

The use of toothpaste for the treatment of dentin hypersensitivity: an integrative literature review

A utilização dos cremes dentais para o tratamento da hipersensibilidade dentinária: uma revisão integrativa de literatura

El uso de pasta dental para el tratamiento de la hipersensibilidad de la dentina: una revisión integradora de la literatura

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REVISA

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RESUMO

Objetivo: examinar a eficácia e os mecanismos de ação dos cremes dentais no tratamento da Hipersensibilidade Dentinária. **Método:** realizou-se uma pesquisa nas bases de dados PubMed, Biblioteca Virtual em Saúde (BVS) e Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), utilizando descritores DeCS/MeSH “Tratamento Odontológico”, “Sensibilidade Dentária” e “Cremes Dentais”. Foram selecionados estudos publicados entre 2013 e 2024. **Resultados:** a eficácia dos cremes dentais é respaldada por evidências clínicas, que demonstram uma redução significativa nos sintomas de sensibilidade ao calor, frio e a estímulos táteis com o uso regular. **Conclusão:** o uso de cremes dentais representa uma abordagem promissora no manejo da Hipersensibilidade Dentinária, embora sejam necessários esforços contínuos para aprimorar a compreensão e o tratamento dessa condição comum.

Descritores: Tratamento Odontológico; Sensibilidade Dentária; Cremes Dentais.

ABSTRACT

Objective: to examine the effectiveness and mechanisms of action of toothpastes in the treatment of Dentin Hypersensitivity. **Method:** a search was conducted in the databases PubMed, Virtual Health Library (VHL) and Latin American and Caribbean Literature in Health Sciences (LILACS), using DeCS/MeSH descriptors “Dental Treatment”, “Dental Sensitivity” and “Toothpastes”. Studies published between 2013 and 2024 were selected. **Results:** the effectiveness of toothpastes is supported by clinical evidence, which demonstrates a significant reduction in symptoms of sensitivity to heat, cold and tactile stimuli with regular use. **Conclusion:** the use of toothpastes represents a promising approach in the management of Dentin Hypersensitivity, although continued efforts are needed to improve the understanding and treatment of this common condition.

Descriptors: Dental Care; Dentin Sensitivity; Toothpastes.

RESUMEN

Objetivo: examinar la eficacia y los mecanismos de acción de las pastas dentales en el tratamiento de la Hipersensibilidad Dentinaria. **Método:** se realizó una búsqueda en las bases de datos PubMed, Biblioteca Virtual en Salud (BVS) y Literatura Latinoamericana y del Caribe en Ciencias de la Salud (LILACS), utilizando los descriptores DeCS/MeSH “Tratamiento Dental”, “Sensibilidad Dental” y “Pastas de dientes”. Se seleccionaron estudios publicados entre 2013 y 2024. **Resultados:** la eficacia de las pastas dentales está respaldada por evidencia clínica, que demuestra una reducción significativa de los síntomas de sensibilidad al calor, al frío y a los estímulos táctiles con el uso regular. **Conclusión:** el uso de pastas dentales representa un enfoque prometedor en el manejo de la hipersensibilidad dentinaria, aunque se necesitan esfuerzos continuos para mejorar la comprensión y el tratamiento de esta condición común.

Descriptores: Tratamiento Dental; Sensibilidad dental; Pastas de dientes.

REVIEW

Introduction

Dentin Hypersensitivity (HD), also known as tooth sensitivity, is defined by a sharp, short-lived pain in response to stimuli on the exposed dentin. This pain can be caused by evaporative, tactile, osmotic or chemical stimuli, and is not associated with other dental pathologies. HD can significantly affect patients' quality of life, compromising daily activities due to discomfort^{1,2}.

Physiologically, several theories have been investigated to explain the mechanisms of tooth sensitivity, with studies in various populations that analyze the prevalence of the condition according to demographic factors, recruitment methods, and study settings. Awareness of HD and the adoption of preventive strategies have motivated a growing number of patients to seek dental treatments to deal with sensitivity, a condition that does not directly involve the presence of bacteria. In recent years, research has indicated an increase in incidence rates, leading HD to be considered a pathology of great clinical relevance^{2,3}.

