Oral Mucositis (OM) Preventive and Healing with Photo Biomodulation (PBM): A Case Series

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ABSTRACT

Oral Mucositis (OM) is a pathological condition affecting the oral mucosa, leading to impaired feeding and further compromising the patient's immune response. The objective of this paper is to show the application of photo biomodulation (at 660nm and 808nm) to relieve pain and improve the healing of aphthous lesions in these patients. We present three clinical cases demonstrating the preventive and healing effect of photo biomodulation (PBM), where we can see the results in these patients, improving their quality of life and the possibility of improving their feeding. We can then conclude, corroborating the literature, that the application of photo biomodulation shows that when applied internally or externally in the oral cavity, recovery is favored in these affected patients.

Keywords: Photo biomodulation; Laser Therapy; Extraoral; Mucositis.

INTRODUCTION

Oral Mucositis (OM) is a pathology that affects the internal mucosa of the oral cavity, leading to impaired feeding, which further depresses the patient's immune response. OM is an inflammatory condition characterized mainly by aphthous lesions that rupture the internal mucous membranes of the oral cavity over a larger area, leading to discomfort and also difficulty in carrying out daily activities, such as eating, drinking and speaking. Therefore, there is often a deficit in weight and in the immune response of these patients[1,2].

The main causes of mucositis are related to chemotherapy, which is a treatment used for cancer patients. Radiotherapy can also lead to this pathology found inside the oral cavity. Autoimmune diseases such as pemphigus and pemphigoid can cause oral mucositis. Oral mucositis can also be caused by infections caused by bacteria, viruses and fungi. Some medications, when administered incorrectly, such as antibiotics and anti-inflammatories, can lead to this condition of oral mucositis due to an adverse effect of these drugs[3]. The main symptoms found in patients with oral mucositis are mainly pain. These patients experience discomfort in the cheeks, tongue and sometimes gums. Swelling and redness occur throughout the mucosa inside the mouth with ulcers of various sizes that can cause bad breath due to inflammation and infection of microorganisms in these regions.

There are several ways to treat oral mucositis using analgesic, anti-inflammatory and antibiotic medications.

Psychological support therapy can be used and oral hygiene care should always be taken into consideration. PBM is a therapy that has been shown to be effective in treating oral mucositis. A soft and anti-inflammatory diet with good hydration should always be considered in these patients to improve their quality of life[1-4].

In this article we will show a series of clinical cases where we applied photobiomulation through the use of a low-power laser device that corroborates the findings in the literature showing that laser therapy has an effect on the prevention and healing of patients with oral mucositis. The main methodological distinction in this paper is the external application of PBM to the oral cavity, administered over a prolonged duration compared to existing protocols in the literature.

MATERIALS AND METHODS

Study Design

This descriptive interventional clinical case series study was performed with written informed consent obtained from all patients, and a full explanation of the treatment was given, including a patient information leaflet. In addition, written informed consent was obtained from all volunteers who participated by showing their photographs in this scientific journal. The study was conducted in accordance with the Declaration of Helsinki.

Eligibility Criteria

Inclusion Criteria

The inclusion criteria were patients aged 18 years or older, with malignant diseases undergoing high doses of chemotherapy (CT) and/or radiotherapy (RT); and with or without intact oral mucosal lining and/or other associated pathologies.

Exclusion Criteria

Incomplete medical records with confusing essential information related to cognitive deficit, which may interfere with understanding responses to key questions (e.g., date of birth/age, current day/month, and address).

- Severe mobility limitations preventing attendance at outpatient care.

- Diabetes mellitus, due to the associated higher risk of oral cavity infections.

Description of Treatment Protocols

The laser device that was employed for all the cases were desenvolved in Brazil where its aiming beam was from a low-power semiconductor diode laser and was transmitted coaxially along the optical fiber. The therapeutic PBM parameters were confirmed with the PM160T power meter, Thorlabs, Newton, NJ, USA. Any possible undesirable thermal effects were avoided by monitoring PBM irradiation with a thermal camera FLIR ONE Pro-iOS (FLIR Systems, Inc. designs, Portland, OR, USA).

