumothorax." *Journal of Pharmaceutical Research International*, November 15, 2021, 1-5. <https://doi.org/10.9734/jpri/2021/v33i50A33375>.
15. Padmawar, Shubham, Dr. Suhas Landge, Prateek Upadhyay, and Mitali Madhusmita. "A Functional and Radiological Outcome Analysis of Hip Forage Procedure, Done for Early Stages(Ficat and Arlet Grade 1 and 2A) of Avascular Necrosis of Head of Femur." *Journal of Pharmaceutical Research International*, December 11, 2021, 97-105. <https://doi.org/10.9734/jpri/2021/v33i54B33770>.
16. Palkrit, Sakshi, Waqar M. Naqvi, and Tasneem Burhani. "Physiotherapeutic Approach in Stress Urinary Incontinence with Prolapsed Uterus: A Case

- Report.” *Journal of Pharmaceutical Research International*, June 30, 2021, 54–59. <https://doi.org/10.9734/jpri/2021/v33i34A31822>.
17. Panbude, Mahima Dipak, Mayuri Manikrao Paropate, Mansi Vinod Pande, Priyanka Dayaram Pal, Chatur Kamlakar Patil, and Ranjana Premnath Sharma. “Evaluation of Effectiveness of Information Booklet Regarding Self-Care among Patients Receiving Chemotherapy in Selected Hospitals of Wardha and Nagpur, India.” *Journal of Evolution of Medical and Dental Sciences* 10, no. 18 (May 3, 2021): 1329–33. <https://doi.org/10.14260/jemds/2021/280>.
 18. Pandey, Aishvarya. “Neurological Disorders Due To Malnourishments.” *Bioscience Biotechnology Research Communications* 14, no. 6 (June 15, 2021): 45–48. <https://doi.org/10.21786/bbrc/14.6.10>.
 19. Pandey, Milind, Sunita Vagha, Raunak Kotecha, and Anchal Manchanda. “Primary Gastric Lymphoma (Diffuse Large B Cell Type).” *Journal of Pharmaceutical Research International*, July 13, 2021, 54–57. <https://doi.org/10.9734/jpri/2021/v33i37A31979>.
 20. Pandey, Milind, Sunita Vagha, Gaurav Mahajan, and Anchal Manchanda. “A Brief Study on Retroperitoneal Paraganglioma.” *Journal of Pharmaceutical Research International*, July 31, 2021, 64–66. <https://doi.org/10.9734/jpri/2021/v33i39B32184>.
 21. Pandey, Vidya Bhushan, Renu Bharat Rathi, Bharat Rathi, and Jitesh Verma. “Evaluation of Comparative Efficacy of Brahmi vs. Haritaki Extract in the Management of Academic Stress in Adolescent Students- A Prakriti Based Double-Blind Randomized Controlled Trial.” *Journal of Pharmaceutical Research International*, November 6, 2021, 159–69. <https://doi.org/10.9734/jpri/2021/v33i48A33233>.
 22. Pandya, Naman Kirit, and Utsav Umang Bhatt. “Inflammatory Myofibroblastic Tumor of Hard Palate: A Lesion of Extreme Rarity.” *Pan African Medical Journal* 38 (2021). <https://doi.org/10.11604/pamj.2021.38.267.28236>.
 23. Pandya, Naman Kirit, and Anendd Arroon Jadhav. “Descending Necrotising Fasciitis of Head and Neck Secondary to Insect Bite: Report of a Rare Case.” *Pan African Medical Journal* 38 (2021). <https://doi.org/10.11604/pamj.2021.38.271.28594>.
 24. Parate, Ashutosh, Vasant Gawande, Suvam Gupta, Ankit Jaiwal, Ashwin Chavan, and Kunal Saoji. “A Comparative Study of Functional Outcome of Olecranon Fractures Managed with Tension Band Wiring Using K Wires with Tension Band Wiring Using Cancellous Screws Fixation.” *Journal of Pharmaceutical Research International*, July 15, 2021, 193–98. <https://doi.org/10.9734/jpri/2021/v33i37A31996>.
 25. Pardasani, Rajiv, and Sohan Lohiya. “Study of Changes in Corneal Thickness and Corneal Endothelial Cell Density after Phacoemulsification Cataract Surgery.” *Journal of Evolution of Medical and Dental Sciences* 10, no. 12 (March 22, 2021): 866–72. <https://doi.org/10.14260/jemds/2021/187>.
 26. Pardhekar, Ashvini Dineshrao, Sadhana Misar(Wajpeyi), and Vinod Ade. “Protocol on Comparative Clinical Efficacy of Tryushanadi Guggul and Navaka Guggul in Sthoulya (Overweight).” *Journal of Pharmaceutical Research International*, June 2, 2021, 169–75. <https://doi.org/10.9734/jpri/2021/v33i30A31628>.
