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Publication status: Not informed by the submitting author

Effect of ozonated sunflower oil on dentin hypersensitivity after basic periodontal therapy: a pilot randomized split-mouth clinical trial

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https://doi.org/10.1590/SciELOPreprints.18910

Submitted on: 2026-11-13
Posted on: 2026-11-13 (version 1)
(YYYY-MM-DD)

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e20260039

Original Article

Effect of ozonated sunflower oil on dentin hypersensitivity after basic periodontal therapy: a pilot randomized split-mouth clinical trial

Efeito do óleo de girassol ozonizado sobre a hipersensibilidade dentinária após terapia periodontal básica: ensaio clínico piloto randomizado do tipo boca dividida

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How to cite:
Tosta ME, Colognese MRV, Borchardt L, Nassar PO, Ueda JK, Camilotti V. Effect of ozonated sunflower oil on dentin hypersensitivity after basic periodontal therapy: a pilot randomized split-mouth clinical trial. Rev Odontol UNESP. 2026;55:e20260039. https://doi.org/

Resumo

Objetivo: Avaliar o efeito do óleo de girassol ozonizado como terapia adjuvante na hipersensibilidade dentinária e nos parâmetros clínicos periodontais após terapia periodontal básica. **Material e método:** Este ensaio clínico piloto, randomizado e de boca dividida, incluiu dez pacientes sistemicamente saudáveis que apresentavam hipersensibilidade dentinária após raspagem supragengival. Em cada participante, as duas arcadas foram aleatoriamente alocadas para receber, após a terapia periodontal básica, óleo de girassol ozonizado como tratamento adjuvante ou nenhum tratamento adicional (controle). A hipersensibilidade dentinária foi avaliada por meio de uma escala visual analógica. O índice de placa e o índice de sangramento gengival foram registrados no início do estudo (baseline) e após sete dias. Os dados foram analisados por meio do teste t para amostras pareadas, adotando-se nível de significância de 5%. **Resultado:** No acompanhamento de sete dias, as arcadas do grupo teste tratadas com óleo de girassol ozonizado como adjuvante apresentaram escores significativamente menores de hipersensibilidade dentinária em comparação às arcadas controle (1,30 ± 0,95 vs. 3,00 ± 0,94; $p < 0,001$). Reduções significativas também foram observadas no índice de placa (34,00 ± 17,76

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vs. 54,00 ± 20,11; p = 0,004) e no índice de sangramento gengival (15,00 ± 15,09 vs. 36,00 ± 24,59; p = 0,010). **Conclusão:** Dentro das limitações deste estudo piloto, o óleo de girassol ozonizado demonstrou potencial para reduzir a hipersensibilidade dentinária e melhorar os parâmetros clínicos periodontais após terapia periodontal básica. Ensaios clínicos randomizados adicionais, com amostras maiores e períodos de acompanhamento mais longos, são necessários para confirmar esses achados.

Descritores: Sensibilidade da dentina; dessensibilizantes dentinários; ozonioterapia; periodontia; índice de placa dentária; índice periodontal.

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Abstract

Objective: To evaluate the effect of adjunctive ozonated sunflower oil on dentin hypersensitivity and periodontal clinical parameters following basic periodontal therapy. **Material and method:** This pilot randomized split-mouth clinical trial included ten systemically healthy patients presenting dentin hypersensitivity after supragingival scaling. In each participant, the two arches were randomly allocated to receive either adjunctive ozonated sunflower oil or no adjunctive treatment after basic periodontal therapy. Dentin hypersensitivity was assessed using a visual analog scale. Plaque index and gingival bleeding index were recorded at baseline and after seven days. Data were analyzed using paired-sample t-tests, adopting a significance level of 5%. **Result:** At the seven-day follow-up, the test arches treated with adjunctive ozonated sunflower oil exhibited significantly lower dentin hypersensitivity scores than the control arches (1.30 ± 0.95 vs. 3.00 ± 0.94; $p < 0.001$). Significant reductions were also observed in plaque index (34.00 ± 17.76 vs. 54.00 ± 20.11; $p = 0.004$) and gingival bleeding index (15.00 ± 15.09 vs. 36.00 ± 24.59; $p = 0.010$). **Conclusion:** Within the limitations of this pilot study, ozonated sunflower oil demonstrated the potential to reduce dentin hypersensitivity and improve clinical periodontal parameters following basic periodontal therapy. Further randomized clinical trials with larger sample sizes and longer follow-up periods are required to confirm these findings.