The laser PBM dosimetry protocol that was employed for all three cases was as follows: (Table 1). Table 1. Show PBM approach

.PBM Approach	Device Specifications	Laser Parameters	Treatment Protocol
Preventive	Cluster: 808 nm + 680 nm Punctual: 808 nm	- 1 minute on each area of the tongue/external cheek - Energy: 36 J per area - 30 seconds per point - Energy: 3 J	- **Intraoral:** Lateral and posterior of right and left tongue, right and left buccal mucosa (cheeks), upper and lower lips - **Extraoral:** Bilateral cheek

Therapeutic	Cluster: 808 nm + 680 nm Punctual: 808 nm	- 1 minute on each area of the tongue/external cheek - Energy: 36 J per area - 30 seconds per point - Energy: 3 J	- **Frequency:** 2 sessions per week - **Duration:** 2 months

Device information (Cluster)

Number of emitters: 6. Light source: Laser.

Laser Beam delivery system: direct (no means of delivery). Irradiation Parameters: wavelength 680 and 808 nm.

Spectral bandwidth: 2.0 nm and 2.5 nm.

Operating mode: continuous emission mode (CW). Beam profile: not Gaussian.

Power output: 100 mW = 0,1W. Irradiance: 5.65 W/cmZ per spot (emitters) Beam spot size at target: an average of 0.03 cmZ Treatment parameters Number of irradiated points depends aerea of lesion. Irradiated area 0.0177 cm2 per spot.

Application technique: spotting/touch.Treatment frequency: twice per week based on minimal 48 h time interval between each session.

Speed of movement: static.

Device Information (Puntual)

Number of emitters: 1. Light source:
Laser.

Beam delivery system: plastic optical fiber. Irradiation Parameters: wavelength 808 nm. Spectral bandwidth: 2.5 nm.

Operating mode: continuous emission mode (CW) Beam profile: multimodal (elliptical) Power output: 100 mW = 0,1W. Irradiance: 3.33 W/cmZ.

Beam spot size at target: Average 0.2 cmZ.

Treatment parameters Number of irradiated points depends aerea of lesion. Irradiated area 0.03 cm2 per spot. Application technique: spotting/touch.

Treatment frequency: twice per week based on minimal 48 h time interval between each session. Speed of movement: static.

Recommended treatments for cancer patients at the oncology center from these cases series report - as documented in Cancerology and Oncology Service of the Santa Casa de Misericórdia de São Carlos.

The chemotherapy and radiotherapy data that we obtained from the oncology center are all described below: an average of 33 radiotherapy sessions and 3 cisplatin chemotherapy sessions were performed.

Chemotherapy protocol with treatment duration: 30 minutes for one vial, 2h30 for one vial with 2 tubes together.

Radiotherapy protocol and treatment duration of 33 sessions of 212cGy, with a total dose of 6,996cGy, with specific radical purpose. The treatment was performed on a 6MV photon linear accelerator, with the RapidArc

technique.

Cases Presentation and Results

The clinical evaluation involved assessing the OM severity OM based on the World Health Organization (WHO) classification, which considers the following criteria[5].

Grade 0 - absence of signs and symptoms; Grade 1 - presence of erythema with no lesions;

Grade 2 - ulcerated mucosa, but the patient can still eat normally;

Grade 3 - presence of ulcers, intense pain, and the patient can only consume liquids; Grade 4 - the patient requires parenteral nutrition and continuous analgesic support.

Clinical case 1.

Patient MCMS, 42-year-old, Afro, photype 5, female who underwent colorectal surgery for which she experienced a significant drop her immunity. She reported an emergence of oral lesions that took a prolonged time to heal, but eventually improved. Upon commencement of chemotherapy, the oral mucosal reappeared. The diagnosis was OM resulted from a damage of the gastrointestinal tract (GIT) due to the cytotoxic effect of the chemotherapy.

Oncology Treatment Protocol Type of tumor: Malignant.

Grade 2.

History of Current Condition Progression: After undergoing colorectal surgery, the patient experienced a significant drop in immunity. She reported the emergence of small oral lesions that took a prolonged time to heal but eventually improved. Upon commencement of chemotherapy, the lesions reappeared.

Laser Treatment Protocol

The application of Vacuum Laser device (Dual red and infrared wavelengths) without the aid of the suction. MP1 applied for 60 seconds (s) intraorally on right and left lateral border of the tongue, as well as the dorsum of the tongue and extraorally on the cheek and vermilion border of lips. The recovery application of infrared (L2-808 nm) applied on the lesion directly.