Several therapeutic approaches for HD are under investigation, including the use of lasers, ions, drying agents, and root coating, with the goal of blocking the neural transmission system or obliterating the dentin tubules. HD treatment has aroused great interest in the dental community, and it is critical to consider the diversity of methods available to provide effective relief to patients^{2,3,4}.

In this context, this integrative literature review aims to examine the efficacy and mechanisms of action of toothpastes in the treatment of Dentin Hypersensitivity, offering a comprehensive view of current knowledge and highlighting future perspectives in this essential area of Dentistry.

Method

The present study is an integrative literature review with an exploratory and descriptive approach, of a qualitative nature. It is based on already published materials, mainly scientific articles, with the aim of offering a current view on the use of toothpastes in the treatment of Dentin Hypersensitivity.

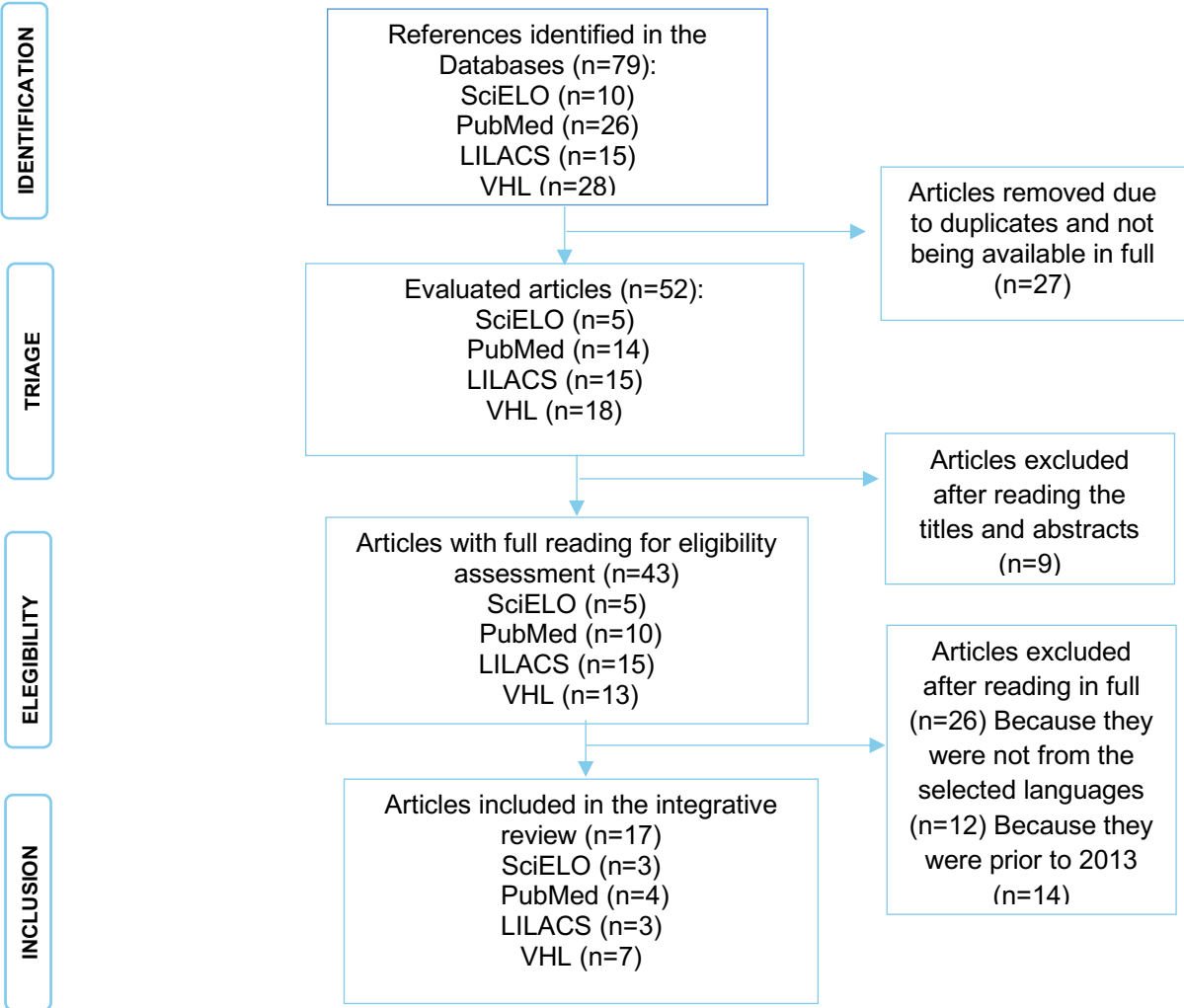
To achieve this objective, the following databases were used: Scientific Electronic Library Online (SciELO), National Library of Medicine (PubMed), Virtual Health Library (VHL) and Latin American and Caribbean Literature on Health Sciences (LILACS). The choice of these databases was based on the wide coverage of relevant articles in the field of dentistry and health in general.