Descriptors: Dentin sensitivity; dentin desensitizing agents; ozone therapy; periodontics; dental plaque index; periodontal index.

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INTRODUCTION

Dentin hypersensitivity (DH) is characterized by acute, short-term pain arising from exposed dentin in response to thermal, evaporative, tactile, or osmotic stimuli, which cannot be attributed to any other dental defect or pathology[1]. This condition is frequently observed after basic periodontal therapy, particularly following non-surgical periodontal treatment, as the resolution of inflammation, reduction of tissue edema, and subsequent soft-tissue remodeling may result in gingival margin displacement and root surface exposure[2]. Although contemporary periodontal instrumentation is aimed at disrupting and removing biofilm and calculus while preserving the root surface, the apical shift of the gingival margin can leave dentinal tubules exposed to the oral environment[2,3]. According to the hydrodynamic theory, these external stimuli induce fluid movement within the tubules, stimulating pulp nerve endings and resulting in significant patient discomfort[4,5].

Despite the availability of numerous desensitizing agents, such as fluorides and potassium nitrates, their clinical efficacy remains inconsistent, often requiring multiple applications or failing to provide long-term relief[6]. Other approaches, including oxalates, calcium phosphates, bioactive glass, and laser therapy, have also been proposed for DH management, but evidence on their comparative long-term efficacy remains limited[7] . Furthermore, persistent DH can hinder effective oral hygiene, leading to biofilm accumulation and compromising the results of periodontal treatment[3,8]. Therefore, there is a growing need for bioactive agents that can simultaneously provide rapid desensitization and promote periodontal health.

Ozonated sunflower oil has emerged as a promising adjunctive therapy for periodontal disease and, more recently, for dentin hypersensitivity[9], due to its potent antimicrobial and anti-inflammatory properties[10–12]. Unlike gaseous or aqueous ozone, the lipid vehicle in ozonated oil ensures greater stability and a sustained release of ozonides, allowing for prolonged contact with the dental tissues[10-13]. Mechanistically, ozonated oil may promote the occlusion of dentinal tubules and modulate the neuro-inflammatory response through the activation of antioxidant pathways, such as the Nrf2/ARE signaling system[14,15], potentially combining rapid symptomatic relief with a reduction in local inflammation[13] .

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While in vitro studies suggest that ozone can alter the microstructure of hard tissues and enhance remineralization[14], clinical evidence regarding its efficacy in managing post-periodontal dentin hypersensitivity is still emerging. Previous clinical trials have mostly assessed gaseous or aqueous ozone, or ozonated oils applied directly into periodontal pockets, whereas the use of ozonated sunflower oil delivered through custom trays, which allows prolonged and standardized contact with the exposed cervical dentin, has not been investigated in patients presenting dentin hypersensitivity after basic periodontal therapy[9] . It was hypothesized that ozonated sunflower oil, used as an adjunct to basic periodontal therapy rather than as a sole therapeutic intervention, would result in a greater reduction of dentin hypersensitivity and improved periodontal clinical parameters compared with basic periodontal therapy. Thus, this pilot randomized split-mouth clinical trial aimed to evaluate the adjunctive effect of ozonated sunflower oil, applied via custom acetate trays, on dentin hypersensitivity and clinical periodontal parameters in patients following basic periodontal therapy.

MATERIAL AND METHOD

STUDY DESIGN

This pilot randomized split-mouth clinical trial was conducted in full compliance with the Declaration of Helsinki and is reported in accordance with the Consolidated Standards of Reporting Trials (CONSORT) 2025 guidelines. The study protocol received prior approval from the Research Ethics Committee Involving Human Beings of the Universidade Estadual do Oeste do Paraná (UNIOESTE) (approval number: 82954724.8.0000.0107). All participants provided written informed consent after receiving a comprehensive explanation of the study procedures, risks, benefits, and their right to withdraw at any time, prior to enrollment. The dental arch was the unit of randomization, and the patient was the unit of analysis. Ozonated sunflower oil was tested as an adjunct to basic periodontal therapy.

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SAMPLE SIZE

Considering the pilot nature of this study, a convenience sample of ten participants was included to obtain preliminary estimates of variability and treatment effect, aiming to support the design of future randomized clinical trials.