Figure 1 - Figure 1 shows the case before treatment. This image shows the lesion in the retromolar region.

Figure 2 – These images show the application of photo mobilization internally and externally to the oral cavity.

Figure 3 – In these two final photos we can see that the patient's injuries have healed.

Clinical case 2.

Patient MAC, 90-year-old, Caucasian, photype 1, male. Nasopharyngeal tumor, squamous cell carcinoma, biopsy performed and non-surgical treatment. 33 radiotherapy sessions and 3 cisplatin chemotherapy sessions. Does not take any medication, except nystatin. Has already had cleaning (prophylaxis) and uses prednisone 0.1%, lidocaine 2%, saline solution 60ml.

Oncology Treatment Protocol Type of tumor: Malignant.

Grade 3.

History of Current Condition Progression: A malignant tumor located between the nose and the palate was treated with radiotherapy. The patient subsequently developed radiotherapy-induced mucositis.

Laser Preventive Protocol

Healing Protocol: Application of VacumLaser device (combining red and infrared lasers) without suction, MP1(no pression negative) is applied for 1 minute on each part of the tongue (sides and center), external cheek, and external lips.

The puntual device, containing infrared laser (808 nm), is applied for 30 seconds directly onto the lesions.

Figure 4 – The image show the case before treatment.

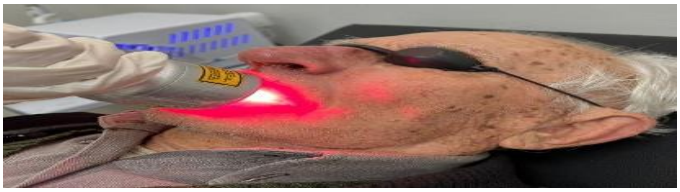

Figure 5 – This image shows the application of photo mobilization internally and externally to the oral avity.

Figure 6 – In these images initial and final photo can see that the patient's injuries have healed.

Clinical case 3.

Patient M. S. C., 54 years old, phototype 1, Caucasian. Nasopharyngeal tumor, squamous cell carcinoma, biopsy performed and non-surgical treatment.. She does not take any medication, except nystatin.

Oncology Treatment Protocol Type of tumor: Malignant.

Grade 0.

History of Current Condition Progression: Malignant tumor located between the nose and the roof of the mouth, undergoing radiotherapy. Oral mucositis lesions appeared in the second week of radiotherapy, after 8 radiotherapy sessions in a very superficial manner.

Laser Preventive Protocol

Application of cluster device (combining red and infrared lasers) is applied for 1 minute on each part of the tongue (sides and center), external cheek, and external lips.

The puntual device, containing infrared laser (808 nm), is applied for 30 seconds directly onto the lesions.

Figure 7 - These images show the case before treatment.

Figure 8 – These images show the application of photo mobilization internally and externally to the oral cavity.

Figure 6 – In these final photos we can see that the patient's no have injuries have.

Usually, after the beginning of OM treatment with laser, several clinical cases have shown the appearance of oral candidiasis, as in this case, where mouthwash solutions with Malvona and Flogoral were administered for 10 days to treat candidiasis.

At the end of the photobiolamination sessions in these three clinical case reports with the pathology of oral mucositis, none of the patients presented lesions in the oral mucosa.

DISCUSSION

Over the 30-day period following the final evaluation of these clinical cases, the OM lesion grade stabilized at grade zero (full recovery). The type 1 cold sore lesion of patient 3 was also completely healed after 30 days of treatment. Based on the treatment outcome, PBM successfully controlled and prevented the lesions that may appear in the oral cavity of a patient undergoing head and neck occult treatment, in addition to improving their quality of life[6,7].

PBM has been shown to be effective in the treatment of OM in many studies, minimizing the lesions and the time they remain in the oral cavity, resulting in a faster healing process[5-7]. In addition, laser therapy alleviates painful symptoms, allowing better nutrition for patients with cancer. It is important to note that the application of PBM in cancer patients must take into account the increase in nitric oxide (NO) and reactive oxygen species (ROS), which can increase the blood supply of tumors (highly vascularized) and the presence of acid radicals in the blood, and it should be noted that very long periods of application of PBM can, in hypothesis, worsen the patient's oncological condition[1].