In the search for articles, the descriptors "Dental Treatment", "Tooth Sensitivity" and "Toothpastes" were used, in Portuguese and English, combined with the Boolean operators AND and OR. The AND operator was applied to cross-reference the descriptors and ensure that the selected studies simultaneously addressed the main topics, as in the combinations "Tooth Sensitivity AND Toothpastes" in Portuguese and "Dentin Hypersensitivity AND Toothpaste" in English. The OR operator was used to include variations and synonyms of the descriptors, expanding the results, as in "Toothpastes OR Dentifrice" and "Toothpaste OR Dentifrice". Finally, the search strategies integrated these combinations, as in "Dental Treatment AND Tooth Sensitivity

AND (Toothpaste OR Dentifrice)" and its English version "Dental Treatment AND Dentin Hypersensitivity AND (Toothpaste OR Dentifrice)".

The inclusion criteria adopted in this study covered articles published between 2013 and 2024, ensuring the use of updated and relevant materials. Studies available in Portuguese or English that directly addressed the use of toothpastes in the treatment of Dentin Hypersensitivity were included. In addition, clinical trial articles, systematic reviews, and experimental studies with well-described methodology were considered. On the other hand, the exclusion criteria involved the disregard of publications unrelated to the theme and not available in full for reading. After applying the selection criteria, 17 articles were included to compose this review.

Figure 1 - Descriptive flowchart of the selection of articles included and excluded in the study.



Source: Prepared by the authors based on Prisma Scr.

Results and Discussion

The table below summarizes the main information about the articles included in this review.

Chart 1 – Summary of the main information of the articles included in the integrative review.

Author	Objective	Results	Conclusion
Camargo et al. (2017) ⁴	To evaluate the cytotoxicity, genotoxicity, antimicrobial activity of desensitizing toothpastes compared to a common paste, and the surface roughness of tooth enamel subjected to brushing with these pastes.	The results were statistically analyzed using the Mann-Whitney U, ANOVA, and Z tests ($p < 0.05$). All toothpastes caused cytotoxic effect on cells ($p < 0.05$), except Colgate® Sensitive.	Although none of the pastes induced genotoxicity, Colgate Sensitive® was also not cytotoxic. Colgate® was the most effective against the microorganisms, and there were no differences in enamel surface roughness between the groups.
Paz; Arruda; Apolinário; Lisboa (2017) ⁵	To investigate the clinical efficacy of three desensitizing toothpastes in reducing HD.	The results revealed that most participants (65.9%) were female, while 47.7% were in the age group of 22 to 40 years and 70.5% had a high school education.	It is concluded that the three toothpastes are effective in the treatment of HD, with no statistically significant differences between them.
Seong et al. (2017) ⁶	To investigate the accurate replication of a silicone impression material about HD-related changes in dentin tubules.	After four weeks, thermal visual analogue scale (VAS) scores were significantly lower than baseline for the non-occlusive toothpaste group; All other pain scores were significantly lower for both treatments.	Both toothpastes reduced clinical sensitivity and increased tubule occlusion.
Bispo (2019) ²	To elucidate the etiology, differential diagnosis, therapies and efficacy in the control of HD.	HD ceases after the removal of the stimulus and does not occur in healthy teeth when exposed to stimuli considered normal.	There is some difficulty in standardizing research and results related to HD, due to the discrepancies in the scores used to assess pain, the diversity of methodologies employed, the subjectivity of symptoms, the multiple variables involved, and the increase in the number of proposed therapies.
Hu et al. (2019) ⁷	To compare the different desensitizing toothpastes with placebo in terms of their effects on HD for 2, 4 and 8 weeks.	A total of 30 RCTs were included, which included eight desensitizing toothpastes. There was no significant difference in effect between toothpastes containing calcium sodium phosphosilicate (CSPS), potassium (K) and strontium (Sr)-containing toothpastes. In addition, there was no significant difference between	No significant difference in desensitizing effects was detected between CSPS, K, and Sr. toothpastes. In addition, there was no significant difference between F and placebo, K, and placebo. A significant placebo effect on HD was found in this study. n-HA toothpastes may be the best