ELIGIBILITY CRITERIA

Systemically healthy adult patients requiring basic periodontal therapy were recruited from the dental clinics of the Universidade Estadual do Oeste do Paraná (UNIOESTE) and through targeted social media announcements between June and November 2025.

Following an initial screening interview, eligible individuals underwent a clinical examination during which periodontal parameters, including plaque index, gingival bleeding index, and probing depth were recorded. All participants subsequently received standardized basic periodontal therapy as part of the study protocol. Dentin hypersensitivity was assessed seveen days after periodontal treatment using a standardized evaporative stimulus (air blast). Only participants presenting persistent dentin hypersensitivity at this evaluation were considered eligible for enrollment, thereby excluding transient sensitivity that may occur immediately after periodontal instrumentation. This assessment defined the baseline of the study, after which arches were randomized and the intervention started. The follow-up assessment was performed seven days later.

To be eligible, participants were required to be systemically healthy non-smokers aged 18 years or older, present periodontal pockets ranging from 4 to 5 mm, exhibit a positive response to the evaporative stimulus, and report a pain score greater than 4 cm on a 10-cm Visual Analogue Scale (VAS). Periodontal pockets were required as an inclusion criterion because basic periodontal therapy constituted the initial treatment phase of the study protocol. Participants were also required to present at least one hypersensitive tooth in each dental arch.

Exclusion criteria included gingival recession exceeding 2 mm, use of any desensitizing agents

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within the preceding six months, antibiotic therapy during the study period or recent use, presence of recently restored teeth, chronic consumption of analgesics or psychotropic medications, use of orthodontic appliances, prior or ongoing desensitizing therapies, pregnancy or breastfeeding; occlusal dysfunctions, active carious lesions, and parafunctional habits such as bruxism or clenching.

RANDOMIZATION, ALLOCATION CONCEALMENT AND BLINDING

Allocation of the dental arch (maxillary or mandibular) to the test or control condition was performed using simple randomization (1:1 ratio) based on a computer-generated random sequence prepared by an independent researcher not involved in clinical procedures. Allocation concealment was ensured using opaque, sealed, sequentially numbered envelopes, which were opened only after baseline assessment and completion of basic periodontal therapy.

All periodontal procedures were performed by the same operator, who remained unaware of group allocation during treatment. A second researcher opened the corresponding envelope and provided instructions regarding the use of the acetate tray containing ozonated sunflower oil exclusively in the test arch. Clinical assessments at baseline and 7 days were conducted by a previously calibrated examiner who was blinded to group allocation and was not involved in treatment or intervention procedures. Data analysis was performed using an anonymized dataset with coded group identification. The split-mouth design was adopted to minimize interindividual variability, and standardized oral hygiene and intervention instructions were provided to all participants to reduce performance bias.

CALIBRATION

Prior to the study, the examiner underwent a calibration exercise for periodontal measurements, including probing depth and clinical attachment level. Calibration was performed in ten patients who did not participate in the main study, with measurements recorded at all periodontal sites. The same sites were re-evaluated by the same examiner after a 24-hour interval, selected to minimize the likelihood of

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biological changes in periodontal conditions between assessments. Intra-examiner reproducibility was assessed using the intraclass correlation coefficient (ICC), and a minimum value of 0.70 was considered acceptable.

CLINICAL INTERVENTIONS

At baseline, the calibrated examiner performed the clinical assessment using a Williams periodontal probe. The following parameters were recorded: plaque index (Silness–Löe), gingival index (Silness–Löe), probing depth, clinical attachment level, and bleeding on probing. Reassessments were performed 7 days after baseline. Probing depth and clinical attachment level were used only to characterize the baseline periodontal condition, since reliable assessment of changes in these parameters requires at least 30 days after non-surfical periodontal therapy, this short follow-up interval is acknowledged as a limitation.

All participants underwent standardized basic periodontal therapy consisting of a single session of supragingival scaling and subgingival root planing performed using manual instruments. Oral hygiene instructions were provided using the modified Bass technique. In the test arch, individualized acetate trays (1 mm thickness) were fabricated from alginate impressions and dental stone casts. Participants were instructed to apply a single drop of ozonated sunflower oil to the vestibular surface of each corresponding tooth within the tray and to wear it for one hour once daily throughout the study period. The ozonated sunflower oil used was Ozoncare® ozonated sunflower oil (Philozon, Balneário Camboriú, Santa Catarina, Brazil), which is commercially available. After insertion, any excess material was removed. Following the one-hour application, participants were instructed to remove and clean the tray, rinse their mouths thoroughly, and abstain from ingesting solid food or liquids for thirty minutes. No adjunctive at-home treatment was prescribed for the control arch.

