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[Case Study] Photobiomodulation (PBMT) and Its Interface with Sleep Dentistry: Clinical Case Report

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Abstract

Introduction: This study aimed to evaluate and raise the therapeutic hypothesis of the use Photobiomodulation (PBMT) as a complementary therapy in patients with sleep disorder (SD) in a broad approach involving other pathologies superimposed on this pathology.

Methods: This is a clinical case report of a patient with Parkinson's disease (PD) complaining of sleep disorder. The proposed treatment is the use of photobiomodulation (PBMT) with intraoral application using an innovative dosimetry. SD was assessed using an adapted analogue scale.

Results: In the evaluation performed after the last session, there was an improvement in the sleep disorder compared to the pre-treatment evaluation. However, one month after the end of the treatment, it was observed that the quality of sleep remained practically the same.

Conclusion: The results of the present study suggest that photobiomodulation could become a new therapeutic perspective for the treatment of sleep disorders (SD). However, controlled, and randomized clinical studies must be carried out to strengthen and confirm the evidence observed in this case report.

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Introduction

Photobiomodulation (PBMT) has been used in modern medicine for the treatment of chronic diseases, emerging as an innovative therapy considered complementary or alternative.[1] There are several reports of the use of photobiomodulation in the literature for the treatment of pathologies of neural origin since the last century,[1] The knowledge in photobiomodulation therapies has increased with great scientific evidence and our outpatient clinical experience has indicated that this therapy can bring benefits to the treatment of sleep disorders (SD)[2] PBMT alone has neural effects with anti-algic effects proven in the literature[1] and our recent research has shown that it is also effective for inducing sleep (unpublished data). PBMT can also be combined with medications and food supplements, producing synergistic effects to these therapeutic substances, sometimes reducing the dosimetry of these substances, and reducing the adverse effects of these substances on the patient.[3]

An increase in anxiety in the general population has been increasingly observed daily, with one of the main effects of this disorder being the origin of sleep disorders.[4] Many patients who come to medical and dental clinics with the main complaint of sleep disorder may sometimes be related to obstructive sleep apnea, among other causes.[3][4][5][6]

Often, the dental professional together with medical professionals makes a careful evaluation through Malan Pah index, polysomnography, among other tests to better diagnose the sleep disorder. In this evaluation of this patient with Parkinson's disease with application through the oral cavity of photobiomodulation, we raised the hypothesis of production of neurotransmitters that may benefit the induction of sleep in these patients with SD.[1]

The dentist treats these patients with occlusal jaw advancement plates, allowing more air to pass through their nasopharyngeal cavity.[4][7][8][9][10][11] This leads to a greater amount of oxygen to the lungs which will also improve the delivery of oxygen to the brain preventing micro awakenings that cause an increase in the heart rate, promoting long-term cardiovascular disorders in this patient. This clinical condition can lead to death. In addition, SD also decreases your quality of life due to the sleepiness you have during the day due to not having restorative sleep. Therefore, the possibility of using photobiomodulation as a complementary therapy for SD is suggested[1][12] along with other known therapies to improve the quality of life of patients with sleep disorders. [2]

Case Report

Patient R.O.M, 57 years old, female, (Figure 1) received at Ambulatory from the Santa Casa de Misericordia de São

Carlos in partnership with the Biophotonic Laboratory of the Institute of Physics of São Carlos at the University of São Paulo, for treatment of SD related to Parkinson's disease (PD) in July 2023.

Figure 1. Shows patient R.O.M, 57 years old and female.

The patient was evaluated using the Parkinson's assessment questionnaire using the MONTREAL COGNITIVE ASSESSMENT (MOCA) and the Unified Parkinson's Disease Rating Scale (UPDRS), to characterize the clinical condition. The patient takes the following medications: phenytoin, amitriptyline, escitalopram, nimesulide. The patient's main complaints were tremor, very strong physical pain, fatigue, and difficulty sleeping.