		fluoride (F) and placebo. The desensitizing toothpaste with the highest probability of being the most effective treatment for HD was nano-hydroxyapatite (n-HA) at 2 and 4 weeks (60% and 67%, respectively), and Ar at 8 weeks (54%).	desensitizing toothpastes for treating HD, followed by Ar toothpaste.
Monterubbiane <i>et al.</i> (2020) ⁸	To evaluate the anti-inflammatory effect and patient appreciation of two toothpastes containing desensitizing agents.	The final sample consisted of 25 individuals, aged between 20 and 58 years. Although no differences were reported in FMPS ($p > 0.05$), both desensitizing toothpastes showed improvement in FMBS. CSPS and HB recorded more AbA compared to CHA ($p < 0.05$). In addition, HB resulted in a higher VAS score than both desensitizing toothpastes ($p < 0.05$).	In conclusion, only CSPS showed an anti-inflammatory effect like that of HB. Despite the low VAS score, CSPS could be considered a valid and effective toothpaste in individuals with dentin hypersensitivity and inflamed gums, highlighting its usefulness in clinical practice.
Seong <i>et al.</i> (2020) ⁹	To compare a calcium and sodium phosphate (CSSP)-based toothpaste with a fluoride negative control toothpaste for HD reduction after 14, 28, and 29 days.	After 14, 28, and 29 days, the CSSP group had significantly lower Schiff scores, lower VAS, and higher Yeaple probe scores compared to the control group (VAS at 14 days, $p < 0.04$; all other comparisons, $p < 0.001$). Quality of life scores improved in both groups, but no significant differences were observed between the groups.	CSSP toothpaste was more effective than fluoride toothpaste in reducing HD pain, with benefit persisting 12 hours after application.
Freitas <i>et al.</i> (2021) ¹⁰	To evaluate randomised controlled trials in adult patients for HD treatment with a toothpaste containing bioactive glass, applied at home or in the office.	Fifteen studies were evaluated, considering seven to be at low risk of bias, four to be at high risk, and four to be at moderate risk.	Bioactive compounds in low concentrations (2.5–7.5%) can be used as HD treatment both at home and in the office.
Lee <i>et al.</i> (2022) ¹¹	To investigate the effect of toothpastes containing CPNE7-derived oligopeptide (CPNE7-DP) and other desensitizing active ingredients on HD.	On SEM images, all four groups of teeth exhibited partial occlusion of the dentin tubules on the tooth surface. In the in vivo hypersensitivity model, group 2 exhibited a newly formed tertiary dentin, while no new hard tissue formation was observed in groups 1, 3, and 4.	CPNE7-DP is a promising active ingredient with long-term dentin sealing effects.
Bak <i>et al.</i> (2023) ¹²	To evaluate HD reduction with a stabilizing stenotic fluoride (SnF2) toothpaste vs. marketed standard fluoride toothpaste.	Both toothpastes demonstrated superior desensitization efficacy compared to commercial toothpaste and conventional sodium monofluorophosphate (SMFP) toothpaste after one week.	Toothpaste stabilized with 0.454% SnF2 showed significant relief in HD in just one week, when compared to commercial toothpaste.

Jang <i>et al.</i> (2023) ¹³	To investigate the treatment of HD with the use of different desensitizing toothpastes	The PT group showed a significant reduction in HD compared to the N group for the air and cold jet stimuli. The PT group had a significantly lower VAS than the N and CS groups.	The tricalcium phosphate-containing toothpaste used in this trial was the most helpful in reducing HD.
Costa (2023) ¹⁴	Compare different types of commercially available treatments for HD due to non-carious cervical lesions and gingival recessions.	Of the 57 patients, most were female, with 43 (75.44%) participants, while 14 were male (24.56%), aged between 23 and 63 years.	All toothpastes showed improvements over the evaluation period. It can be concluded that the treatments evaluated are effective in reducing HD over 3 months.