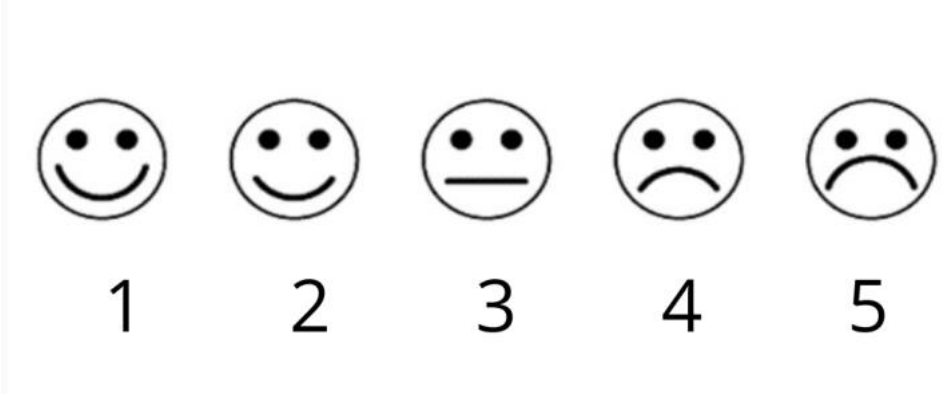
OUTCOME MEASURES

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Primary outcome

Dentin hypersensitivity (DH) was assessed using a Visual Analogue Scale (VAS) ranging from 1 to 5 (Figure 1). Assessments were conducted following a standardized evaporative stimulus (air blast) applied for 1 second at a distance of approximately 1 cm from the exposed tooth surface, with the air directed perpendicularly to the cervical area while isolating adjacent teeth with cotton rolls to prevent cross-stimulation. The VAS scores were defined as follows: 1 (no pain), 2 (mild discomfort), 3 (moderate pain), 4 (severe pain), and 5 (unbearable pain).

Figure 1. Visual Analogue Scale (VAS) used for data collection, with anchors from 1 (no pain) to 5 (unbearable pain).



Secondary outcomes

Plaque accumulation was assessed using the Plaque Index (PI) according to the criteria of Silness and Löe. Gingival inflammation was evaluated using the Gingival Bleeding Index (GBI). All clinical measurements were recorded at baseline (immediately after basic periodontal therapy) and after a 7-day follow-up period. All assessments were performed by a single, previously calibrated examiner who was blinded to the group allocation.

STATISTICAL ANALYSIS

Data were analyzed using descriptive and inferential statistics to evaluate the efficacy of the

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adjunctive use of ozonated sunflower oil. The normality of data distribution was assessed using the Shapiro-Wilk test. Continuous variables, including the Plaque Index, Gingival Bleeding Index, and Dentin Hypersensitivity (VAS) scores, were expressed as mean ± standard deviation (SD).

