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CASE REPORT

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Photobiomodulation therapy for persistent neurosensory disorders after orthognathic surgery: a case report

Terapia de fotobiomodulação para distúrbios neurossensoriais persistentes após cirurgia ortognática: relato de caso

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ABSTRACT

Objective: Orthognathic surgery is widely used to correct dentofacial deformities, but it can lead to postoperative neurosensory complications, such as paresthesia, which can significantly affect quality of life. This case report evaluates photobiomodulation therapy (PBMT) as a non-invasive intervention for persistent inferior alveolar nerve paresthesia refractory to conventional therapies. **Case report:** A 26-year-old woman with chronic neurosensory disorder after orthognathic surgery underwent PBMT with an 808 nm diode laser (Therapy XT, DMC®, continuous mode, in contact), spot area of 0.098 cm^2, power of 100 mW and energy density of 1.02 W/cm^2. The protocol consisted of ten consecutive sessions, performed with a seven-day interval between each application. Irradiation included 34 extraoral and 10 intraoral points, spaced 1 cm apart. The progressive dosimetry protocol was used: 2 J per point (initial 4 sessions) and 4 J per point (subsequent sessions), totaling 10 sessions. The reduced initial values of 30-60 (chin) and 10 (lower lip) evolved to 80-90 on the progressive sensitivity scale in the previously compromised areas, with no reports of adverse effects. **Conclusion:** This case report suggests the potential effectiveness of PBMT as a treatment for long-standing postoperative paresthesia; however, the findings are preliminary and cannot be generalized to all patients. Further controlled clinical studies are needed to confirm efficacy and support protocol standardization.

KEYWORDS

Case report; Low-level light therapy; Mandibular nerve; Orthognathic surgery; Paresthesia.

RESUMO

Objetivo: A cirurgia ortognática é amplamente utilizada para corrigir deformidades dentofaciais, mas pode levar a complicações neurossensoriais pós-operatórias, como parestesia, que podem afetar significativamente a qualidade de vida. Este relato de caso avalia a terapia de fotobiomodulação (PBMT) como uma intervenção não invasiva para parestesia persistente do nervo alveolar inferior refratária às terapias convencionais. **Relato de caso:** Uma mulher de 26 anos com distúrbio neurossensorial crônico após cirurgia ortognática foi submetida a PBMT com um laser de diodo de 808 nm (Therapy XT, DMC®, modo contínuo, em contato), área de spot de 0,098 cm^2, potência de 100 mW e densidade de energia de 1,02 W/cm^2. O protocolo consistiu em dez sessões consecutivas, realizadas com intervalo de sete dias entre cada aplicação. A irradiação contemplou 34 pontos extraorais e 10 intraorais, espaçados em 1 cm. Utilizou-se o protocolo de dosimetria progressiva: 2 J por ponto (4 sessões iniciais) e 4 J por ponto (sessões subsequentes), totalizando 10 sessões. Os valores iniciais reduzidos de 30 - 60 (mento) e 10 (lábio inferior) evoluíram para 80 - 90 na escala progressiva de sensibilidade nas áreas previamente comprometidas, sem relatos de efeitos adversos. **Conclusão:** Este relato de caso sugere a potencial eficácia da PBMT como tratamento para parestesia pós-operatória de longa duração, no entanto, os achados são preliminares e não podem ser generalizados para todos os pacientes. Mais estudos clínicos controlados são necessários para confirmar a eficácia e embasar a padronização do protocolo.

PALAVRAS-CHAVE

Relato de caso; Terapia de luz de baixa intensidade; Nervo mandibular, Cirurgia ortognática; Parestesia.

INTRODUCTION

Surgeons frequently perform orthognathic surgery to correct dentofacial deformities, improving both function and aesthetics. Nevertheless, postoperative neurosensory complications, notably inferior alveolar nerve paresthesia, remain clinically relevant.. This case report presents a structured therapeutic approach for persistent paresthesia after orthognathic surgery and suggests the potential efficacy of photobiomodulation therapy (PBMT) when conventional strategies are insufficient [1-3].