Clinical observational assessment was carried out using an analogue scale adapted for sleep disturbance before the start of treatment, in the last session and 30 days after the end of treatment. Throughout the treatment, all complaints or improvements self-reported by the patient were noted. The photobiomodulation treatment was carried out with the iLi2 Infrared Laser DUO MM Optics (São Carlos - SP, Brazil) for 20 minutes inside the oral. Figure 2 is a visual representation

of the photobiomodulation application area, which corresponds to the transpalatal region, with the inclination of the light beam directed towards the pituitary gland. The area of application was adapted from studies of Hamblin.[1]

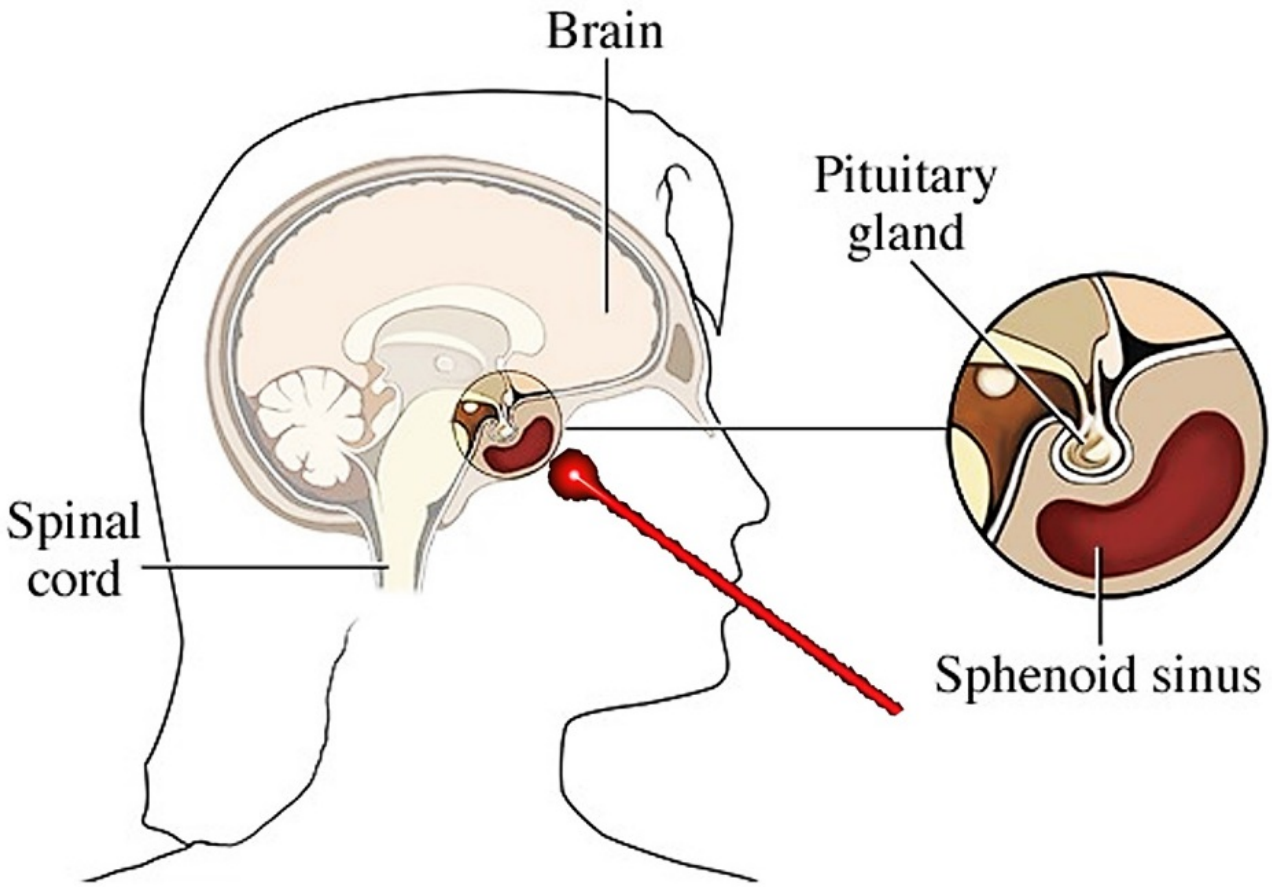

Figure 2. Shows an adapted (Medical Illustration Copyright© 2020 Nucleus Medical Media. All rights reserved) drawing of the exact transpalatal location where the laser spot was applied.

