

The effects of photobiomodulation therapy for the treatment of dentin hypersensitivity

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ABSTRACT | *Objective:* This case report proposes a treatment for dentin hypersensitivity (DH) using photobiomodulation (PBT) with low power diode laser. *Methods and Results:* Male patient, 28 years old, reporting “dental sensitivity,” diagnosed by anamnesis and intraoral examination, with non-carious cervical lesions (NCCL) and DH on teeth 15 to 25, with different pain intensities, measured with visual analogue scale (VAS). For DH treatment, a PBT was proposed, with 808nm, 100mW, 20s and 2J of energy, applied during 3 sessions, with one-week interval and reevaluation after 30 days. After the first session, the patient reported improvement of sensitivity in all teeth, except for 15, that remained sensitive even during the reevaluation. *Conclusion:* PBT was effective in DH treatment, with desensitization being observed for 30 days in 90% of treated teeth.

DESCRIPTORS | Dentin Sensitivity; Laser Therapy; Lasers.

RESUMO | **Os efeitos da terapia de fotobiomodulação no tratamento da hipersensibilidade dentinária** • *Objetivo:* Este relato de caso propõe um tratamento para a hipersensibilidade dentinária (HD) usando fotobiomodulação (FBM) com laser de diodo de baixa potência. *Métodos e Resultados:* Paciente do sexo masculino, 28 anos, relatando “sensibilidade da dentina”, diagnosticado por anamnese e exame intraoral, com lesões cervicais não cariosas (LCNC) e HD nos dentes 15 a 25, com diferentes intensidades de dor, medidas com escala visual analógica (EVA). Para o tratamento da HD, foi proposto uma FBM, com 808nm, 100mW, 20s e 2J de energia, aplicada durante 3 sessões, com intervalo de uma semana e reavaliação após 30 dias. Após a primeira sessão, o paciente relatou melhora da sensibilidade em todos os dentes, exceto no 15, que permaneceu sensível mesmo durante a reavaliação. *Conclusão:* FBM foi eficaz no tratamento da HD, com dessensibilização sendo observada por 30 dias em 90% dos dentes tratados.

DESCRIPTORES | Sensibilidade da Dentina; Terapia a Laser; Lasers.

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INTRODUCTION

Dentin hypersensitivity (DH) is characterized as a short-term, acute pain in response for several external stimuli that cannot be attributed to any other dental pathology.^{1,2}

Dentin exposure in the cervical region can be caused by dental wear such as abrasions, erosion, and abfraction,³ as well as gingival recession, possibly causing DH.⁴ External stimuli, which may be evaporative, thermal, osmotic and tactile, may expose dentin from mild discomfort to extreme pain, affecting patient's eating habits and oral hygiene, and even negatively affect their quality of life.⁵

The hydrodynamic theory proposed by Brännström and Aström⁶ is currently the most accepted theory to explain the mechanism of pain of DH due to dentin exposure. According to this theory, physical stimuli promote a movement of the dentinal fluid inside dentinal tubules, leading to the contraction or distension of the odontoblastic processes that stimulate nerve fibers present at the dentin-pulp interface, which cause sensation of pain.⁶⁻⁸

Treatment approaches have been targeted according to the severity of pain. The use of desensitizing agents by the patient at home such as the use of fluoride-containing dentifrices and/or potassium nitrate⁹ represents one of the treatment alternatives, as well as therapies performed by the dentist, with the application of fluoride varnishes, glutaraldehyde, binding agents, sealants, oxalates,³ restorative materials and even photobiomodulation therapy (PBT) through the application of low-power lasers.^{10,11}

PBT causes direct action on nerve impulse conduction, as it acts on the Na⁺/K⁺ pump, interfering in the polarity of the cell membrane and blocking the transmission of the pain impulse, without temperature increase.¹² This treatment also stimulates circulation and cell activity, acting on the biomodulation, forming reactive dentin¹⁰ and resulting in an analgesic and modulating action of the inflammatory process.^{13,14,15}

Thus, this clinical case aims to propose a treatment for DH using PBT with diode semiconductor lasers.