Researchers have proposed several approaches to address neurosensory deficits, including pharmacologic interventions (e.g., corticosteroids, B-complex vitamins), acupuncture, physiotherapy, and microsurgical nerve repair [4,5]. Variable outcomes and limited durability have motivated interest in adjunctive modalities such as PBMT.

Researchers have investigated PBMT for its capacity to modulate mitochondrial activity, attenuate inflammation, and support tissue repair. Its noninvasive profile and favorable safety record make it a plausible adjunct for neurosensory disorders following third-molar extraction, dental implant placement, or orthognathic surgery [6,7]. However, heterogeneity in parameters and protocols hampers reproducibility and direct comparison across studies. Preclinical and clinical observations support further research to clarify long-term effects, relapse risk, and optimal dosing schedules, and to advance greater reproducibility and standardization in PBMT [8].

This case report describes an unusual and clinically challenging scenario: a patient who remained with persistent neurosensory deficit for more than two years after orthognathic surgery, despite undergoing other rehabilitation modalities such as physiotherapy and acupuncture. Chronic paresthesia of such duration is generally associated with a limited prognosis for spontaneous recovery, making therapeutic intervention essential. The implementation of a structured Photobiomodulation Therapy (PBMT) protocol in this context offers a valuable clinical perspective on a non-invasive approach to late-stage neural rehabilitation. In addition to treating a refractory condition, this case contributes exploratory evidence that can inform future clinical protocols and expand therapeutic strategies for long-standing inferior alveolar nerve injuries.

MATERIALS AND METHODS

This case report was based on clinical data from a patient with persistent inferior alveolar nerve paresthesia following orthognathic surgery, treated at the Integrated Dentistry Clinic of the Catholic University of Brasília, Brazil.

The authors prepared this case report in accordance with the CARE guidelines [9].

The Research Ethics Committee of the Catholic University of Brasília approved the study (CAAE: 86495225.5.0000.0029). The patient provided written informed consent for treatment and for the use of clinical data and images for publication.

As shown in Table I, the PBMT protocol was delivered with an 808-nm diode laser (Therapy XT, DMC, São Carlos, Brazil) over ten sessions, performed once weekly for ten consecutive weeks, in continuous wave mode. We applied fixed energy densities of 20.4 J/cm^2 (2 J per point) for the first four sessions and 40.8 J/cm^2 (4 J per point) for the last six sessions. The parameters included a power of 0.1 W, a spot size of 0.098 cm^2, and an irradiance of approximately 1.02 W/cm^2. A total of 34 extraoral and 10 intraoral points were irradiated, spaced 1 cm apart; the exposure time per point ranged from 20 to 40 seconds, according to the prescribed energy per point. The laser tip was applied in direct contact with the skin or mucosa, using the manufacturer-provided spacer to minimize beam divergence and ensure accurate energy delivery. The procedure was standardized in this manner for all sessions. All procedures followed standard biosafety protocols.

Table I - Laser parameters used in the treatment of paresthesia

Parameter	Value
Wavelength (nm)	808
Power (W)	0,1
Energy per point (J)	2 and 4
Exposure time (sec)	20 and 40
Emission mode	Continuous
Equipment tip-tissue distance	Contact
Spot size (cm^2)	0.098
Energy density (J/cm^2)	20.4 and 40.8
Power density (W/cm^2)	1.02
Number of points	34 extraoral + 10 intraoral

To monitor outcomes, we assessed sensory perception using an adapted 0–100 Visual Analogue Scale (VAS). We acknowledge that this modification is not validated for paresthesia; however, we employed it in an exploratory manner to capture the patient's subjective perception of neurosensory improvement throughout treatment. This approach provided a practical tool for documenting clinical evolution from a patient-centered perspective, while acknowledging its limitations as a standardized outcome measure.