Toothpastes developed to treat Dentin Hypersensitivity act through specific mechanisms that aim to relieve the uncomfortable symptoms experienced by patients^{1-3,15}. One of the main targets of these creams is exposed dentin, where the dentin tubules are unprotected due to enamel loss or receding gums². These creams often contain active ingredients that form a physical barrier on the dentin surface, preventing the transmission of painful stimuli to the underlying nerves. Among these ingredients, potassium nitrate, sodium fluoride, strontium chloride and arginine stand out^{6,9}.

Potassium nitrate is known for its ability to decrease the excitability of the dentin nerves, reducing sensitivity to external stimuli. In turn, sodium fluoride strengthens tooth enamel and promotes remineralization, helping to close exposed dentin tubules^{2,10}. Strontium chloride and arginine have been increasingly used in toothpastes for dentin hypersensitivity due to their properties of forming a protective layer on the dentin, thus blocking the passage of painful stimuli. These combined mechanisms of action help reduce the permeability of the dentin tubules and associated tooth sensitivity, providing effective and long-lasting relief for patients¹¹.

The effectiveness of toothpastes in the treatment of dentin hypersensitivity has been widely documented through rigorous clinical studies and meta-analyses.^{2,6,9,15-17} Research shows that regular use of these products can result in a significant reduction in symptoms of tooth sensitivity, providing relief to affected patients¹².

Randomized controlled trials have consistently demonstrated that hypersensitivity-specific toothpastes are able to reduce sensitivity to heat, cold, and tactile stimuli, thereby improving patients' quality of life. In addition, many of these studies have reported a progressive improvement in symptoms over time, suggesting a cumulative effect of treatment.^{5,7,10,11,16} In addition to clinical evidence, patient reports also corroborate the effectiveness of toothpastes in relieving tooth sensitivity. Many patients report a significant improvement in sensitivity and discomfort after regular use of these products, which reinforces their acceptance and popularity among dental professionals and the general public. However, it is important to note that the response to treatment may vary between individuals, and not all patients may experience the same degree of symptom relief¹¹.

While toothpastes for Dentin Hypersensitivity are effective in relieving symptoms in the short term, it is critical to consider their implications and

potential effects when used in the long term. While these products offer immediate relief from sensitivity, issues related to safety, continued efficacy, and potential adverse effects need to be carefully evaluated¹⁷.

A common concern is whether long-term use of hypersensitivity-specific toothpastes may lead to decreased effectiveness over time or resistance formation. Studies^{2,8,10,16} have investigated this issue and, to date, there is no conclusive evidence that the body develops tolerance to the active ingredients present in these products. However, continuous monitoring is necessary to keep track of any change in treatment response¹.

Another important consideration concerns the potential side effects associated with long-term use of certain active ingredients. For example, excess fluoride can lead to dental fluorosis, a condition characterized by staining or discoloration of the enamel⁴. It is essential for dental professionals to educate patients on the proper amount of toothpaste to use and any necessary precautions to avoid adverse effects.

Additionally, the continued use of hypersensitivity-specific toothpastes can raise concerns about possible tooth enamel wear. While these products are intended to protect exposed dentin and reduce sensitivity, their long-term impact on enamel integrity requires further evaluation. Therefore, while toothpastes offer significant benefits in relieving symptoms, it is critical to balance these benefits with careful evaluation of potential risks and long-term effects.^{14,15}

In addition to the use of specific toothpastes for Dentin Hypersensitivity, there are other therapeutic approaches that can complement or serve as alternatives in the treatment of this condition^{1,4,5,8,12,14}. These strategies aim to provide symptom relief and improve the quality of life for affected patients by offering a wider range of treatment options. A commonly used complementary approach is the application of fluoride varnishes or gels, which help strengthen tooth enamel and reduce the permeability of exposed dentin tubules⁹. These products can be applied in the dental office or prescribed for home use, depending on the severity of the sensitivity and the patient's preferences. In addition, low-level laser treatments have been investigated as a promising option for the treatment of dentin hypersensitivity¹⁻⁴.