OM in the oral cavity often leads to interruption of chemotherapy or radiotherapy treatment due to the patient's inability to eat well and drink liquid foods. Therefore, preventive and curative treatment with PBM can also help to improve the results of oncological treatment in terms of speed of recovery and avoid interruptions in these treatments[8-10].

A recent study[8] in children observed a significant clinical difference between the treated group and the control group. The PBM group had a higher prevalence of absence of oral mucositis with a decrease in the incidence of OM than the control group (P value < 0.001, effect size = 0.796) with higher rates of healthy oral mucosa in the PBM group. In this same study, they concluded that PBM effectively reduces the incidence and severity of chemotherapy-induced oral mucositis in pediatric patients diagnosed with Acute Myeloid Leukemia (AML).

In another recent study[11] the authors suggested that irradiance appears to be less significant than fluence in terms of efficacy for providing a viable treatment duration, showing that intraoral protocols that used a wide range of irradiances, 24–31.25 mW/cm^2 for He-Ne lasers and 417–1,000 mW/cm^2 for diode lasers, were more effective. However, they concluded in the same article that extraoral PBMT has advantages over intraoral PBMT, but lacks evidence of efficacy and requires additional

dosimetric considerations due to the anatomical structures through which the light must pass before reaching the oral mucosa.

The literature indicates that oncological treatment with PBM must consider various laboratory and clinical studies in oncological treatment, but mainly the concern with the photo deactivation of nitrous oxide that can increase angiogenesis and blood supply to a tumor region must be considered[12-14]. In view of this, we know

that sometimes simple studies performed on experimental determination of phantom scatter or even studies using Monte Carlo simulation can lead us to a truly different clinical result[15,16]. We are publishing these three clinical cases in Brazilian patients with various phototypes to confirm our clinical observation of effective recovery results in these patients with mucositis undergoing oncological treatment with improved quality of life.

This work is of relevant importance because it demonstrates that patients who have undergone surgery in the oral cavity, tongue or jaw sometimes have difficulty opening their mouths. In these cases, extrabuccal application with PBM becomes an alternative way to benefit these patients. In addition, our work shows that the application made with PBM with this innovative protocol considers taking a longer time of light application so that the photons have time to react with all the photo absorbers present in the mitochondria and cells, which provides a possibility of greater efficacy in these treatments. Obviously, longitudinal, randomized, double-blind studies with a larger number of volunteers must be carried out to prove all these clinical observational effects that we found in the cases presented here.

CONCLUSION

OM is an inflammatory alteration of the mucosa resulting from damage to the gastrointestinal tract due to cytotoxic effects during Radiotherapy or Chemotherapy of the Head and Neck. PBM, applied through Low-Level Laser Therapy (LLLT) in patients undergoing Radiotherapy or Chemotherapy, reduced or prevented the manifestation of these lesions. PBM has been shown to be an effective complementary or alternative therapy in integrative dentistry for the treatment of OM.

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Conflict Of Interest Statement

The authors declare no conflict of interest.

REFERENCES

1. Nogueira, M. S., Gianini, C. A., Pereira, R. B., Silvani, G., Bagnato, V. S., & Panhóca, V. H. (2024, March). Photobiomodulation therapy for the management of oral mucositis: a clinical case. In Imaging, Therapeutics, and Advanced Technology in Head and Neck Surgery and Otolaryngology 2024 (Vol. 12818, pp. 19-22). SPIE.
2. Amaro, J. S., de Oliveira Júnior, J. K., de Oliveira, M. A. C., de Sousa, R. V., Amaro, J. B. S., Barnabé, L. É. G., & Marinho-Vieira, L. E. (2022). Fotobiomodulação como tratamento auxiliar de mucosite oral em pacientes submetidos a tratamentos antineoplásicos: revisão integrativa. Research, Society and Development, 11(8), e15511830827-e15511830827.
3. Zadik, Y., Arany, P. R., Fregnani, E. R., Bossi, P., Antunes, H. S., Bensadoun, R. J., ... & Mucositis Study Group of the Multinational Association of Supportive Care in Cancer/International Society of Oral Oncology (MASCC/ISOO). (2019). Systematic review of photo biomodulation for the management of oral mucositis in cancer patients and clinical practice guidelines. Supportive Care in Cancer, 27, 3969-3983.
4. Cronshaw, M., Parker, S., Anagnostaki, E., Mylona, V., Lynch, E., & Grootveld, M. (2020).