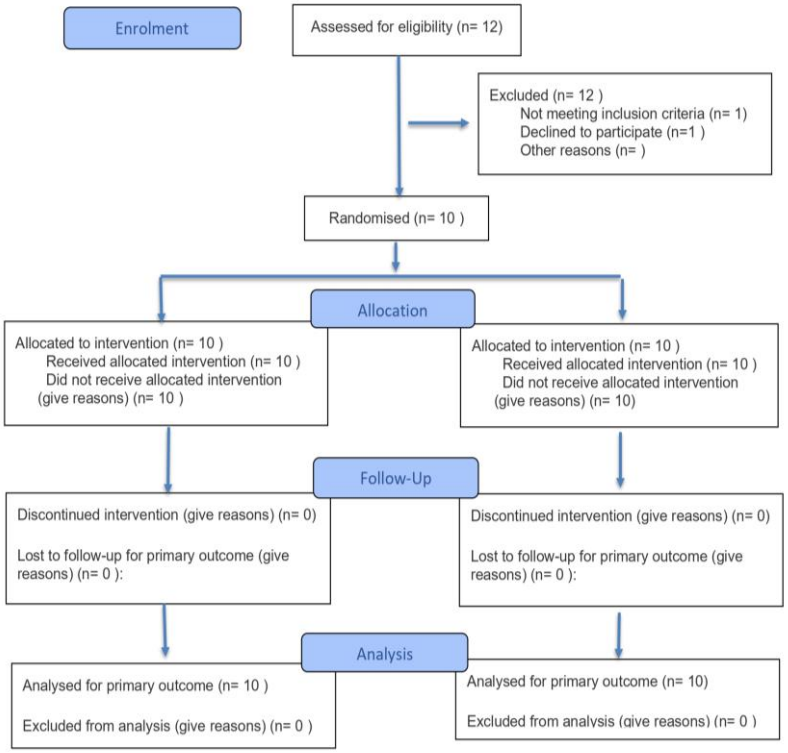
Since a split-mouth design was employed, paired-sample t-tests were used to compare the means between the test (ozonated oil) and control arches. For all analyses, the significance level was set at $p < 0.05$. Statistical processing was performed using the jamovi software, version 28.7 (The jamovi project, Sydney, Australia).

RESULT

A total of twelve individuals were assessed for eligibility. Two participants were excluded, one because they did not meet the inclusion criteria and one because they declined to participate. Ten participants were enrolled and randomized. Each participant contributed one arch allocated to the ozonated sunflower oil group and one arch allocated to the control group. All participants completed the 7-day follow-up, and no dropouts were recorded during the study period. All ten participants were included in the final analysis (Figure 2).

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Figure 2. CONSORT flow diagram of the trial.



Because the study adopted a split-mouth design, the test and control arches belonged to the same participants. Thus, all participant-related characteristics were shared between the two groups, while the allocation of arches was randomized. This design minimized the influence of inter-individual variability on the outcomes evaluated.

The clinical outcomes assessed are presented in Table 1. The plaque index was significantly lower in arches treated with ozonated sunflower oil (34.00 ± 17.76) than in control arches (54.00 ± 20.11; $p = 0.004$). Similarly, the gingival bleeding index was significantly lower in the ozonated oil arches (15.00 ± 15.09) compared with the control arches (36.00 ± 24.59; $p = 0.010$).

Regarding dentin hypersensitivity, significantly lower scores were observed in the ozonated oil

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group than in the control group. Mean hypersensitivity scores were 1.30 ± 0.95 and 3.00 ± 0.94 for the ozonated oil and control groups, respectively ($p < 0.001$). This outcome exhibited the greatest difference between the evaluated conditions, indicating a substantial reduction in dentin hypersensitivity following the application of ozonated sunflower oil.

Table 1. Comparison of plaque index, gingival bleeding index, and dentin hypersensitivity between control group and the ozonated sunflower oil group at the follow-up

Variable	Control group (mean ± SD)	Ozonated oil group (mean ± SD)	Paired t-test (t)	p-value
Plaque index	54.00 ± 20.11	34 ± 17.76*	-3.87	0.004
Gingival bleeding index	36.00 ± 24.59	15.00 ± 15.09*	-3.28	0.010
Dentin hypersensitivity	3.00 ± 0.94	1.30 ± 0.95*	-6.53	<0.001

DISCUSSION

This pilot randomized split-mouth trial found that the adjunctive use of ozonated sunflower oil applied via an acetate tray was associated with lower plaque accumulation, gingival bleeding, and dentin hypersensitivity than basic periodontal therapy alone. After one week of daily use, the test arches showed lower scores for all outcomes, highlighting the therapeutic potential of this vehicle. These results regarding dentin hypersensitivity (DH) are consistent with the in vitro findings by Lena et al.[15] (2017) , who reported dentinal tubule occlusion when ozonated oil was used. The pronounced difference observed here, the greatest among all variables ($p < 0.001$), may be explained by the hydrodynamic theory. The high-viscosity oil may provide a physical seal of the exposed tubules, while the ozone may promote a localized remineralizing effect on the dental microstructure, as suggested by Liu et al.[9] (2025).