CASE REPORT

This clinical case shows the application of the association of PBT with a glass ionomer cement restoration for DH treatment. A 28-year-old men sought the Clinic of Laser in Dentistry with a major complaint of “dental sensitivity” in several teeth. During anamnesis, the patient reported avoiding the intake of cold and acidic foods and drinks to prevent pain.

After clinical examination, no pathology was identified. However, the presence of non-carious cervical lesions (NCCL) involving teeth 11,12,13,14,15, 21, 22, 23, 24 and 25 was observed (Figure 1).



Figure 1 | Initial evaluation of non-carious cervical lesions.

Thus, a specific examination was performed to detect DH, measuring the pain intensity of these teeth. Initially, this examination consisted of a tactile test, performed in a standardized way by the same examiner with the use of a probe applied perpendicular through the exposed dentin region (buccal and / or lingual surfaces), from mesial to distal direction, with light pressure.¹⁶

Subsequently, a test to identify cold-air sensitivity was performed by applying an air spray, perpendicular to the exposed dentin at approximately 1 cm for 3 seconds¹⁶ (Figure 2). A visual analogue scale (VAS) was used to identify through scores (0-10) the degree of discomfort

reported by the patient before and after the evaporative stimuli with the triple syringe (Figure 2). These scores are shown in Table 1 and compared with the scores found after treatment.



Figure 2 | Evaporative test performed with triple syringe on each dental element.

After DH diagnosis, a weekly treatment with 3 sessions of PBT was proposed, with re-evaluation after 30 days of the end of the third session. The patient was elucidated about the proposed treatment using low-power laser, which only started after he signed an informed consent form.

As clinical protocol, low-power diode laser (GaAlAs, MMoptics®, Laser Duo, São Carlos, SP,

Brazil) was used with the following parameters: wavelength of 808 nm (infrared), 2J energy per point, 20 seconds, 100 mW. The laser was applied in four points in each tooth: three points in the cervical region (mesial, medial and distal) and one point in the apical region^{10,17} (Figure 3). At the end of each session, a new evaporative test was performed to reevaluate the degree of sensitivity after therapy.

The patient reported improvement of sensitivity since the first session. In the second and third sessions, only one tooth 15 (score 8) presented the same degree of sensitivity reported at the diagnosis. In the third session, based on reports of improvement already presented by the other teeth in previous sessions, only teeth 11,14,15, 22, 23 and 25 were irradiated.

At the end of the 3 sessions, the patient reported some discomfort only in tooth 15; however, he already could ingest cold and acidic drinks without the pain described at the beginning of the treatment. After 30 days of the last session, reevaluation was performed with evaporative test and the degree of sensitivity was measured. Currently, only tooth 15 presented score 7 of sensitivity, showing desensitization in 90% of teeth.

Table 1 | Degree of sensitivity reported for each tooth, using the visual analogue scale, after each photobiomodulation therapy session and reevaluation.

Degree of sensitivity Tooth	1 st session		2 nd session		3 rd session		Reevaluation
	Initial	Final	Initial	Final	Initial	Final	
11	1	0	0	0	2	0	
12	1	0	1	0	1	–	
13	3	0	2	0	1	–	
14	3	2	4	0	2	0	
15	8	5	8	3	8	4	
21	2	1	4	1	1	–	
22	2	0	2	0	2	1	0
23	4	0	2	1	2	1	1
24	6	2	2	1	1	–	2
25	6	1	1	1	2	1	1



Figure 3 | Low-power Diode Laser Application: Cervical point.

Thus, chemically activated glass ionomer cement (Maxxion R, FGM®, Joinville, SC, Brazil) was chosen to be used on tooth 15 (Figure 4). After the restorative procedure, the sensitivity reduced to score 2.



Figure 4 | Glass ionomer cement restoration on tooth 15.