Photobiomodulation and oral mucositis: a systematic review. Dentistry journal, 8(3), 87.

5. Gabriel, A. D. F., Soares, J. B., Kovalski, L. N. S., Curra, M., Pinto, M. B. R., Wagner, V. P., ... & Martins, M. D. (2025). Efficacy of extraoral photo biomodulation therapy in the management of oral mucositis in pediatric oncology patients: a preliminary study. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology, 139(2), e54.
6. Courtois, E., Bouleftour, W., Guy, J. B., Louati, S., Bensadoun, R. J., Rodriguez-Lafrasse, C., & Magné, N. (2021). Mechanisms of Photo Biomodulation (PBM) focused on oral mucositis prevention and treatment: a scoping review. BMC Oral Health, 21(1), 220.
7. Hafner, D., Hrast, P., Tomaževič, T., Jazbec, J., & Kavčič, M. (2023). Photobiomodulation for chemotherapy-induced oral mucositis in pediatric patients. Biomolecules, 13(3), 418.
8. Elkady, R. E., Khedr, R., Hassan, M., Bayoumy, S. E., Mahmoud, S., Hanafy, E., ... & Haddad, A. E. (2025). Photobiomodulation Therapy in the Prevention of Chemotherapy Induced Oral Mucositis in Children with Acute Myeloid Leukemia: A Randomized, Double-blind, Clinical trial. Pediatric Blood & Cancer, 72(1), e31400.
9. Fiwek, P., Emerich, K., Irga-Jaworska, N., & Pomiecko, D. (2022). Photobiomodulation Treatment in Chemotherapy-Induced Oral Mucositis in Young Hematological Patients—A Pilot Study. Medicina, 58(8), 1023.
10. Fiwek, P., Emerich, K., Irga-Jaworska, N., & Pomiecko, D. (2022). Photobiomodulation Treatment in Chemotherapy-Induced Oral Mucositis in Young Hematological Patients—A Pilot Study. Medicina, 58(8), 1023.
11. Adnan, A., Yaroslavsky, A. N., Carroll, J. D., Selting, W., Juliano, A. F., London, W. B., ... & Treister, N. S. (2021). The path to an evidence-based treatment protocol for extraoral photo biomodulation therapy for the prevention of oral mucositis. Frontiers in Oral Health, 2, 689386.
12. Kauark-Fontes, E., Migliorati, C. A., Epstein, J. B., Treister, N. S., Alves, C. G. B., Faria, K. M., ... & Santos-Silva, A. R. (2022). Extraoral photobiomodulation for prevention of oral and oropharyngeal mucositis in head and neck cancer patients: interim analysis of a randomized, double-blind, clinical trial. Supportive care in cancer, 1-12.
13. Shen, B., Zhou, Y., Wu, D., & Liu, J. (2024). Efficacy of photobiomodulation therapy in the management of oral mucositis in patients with head and neck cancer: A systematic review and meta-analysis of randomized controlled trials. Head & Neck, 46(4), 936-950.
14. Parra-Rojas, S., Cassol Spanemberg, J., del Mar Díaz-Robayna, N., Peralta-Mamani, M., & Velázquez Cayón, R. T. (2024). Assessing the Cost-Effectiveness of Photobiomodulation for Oral Mucositis Prevention and Treatment: A Systematic Review. Biomedicines, 12(10), 2366.
15. Yaroslavsky, A. N., Iorizzo, T. W., Juliano, A. F., Adnan, A., Carroll, J. D., Sonis, S. T., ... & Treister, N. S. (2023). Monte Carlo based dosimetry of extraoral photobiomodulation for prevention of oral mucositis. Scientific Reports, 13(1), 20425.
16. Yang, W., Sourvanos, D., Dimofte, A., Busch, T. M., Arany, P., Schoenbaum, T., ... & Zhu, T. C. (2025, March). Monte Carlo simulation of temperature distribution for skin tissue during photobiomodulation. In Mechanisms of Photobiomodulation Therapy XIX (Vol. 13297, pp. 17-24). SPIE.