Complementarily, Dalbosco et al.[16] (2024) demonstrated that pretreatment with ozonated sunflower oil as a desensitizing agent prior to in-office bleaching did not alter enamel microhardness,

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unlike traditional agents. These authors also found ozonated oil to be more effective in pain control than potassium nitrate and fluoride, which is in line with our fidnings, although in a different clinical context. Supporting these observations, Veena et al.[14] (2020) showed that both ozonated and extra virgin olive oil improved oral health–related quality of life, with 90% of participants reporting clinical improvement. Other clinical studies have investigated different ozone formulations and application protocols for dentin hypersensitivity.

However, it is important to contextualize our results with a recent systematic review which indicated that medicinal ozone, in water or gaseous forms, might not have a significant additional effect on plaque index or gingival bleeding in periodontitis treatment[9]. Our study diverges from these conclusions likely due to the vehicle used. The lipid matrix of the sunflower oil allows for a sustained release of ozonides may provide a hydrophobic barrier that interferes with the initial adhesion of the dental pellicle. This prolonged contact time is superior to the short half-life of gas or aqueous ozone, which could help explain the lower plaque index ($p = 0.004$) and gingival bleeding index ($p = 0.010$) observed in our participants.

The biological rationale for these effects may lie in the peroxide index of the Philozon® oil used. This concentration of bioactive compounds triggers an oxidative stress that damages microbial cell structures and metabolism, while simultaneously activating the Nrf2/ARE antioxidant pathway. This pathway modulates immune responses and bio-stimulates dental and periodontal cells[13]. Furthermore, topical ozone application has been reported to enhance peripheral oxygen perfusion and overall metabolism by inducing structural changes in erythrocytes[17].

The choice of this specific product, with its high concentration of peroxides and ozonides, aimed at effective control of periodontal health parameters. Our data align with several randomized clinical trials where ozonated sunflower oil, as an adjunct to standard hygiene or scaling and root planing, significantly reduced clinical indices and anaerobic bacterial counts compared to control groups [18–21]. No adverse effects were reported, although this should be interpreted with caution given the small sample and short

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follow up[22].

By utilizing a split-mouth design, this study minimized inter-individual biological variability, as each participant served as their own control. Despite these strengths, some limitations persist. The sample size was small, as expected for a pilot study, so the precision of the estimates is limited, and statistical significance should not be taken as evidence of a large or clinically relevant effect. Furthermore, the reliance on a subjective scale introduces a degree of subjectivity inherent to dentin hypersensitivity assessment. In addition, the follow-up period does not allow assessing the persistence of the desensitizing effect, participants could not be blinded and no placebo was used. Consequently, further investigation with larger populations and longer longitudinal tracking is essential to validate these preliminary results and refine clinical management protocols for gingivitis and dentin hypersensitivity.

CONCLUSION

The adjunctive daily application of ozonated sunflower oil using custom trays, following basic periodontal therapy, proved highly effective in rapidly reducing dentin hypersensitivity and improving key clinical periodontal parameters, including plaque accumulation and gingival bleeding indices. These outcomes highlight the potential of ozonated sunflower oil as a safe, cost-effective, and bioactive desensitizing and anti-inflammatory agent, likely attributable to its elevated peroxide content and broad therapeutic properties. Although these pilot findings are encouraging, they remain preliminary. Future long-term, multicenter randomized controlled trials are essential to confirm the durability of these effects, refine standardized clinical protocols, and further validate the role of ozonated sunflower oil in the comprehensive management of post-periodontal dentin hypersensitivity and gingival inflammation.

AUTHORS' CONTRIBUTIONS

Maria Eduarda Tosta: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing – Original Draft.

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Maria Ritha Veiga Colognese: Formal Analysis, Data Curation, Visualization, Writing – Original Draft, Writing – Review & Editing.

Lara Borchardt: Investigation, Data Curation, Validation, Writing – Review & Editing.

Patrícia Oehlmeyer Nassar: Methodology, Validation, Supervision, Writing – Review & Editing.

Julio Katuhide Ueda: Methodology, Resources, Supervision, Writing – Review & Editing.

Veridiana Camilotti: Conceptualization, Methodology, Supervision, Project Administration, Funding Acquisition, Writing – Review & Editing.

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CONFLICTS OF INTERESTS

The authors declare that there is no conflict of interest related to this study.

DATA AVAILABILITY

The contents underlying the research text are included in the manuscript.

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Received: June 30, 2026

Accepted: November 8, 2026

SciELO Preprints - This document is a preprint and its current status is available at: https://doi.org/10.1590/SciELOPreprints.18910

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