CASE REPORT

A 26-year-old female patient was referred to our department with a persistent tingling sensation in her chin and lower lip (mainly on the right) since undergoing orthognathic surgery in 2021. Sensory loss became evident and persisted for 2 years, despite treatment with 10 physiotherapy sessions and 10 acupuncture sessions, which did not show significant improvement. The patient had no medical history of systemic disorders. The patient shared a detailed history that included her initial complaints after surgery. The patient provided a concise postoperative history detailing prior conservative treatments and persistent symptoms, which contextualized the chronic course.

At the first consultation at the integrated dental clinic of the Catholic University of Brasília, a sensory examination revealed reduced sensation in the chin and lower lip on the right side.

Treatment was performed using a GaAlAs infrared diode laser (Therapy XT®, DMC, São Carlos, Brazil), 808 nm, 100 mW, continuous mode, in contact, with a spot size of 0.098 cm^2 and irradiance of 1.02 W/cm^2. A progressive-dose PBMT protocol was adopted to optimize late-phase neural responsiveness. Irradiation was applied both extraorally and intraorally along the trajectory of the inferior alveolar nerve, covering 44 points in total (34 extraoral and 10 intraoral), spaced 1 cm apart. During the first four sessions, 2 J were delivered per point (20 s; 20.4 J/cm^2), followed by 4 J per point (40 s; 40.8 J/cm^2) in the remaining six sessions, performed once weekly over ten consecutive weeks. Figure 1 illustrates the equipment used (Figure 1A) and the distribution of the extraoral (Figure 1B) and intraoral irradiation points (Figure 1C).

Although the researchers did not conduct statistical analysis due to the single-patient design, they monitored clinical evolution and treatment response through repeated VAS measurements across multiple sessions. The observed improvement suggests that PBMT may provide potential benefit in managing persistent paresthesia.

The clinicians reported no adverse effects, corroborating the safety profile of PBMT. As previously mentioned, the patient progressively noticed the initial effects of PBMT throughout the sessions. The clinicians analyzed the evolution of sensory recovery using the Visual Analogue Scale (VAS) based on the data presented in Table II. They observed a significant improvement in sensitivity when comparing baseline with the final session. The left chin region increased from 60 to 90, the right chin from 30 to 80, and the lower lip from 10 to 90 on the VAS (0–100), indicating substantial sensory recovery over ten sessions.

The patient reported progressive improvement in neurosensory perception throughout the photobiomodulation therapy. She described the sessions as comfortable and painless, noting that the treatment contributed to both functional recovery and emotional relief after a prolonged period of altered sensitivity. At the end of the ten sessions, she expressed satisfaction with the results, considering the therapy well tolerated and effective in restoring confidence and improving her quality of life.

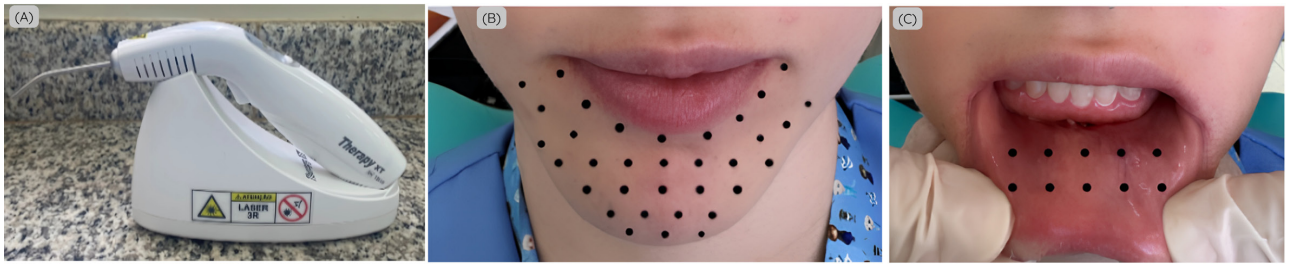

Figure 1 - (A) Schematic illustration of the 808-nm diode laser (Therapy XT, DMC) used in continuous mode; (B) distribution of 34 extraoral points over the chin region; (C) 10 intraoral points along the lower lip mucosa. All points were spaced 1 cm apart.