 27. Parihar, Pratapsingh Hanumantsingh, and Sharvari Shashikant Gulve. “Mediastinal Extension of Pancreatic Pseudocyst – A Case Report.” *Journal of Evolution of Medical and Dental Sciences* 10, no. 5 (February 1, 2021): 316–18. <https://doi.org/10.14260/jemds/2021/70>.
 28. Parsodkar, Rucha P., Aliabbas A. Husain, Gargi D. Mudey, Lokendra R. Singh, and Rajpal S. Kashyap. “Diagnosis of Bacterial Meningitis and AMR Profile Using Molecular and Immunological Techniques.” *Journal of Pharmaceutical Research International*, July 22, 2021, 89–105. <https://doi.org/10.9734/jpri/2021/v33i38A32063>.
 29. Parveen, Sana, Shraddha Jain, Sunil Kumar, Sourya Acharya, and Dhruv Talwar. “Evolution of Middle Ear Modelling Techniques: A Review.” *Cureus*, December 30, 2021. <https://doi.org/10.7759/cureus.20829>.
 30. Parwe, Shweta, Poonam Ashtankar, Piyush Bhagwat, and Milind Nisargandha. “Study the Efficacy of Rodhradigana Vasti in the Management of Sthaulya (Overweight).” *Journal of Pharmaceutical Research International*, July 2, 2021, 158–66. <https://doi.org/10.9734/jpri/2021/v33i34B31858>.
 31. Parwe, Shweta, Sandip Jadhav, and Milind Nisargandha. “Comparative Clinical Trial on Aragwadha Erand and Trivrutta Eranda Nitya Virechana in Gridhrasi (Lumbago Sciatica Syndrome): A Study Protocol.” *Journal of Pharmaceutical Research International*, July 29, 2021, 68–74. <https://doi.org/10.9734/jpri/2021/v33i39A32143>.
 32. Parwe, Shweta, Manju Mohan, Piyush Bhagwat, and Milind Nisargandha. “Effect of Rodhradi Gana Udavartana in the Management of Sthaulya (Overweight) with Special Reference to Obesity.” *International Journal of Pharma and Bio Sciences* 11, no. 3 (May 4, 2021). <https://doi.org/10.22376/ijpbs/lpr.2021.11.1.L30-37>.
 33. Parwe, Shweta, Swati Tikale, Puja Shrivastav, and Milind Nisargandha. “A Critical Review on Formulations Used in the Management of Malavstambha (Constipation).” *Journal of Pharmaceutical Research International*, June 30, 2021, 92–100. <https://doi.org/10.9734/jpri/2021/v33i34A31828>.
 34. (Pate), Meenakshi Yeola, Kushagra Singh, Darshana Tote, Azeem Javed Aalam, and Pankaj Gharde. “Metastatic Carcinoma Breast Presenting as Appendicular Abscess.” *JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH*, 2021. <https://doi.org/10.7860/JCDR/2021/44398.14412>.
 35. Patel, Abhi, Swarupa Chakole, and Neha Bhatt. “Psychological Stress Due to Covid-19 on Pregnant Women in Post Partal Period.” *Journal of Pharmaceutical Research International*, December 16, 2021, 458–61. <https://doi.org/10.9734/jpri/2021/v33i58B34225>.
 36. Patel, Aditya, Samrudhi Gujar, Savita Pohekar, Ruchira Ankar, Arati Raut, Sheetal Sakharkar, Vaishali Tembhare, and Pranali Wagh. “Non-Hodgkin’s Lymphoma: A Case Report.” *Journal of Pharmaceutical Research International*, December 8, 2021, 264–67. <https://doi.org/10.9734/jpri/2021/v33i53B33705>.
 37. Patel, Divyank, Zainab Gandhi, Rupak Desai, Jilmil Raina, Vikram Itare, Fariah Asha Haque, Taha Saeed, et al. “Impact of Alcohol Use Disorder on Stroke Risk in Geriatric Patients with Prediabetes: A Nationwide Analysis.” *International Journal of Clinical Practice* 75, no. 9 (September 2021). <https://doi.org/10.1111/ijcp.14477>.
 38. Patel, Drashti. “Covid-19 In Pregnant Women.” *Bioscience Biotechnology Research Communications* 14, no. 6 (June 15, 2021): 275–79. <https://doi.org/10.21786/bbrc/14.6.58>.
 39. Patel, Leksha Atul, Vaishnavi Dilip Yadav, Moli Jai Jain, and Om C. Wadhokar. “Positive Outcomes of Comprehensive Exercise Program on Restoration of Functional Level and Quality of Life in a Patient with Rheumatic Heart Disease Undergone Mitral Valve Replacement: A Case Report.” *Journal of Pharmaceutical Research International*, October 15, 2021, 379–84. <https://doi.org/10.9734/jpri/2021/v33i46A32879>.