DISCUSSION

Dentin hypersensitivity (DH) is classified as a painful response to different stimuli,^{18,19} which may occur at any age, with etiology and pathogenesis

associated or not with non-carious cervical lesions (abfraction, abrasion and erosion).^{3,20} Regarding prevalence, premolars are the most affected teeth.²¹

Treatments with desensitizing agents represent a great alternative for cases of DH; however, studies have shown that their results are not long-lasting,^{3,22-24} because the materials used have different mechanisms of action^{3,9,25} and depend on the patient's oral conditions and habits (masticatory overload).²⁶

Based on the literature, when using conventional desensitizers or restorative materials alone for cases of DH, few results are promising in the long term.^{3,22-24}

Despite its higher cost, laser treatment shows satisfactory clinical results in a shorter time interval, often obtained at the end of the first treatment session.^{10,27-34} Moreover, long periods of analgesia is observed after the end of treatment due to the repeated low-power laser sessions (on average four), unlike what is observed with other desensitization methods.³⁵ This clinical case presented its positive result and, therefore, showed the importance of this treatment for DH.

PDT presents action with neural effects, such as potassium desensitizing solutions, blocking the axonic action and the nervous stimulus, which prevents the transmission of pain signs to the central nervous system.³⁶

A systematic review carried out by Machado et al.²⁶ compared low-power laser therapy with placebo treatments for DH and other therapies performed at the dentist's office. They showed that the studies used different parameters, however, with punctual applications in 4 sessions and observed the effectiveness of this therapy immediately after irradiation. In this clinical case, a reduction in pain perception since the first session of therapy with low-power laser was observed, remaining even after 30 days of evaluation, with a single exception, which was the case of tooth 15.

The mechanism by which low-power laser therapy is effective is explained by the stimulation of the Na^+ / K^+ pump in cell membranes, which hyperpolarizes the membrane and increase the pain threshold and stimulate the odontoblasts, leading to higher production of tertiary dentin^{35,37} and biomodulation, activating the analgesic and modulatory effects on the inflammatory process.^{13,14}

According to the literature, low-power laser therapy for DH cases with diode semiconductor lasers using wavelengths in the range of 635-830 nm and dosages in the range of 2-10 J / cm² are safe for this purpose.³⁸ Thus, the parameters used in this clinical case are within this therapeutic window, and the treatment was successful in 90% of teeth.

For this case report, the visual analogue scale (VAS) was used to evaluate the patient's pain response, since the evaluation and quantification of this parameter in cases of DH is difficult. This scale is widely used, accepted and validated in literature for the evaluation of pain.^{10,27,36,39,40} A single dental air syringe stimulus was used because it was a clinically relevant measure, as described in other studies.^{39,41,42} As the patient did not report sensitivity to tactile tests with the exploratory probe in the 1st session, it was not necessary to use this stimulus as an evaluation procedure.

Treatment with PDT for DH has been promising due to the beneficial effects observed after its application. It is worth mentioning that even if the patient is in any type of treatment for the relief of pain caused by DH, treatment will only succeed if combined with the removal of the harmful stimulus causing the disease.⁵ For this reason, in this clinical case, the patient was educated to change some habits such as vigorous brushing and avoid brushing immediately after the consumption of acidic foods to avoid the progression of NCCL prior to treatment.

As the patient did not report discomfort with teeth aesthetics regarding the structural losses observed with the onset of NCCLs in tooth 15,

a direct restoration with glass ionomer cement (MaxxionR, FGM®, Joinville, SC, Brazil) was made because it was the only tooth that presented lesion depth greater than 1.5 mm without sensitivity remission after PDT. After restorative procedure, a new evaporative test was performed on this tooth, resulting in an effective pain reduction observed using the VAS scale.

The restorative material acts by obliterating dentinal tubules, which prevents the movement of the dentinal fluid (Branstrom's Theory),⁶ without temperature increase, which could cause irreversible damage to pulp or dentin.¹⁵ This is the reason why the association of low-power lasers with restorative materials is shown to be effective in the treatment of DH.

The protocol proposal in this study with low-power laser (within PDT), in the infrared range (808 nm), associated with restoration with chemically activated glass ionomer cement, in cases of dentinal loss greater than 1.5 mm deep, has been shown to be efficient in reducing dentin hypersensitivity and patient discomfort after 3 sessions, with desensitization remaining after 30 days of evaluation.

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