Table II - Sensory Sensitivity per Session Assessed by the Visual Analogue Scale (VAS 0–100)

Session	Chin (left)	Chin (right)	Lower lip (left)	Lower lip (right)
Baseline	60	30	10	10
1	60	30	20	10
2	60	40	40	30
3	70	60	70	60
4	80	60	70	60
5	80	60	70	60
6	80	70	80	70
7	90	80	80	70
8	90	80	90	80
9	90	80	90	90
10	90	80	90	90
% of improvement	**30**	**50**	**80**	**80**

DISCUSSION

The study contributes to the published literature that supports the clinical use of photobiomodulation therapy (PBMT) for managing persistent orofacial paresthesia after orthognathic surgery. The clinical relevance of this case lies in the chronic sensory disturbance (more than 2 years) and the ineffectiveness of other treatment alternatives, such as physical therapy and acupuncture. This extensive sensory recovery observed with PBMT after such a long time exemplifies the potential of this modality in typically treatment-refractory conditions [1,2,10,11].

Case reports and clinical case series have cited the advantages of PBMT for promoting neural regeneration. For example, among cases of oral paresthesia treated with low-level laser therapy in 125 patients, sensory improvement was revealed in individuals with delayed nerve damage [4]. Researchers have reported similarly beneficial results in patients with neurosensory deficits following third molar surgeries and dental implant procedures [3]. However, the use of PBMT in cases with long-lasting paresthesia, such as the current case, appears to be poorly described and, therefore, this case appears to be particularly relevant [1,2,7,12].

Furthermore, the present case illustrates that PBMT is low-risk and noninvasive, and it can be integrated into routine clinical dental practice. The patient did not experience any complications and tolerated the protocol without any problems.

The effect of PBMT is based on the absorption of photons by the chromophores in the tissue, initiating a series of biochemical reactions that result in tissue reparation. One of the key molecules targeted is cytochrome c oxidase, a key mitochondrial enzyme involved in oxidative phosphorylation, which, when activated, enhances ATP production. This molecule provides energy to the metabolic reactions of each cell. Higher and lower doses of different types of PBMT can also modulate the production of reactive oxygen species (ROS) and nitric oxide (NO), resulting in less oxidative stress and inflammation. These events are key mechanisms underlying the beneficial effects of PBMT on neuroregeneration, as the ability to regenerate nerve tissues and inflammation locally at the injured site has been improved [1,2,13,14].

Despite its effectiveness, the application of PBMT still presents notable limitations. One of the primary challenges is the absence of well-established therapeutic protocols. Current evidence indicates significant variability in laser parameters, including wavelength, energy density, and treatment duration, which remain largely empirical and arbitrary in most clinical settings. For instance, this issue was emphasized in a systematic review, highlighting that although PBMT showed promising results for treating iatrogenic late paresthesia, the lack of standardization across studies impeded consistent outcome comparisons and clinical recommendations [15]. Furthermore, clinical outcomes also vary according to the type and severity of nerve injury. Cases with preserved axonal continuity tend to recover better. They may

be more responsive to PBMT, whereas complete discontinuities often require surgical repair and show limited potential for functional recovery with PBMT alone. This variability is coherent with PBMT's proposed mechanisms enhancing mitochondrial bioenergetics, modulating nitric oxide and reactive oxygen species, and supporting microvascular repair which presuppose residual regenerative capacity. Accordingly, future studies should stratify patients by injury pattern to better define dose–response relationships and establish reproducible protocols [3,5,10,12,13,14,16,17].