The laser can be used to seal the exposed dentin tubules, thereby reducing sensitivity and providing long-lasting relief to patients. Dentin desensitization techniques, such as the application of desensitizing agents or the use of appropriate restorative materials, may also be considered for more severe cases of dentin hypersensitivity. These techniques aim to block the passage of painful stimuli to the dentin nerves, providing effective symptom relief^{2,12,15,16}.

Consistent clinical studies have demonstrated the efficacy of compounds such as potassium nitrate, sodium fluoride, strontium chloride, and arginine in reducing nerve excitability and obstructing exposed dentin tubules^{1,6,9,17}. However, although the literature presents favorable results in relation to symptom reduction, there is significant variability in the levels of relief reported, suggesting an individualized response to treatment^{11,13}.

Potassium nitrate is widely recognized for its ability to decrease nerve response, acting directly on the depolarization of dentin nerves, and this function has been supported by several clinical trials^{2,13}. On the other hand,

sodium fluoride, in addition to strengthening enamel and promoting remineralization, has shown promising results in dentin tubule occlusion, as confirmed by in vitro and in vivo studies^{5,9}. However, one issue that remains without consensus is the optimal dosage of fluoride to balance the beneficial effects without inducing fluorosis, a well-documented complication in cases of excessive fluoride exposure⁴.

In addition to the active ingredients already widely explored, the use of strontium chloride and arginine has gained prominence in commercial products due to their ability to form a physical barrier over exposed dentin, blocking the movement of fluids in the tubules^{6,9}. However, studies investigating the efficacy of these compounds are relatively recent, and more long-term investigations are needed to assess the permanence of the effects and the possible impacts on tooth enamel integrity^{8,15}.

Another relevant aspect discussed in the literature is the issue of prolonged use of toothpastes for HD. Although the studies reviewed to date do not demonstrate robust evidence of the development of resistance or tolerance to active ingredients, long-term safety and efficacy have yet to be explored in greater depth. The possibility of enamel wear due to the continuous use of these products, although little reported, also raises questions about the safety of such products in prolonged therapeutic regimens^{6,9,12,14,17}.

Regarding therapeutic alternatives, the review highlights the efficacy of fluoride varnishes and low-level laser treatments as promising adjuvants in the management of dentin hypersensitivity. Controlled studies indicate that the use of laser can effectively seal the dentin tubules, providing prolonged relief to patients, especially in more severe cases^{6,14}. However, more research is needed to standardize these protocols and determine their advantages over conventional methods such as toothpastes¹⁴.

Despite the advances, there are several gaps in the literature. Most of the studies reviewed do not consistently address the variables that may influence the response to treatment, such as diet, oral hygiene habits, or the presence of comorbidities, which may interfere with the effectiveness of the products. In addition, there is a lack of long-term studies evaluating the maintenance of effects after discontinuation of HD-specific toothpastes^{4,10}.

In summary, while toothpastes for dentin hypersensitivity represent a practical and affordable solution for patients, their effectiveness can vary between individuals, and prolonged use requires careful monitoring. The reviewed literature suggests that a combined approach, using toothpastes in conjunction with other therapies such as laser and fluoride varnishes, may be a more effective strategy to ensure long-lasting results and minimize risks. Future studies should focus on exploring the interaction between different treatments and further evaluating the long-term impact of these products on global dental health.

Conclusion

Advances in the treatment of dentin hypersensitivity through desensitizing toothpastes and other therapeutic approaches are significant, but issues still need further investigation. The results indicate that, although several therapeutic approaches have been investigated, toothpastes remain an

affordable and effective option for many patients, contributing to improved quality of life by relieving pain associated with the condition.

However, there are still gaps that need to be explored. Research should focus on identifying new active ingredients and assessing the long-term efficacy of available treatments, as well as exploring biomarkers that can predict treatment response. It is essential for dental professionals to adopt these new strategies and stay up-to-date on advances in the field.

Finally, continued commitment to research and development of safe and effective interventions is essential. By addressing these issues, we will be able to provide lasting relief for patients facing dentin hypersensitivity, improving their quality of life and promoting more effective dental care.

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