The iLi2 Infrared DUO MMO Laser has 150 mW of power and was applied to the intraoral cavity with an infrared wavelength (808 nm) for 20 minutes, delivering a total energy of 180 J per session. The laser beam area was 0,03 cm². The fluence was 6.000 J/cm2 and irradiance was 5 W/cm2. The treatment protocol consisted of 2 weekly sessions (Monday and Thursday) performed for 3 months (33 sessions). This protocol was developed by the researchers based on previous studies[13][14][15]

This case report is part of a research project approved by the Ethics Committee of Santa Casa de Misericordia de São Carlos with CAAE: 66448722.2.1001.8148 across nº 6.005.480.

Results and Discussion

Before treatment, an adapted assessment for DS was carried out based on a visual analogue scale (VAS), where the

patient assigned a score of 4, where 10 (ten) corresponds to normal sleep and a score of 0 (zero) corresponding to the bad situation relative to normal sleep.

Throughout each session, researchers recorded the patient's spontaneous reports of perceived improvements in tremor and muscle stiffness. After the last session, the patient obtained a score of 8 on the adapted visual analogue scale (VAS), which corresponds to better quality of sleep. One month after treatment, the sleep disorder was reassessed and the score given was 9, indicating continued improvement in sleep quality.

PD is a neurodegenerative, progressive, multifactorial and multisystemic disease, characterized by the reduction of dopaminergic neurons. PD generates motor symptoms such as: muscle rigidity, resting tremors and postural instability and non-motor symptoms such as: chronic pain, autonomic dysfunction, cognitive impairment, neurobehavioral disorders, and sleep changes.[16][17][18][19] Furthermore, one of the most prevalent non-motor symptoms are sleep disorders, whose etiology is associated with circadian dysregulation, and which have been associated with the rapid deterioration of postural control, impairments in manual dexterity and gait.[20][21]

There is still no treatment capable of reversing the neuronal degeneration resulting from Parkinson's. Existing treatments make it possible to improve or control motor and non-motor symptoms, through pharmacological, non-pharmacological, surgical, and alternative treatments.[18]

In this context, photobiomodulation has been associated with neuroprotective effects through anti-inflammatory and antioxidant actions. In this context, previous studies have demonstrated that photobiomodulation promotes improvements in sleep duration, efficiency, and general sleep quality.[22][23]

It should be noted that when photobiomodulation was applied for several minutes in cancer patients or those with a previous history of oncological pathologies, the application time should be reduced as much as possible. The literature shows that a systemic effect can occur on the patient through this therapy due to the shutdown of nitrous oxide in the blood circulation, which increases blood supply to tissues and can worsen the cancerous manifestation in organs compromised by this pathology.[24]

Therefore, the clinical results observed in the present case report corroborate previous studies that postulate the clinical effects of photobiomodulation on sleep disorders. Given these findings, new studies should be carried out, in which patients use the Epworth Index, which is widely used for SD research, as it is an easy-to-complete assessment in the responses of patients with different levels of education.[25]

As this is a case report, the possible placebo effect of photobiomodulation on the patient was not controlled, which is considered a limitation of the study. Another limitation found was the lack of randomized and controlled clinical studies that used photobiomodulation protocols in the treatment of sleep disorders, whether related to neurodegenerative diseases, such as Parkinson's.

Conclusion

The results of the present case study suggest that photobiomodulation could become a new therapeutic perspective for the treatment of sleep disorders. However, controlled and randomized clinical studies must be carried out to strengthen and confirm the evidence observed in this case report.

Statements and Declarations

Author Contributions

Vitor Hugo Panhoca and Marcela Sene-Fiorese were involved with writing— original draft. Carolina Alvarez, Vitor Hugo Panhóca and Carolina de Almeida Gianini were involved with patient treatment. Vitor Hugo Panhoca, Viviane Brocca de Souza, Simone Aparecida Ferreira and Marcela Sene-Fiorese were involved in conception of research, review, and editing. Vanderlei Salvador Bagnato he maintained the research with support through funding funds to projects.

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Conflicts of Interest

The authors declare no conflicts of interest.

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

About the Authors

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- Graduated in Dentistry from the Faculty of Dentistry of the Federal University of Rio

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- Master's in Biotechnology from UFSCar. PhD in Biotechnology from UFSCar.
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- Qualified in LASER THERAPY by the Federal Council of Dentistry (Brazil).
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- Has experience around Physics, with an emphasis on Biophotonics.
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