Several studies have widely demonstrated that photobiomodulation therapy (PBMT) alleviates painful symptoms and stimulates tissue healing. Laser emitted light energy penetrates biological tissues and triggers a series of cellular events that, among other effects, modulate inflammation and reduce oxidative stress. This immune response involves the induction of anti-inflammatory cytokines, including IL-10, and the inhibition of proinflammatory effects or molecules, resulting ultimately in decreased tissue damage and facilitation of tissue repair [10,18].

Although we detected some cases of spontaneous remission, this is usually incomplete and requires additional therapeutic strategies. Researchers have suggested PBMT as a possible alternative [1-3,19].

During PBMT protocols, the constantly raised sensitivity implies that this therapy might constitute a valuable intervention for neural rehabilitation, also in a clinically relevant condition such as persistent paresthesia. The literature has reported that PBMT significantly shortens the recovery time and improves neurosensory function for patients [7,17,20].

Despite some limitations, which can be addressed, other authors and researchers could replicate similar cases, showing that it is possible to replicate. More studies, particularly in therapy randomized controlled trials, are required to identify optimal regimens and demonstrate the long-term efficacy of this therapy [16].

It is essential to note that the present study is a single-patient case report, which represents a relatively low level of evidence compared to clinical trials or systematic reviews. Its findings should therefore be regarded as exploratory and hypothesis-generating, not confirmatory. Moreover, the absence of a control group and the reliance on a subjective, non-validated adaptation of the Visual Analogue Scale (VAS) for neurosensory assessment are important limitations that restrict generalizability. These aspects highlight the need for cautious interpretation and reinforce the importance of future controlled studies to confirm and expand these observations. Considering its noninvasive profile and favorable safety record, PBMT emerges as a promising adjunct for persistent postoperative paresthesia. Nevertheless, patient selection, injury severity, and timing likely influence outcomes. Controlled studies are required to confirm effectiveness and to define standardized, reproducible protocols.

CONCLUSION

The photobiomodulation therapy (PBMT) protocol with progressive dosimetry demonstrated clinically meaningful neurosensory recovery in a chronic case of inferior alveolar nerve paresthesia refractory to conventional therapies. The treatment was safe, well tolerated, and resulted in a substantial improvement in functional sensitivity after long-standing postoperative impairment. Although these findings highlight the therapeutic potential of PBMT for persistent neurosensory deficits, they must be interpreted cautiously, as this is a single patient case report. Controlled clinical trials with standardized parameters are essential to validate these observations and support evidence-based clinical guidelines.

Author's Contributions

RRTBA: Conceptualization, Methodology, Software, Validation, Formal Analysis, Investigation, Resources, Data Curation, Writing – Original Draft Preparation, Writing – Review & Editing, Visualization, Supervision, Project Administration. AMCS: Software, Validation, Formal Analysis, Investigation, Resources, Data Curation, Writing – Original Draft Preparation, Writing – Review & Editing, Visualization, Supervision, Project Administration. GGS: Software, Validation, Formal Analysis, Investigation, Resources, Data Curation, Writing – Original Draft Preparation, Writing – Review & Editing, Visualization, Supervision, Project Administration. EMGLD: Conceptualization, Methodology, Software, Validation, Formal Analysis, Investigation, Resources, Data Curation, Writing – Original Draft Preparation, Writing – Review & Editing, Visualization, Supervision, Project Administration.

Conflict of Interest

The authors declare that there are no conflicts of interest. No external funding agency was involved in the study's design, data collection, analysis, interpretation, manuscript writing, or decision to publish the results.

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Regulatory Statement

The researchers conducted this study by all guidelines and policies established by the local human subjects oversight committee at the Catholic University of Brasília. The Research Ethics Committee of the Catholic University of Brasília (CEP/UCB) reviewed and approved the study protocol under approval number 7.509.923 (CAAE: 86495225.5.0000.0029).

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