

Review Article

Effectiveness of stannous fluoride in treating gingivitis: a literature review

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ABSTRACT

The purpose of the study was to investigate and evaluate the existing research studies on stannous fluoride (SnF₂) dentifrices to answer the question of whether they are effective in enhancing oral health and reducing gingival inflammation. The study utilized a systematic approach, including a comprehensive literature search for relevant randomized controlled trials (RCT) and cohort studies. Inclusion criteria focused on SnF₂ dentifrices' effects on periodontal health in individuals with gingivitis. The reviewed studies consistently demonstrated that dentifrices containing SnF₂ were more effective than both negative and positive controls in improving periodontal health. The findings support the potential of SnF₂ dentifrices as a promising option for enhancing oral health and reducing gingival inflammation. Further well-designed randomized trials are needed to strengthen the evidence base and provide comprehensive support for the efficacy of SnF₂ dentifrices in improving oral health.

Keywords: SnF₂, Gingivitis, Periodontology, Oral health

INTRODUCTION

Gingivitis and its potential sequelae can be avoided with a preventive plan for gingival health that includes daily mechanical plaque cleaning at home as well as frequent professional care. According to research on oral hygiene compliance, many individuals fail to achieve the degree of plaque removal required to prevent disease, with insufficient brushing technique, time, and a low prevalence of frequent dental flossing.¹ Dental plaque, which is a major aggregation of various populations of organisms, is known to form quickly on tooth surfaces and is present as a biofilm that adheres to the teeth.² Dental plaque buildup and common oral diseases have been linked by clinical researchers and reducing the effects of these diseases is a top objective in oral health care. In cases when these methods fall short of providing

appropriate plaque management, antimicrobial agents might be added to oral healthcare products.³

There are several commercial dentifrices on the market right now, and they all include various active components, each of which serves a specific purpose. In general, fluorides have been regarded as the most significant active component in toothpaste.⁴

In dentistry, SnF₂ has been used for a considerable period of time. The substance was initially used in toothpastes as an anti-caries agent. A 0.454% SnF₂ formulation has been shown to provide clinical efficacy for gingivitis control in a stabilized dentifrice form or in the form of anhydrous gels.⁵ The existence of free stannous ions in SnF₂ has been substantially implicated in its actions; nevertheless, stannous ions lose their efficacy when they are oxidized to stannic ions, negating their intended role in dental

therapy.⁶ While SnF2 has frequently been associated with extrinsic staining, advancements in formulations, such as incorporation of polyphosphates, have resolved this issue.

Considering the substantial body of evidence supporting the effectiveness (SnF2) in the treatment of gingival health conditions, we deemed it necessary to conduct a comprehensive review of the scientific literature on the subject. The findings of this review could provide valuable insights into the specific benefits of SnF2 use. Overall, the review aims to provide a more nuanced and informed understanding of the role of SnF2 in promoting periodontal health, thereby contributing to the development of evidence-based approaches for the prevention and management of gingival health conditions.

The aim of this literature review is to evaluate the efficacy of SnF2 toothpaste in managing gingivitis among patients. By synthesizing and analyzing the available evidence on the subject, the review seeks to provide a comprehensive understanding of the benefits of SnF2 toothpaste in treating gingivitis.

GINGIVITIS PATHOGENESIS

Microbial plaque deposits in the gingival sulcus or near it are the cause of gingivitis. *Actinomyces*, *fusobacterium*, *Treponema*, *Veillonella*, and *Streptococcus* species are microbes more strongly linked to etiology of gingivitis.⁷

Molecules implicated in pathogenesis can be classified into 2 distinct types.: those obtained from the subgingival microbiota (i.e., microbial virulence factors) and those derived from host immune-inflammatory response.

Although "periopathogenic bacteria" are still recognized as the primary starting agents, the host's immune-inflammatory response to these pathogens plays a significant role in pathogenesis of periodontal disease.⁸

TYPES OF DENTIFRICES

Dentifrices

To prevent and treat caries, toothpaste has been utilized as a local source of fluoride, with a 19-27% reduction in caries development.^{9,10} These aids in remineralizing enamel, especially in cases of early demineralization that may not be clinically visible. Managing early decay involves reducing etiological factors like dental plaque and increasing remineralizing substances such as fluoride.¹¹

Regular use of fluoride toothpaste has been proven effective over the last two decades, although caution is needed in early childhood to prevent fluorosis.¹¹

For periodontal disease prevention, regular plaque removal is crucial, and toothpaste formulations often incorporate antiseptic and antibacterial substances such as triclosan, chlorhexidine, and hydrogen peroxide.¹²

Natural plant extracts, essential oils, enzymes, and vitamins in toothpaste have demonstrated antibacterial effectiveness similar to chlorhexidine-containing ones.¹³

Whitening and bleaching toothpastes serve different purposes. Whitening toothpastes aim to remove plaque mechanically or chemically, with abrasive substances or enzymes, while Bleaching toothpastes typically contain chemicals such as hydrogen peroxide or calcium peroxide. The concentration of these bleaching agents in toothpaste is low, and their efficacy in improving internal tooth color is not well-established.^{14,15}

Lastly, some toothpaste formulations claim to treat specific conditions, such as those containing olive oil, betaine, and xylitol to stimulate salivary secretion.¹⁶

Treatment of gingivitis with fluoride

Literature review evidence supports the effectiveness of SnF2 dentifrices in enhancing oral health and reducing gingival inflammation. Studies consistently observed SnF2 dentifrices significantly reducing bleeding sites, Loe-Silness gingivitis index (LSGI), and plaque scores. Subjects utilizing SnF2 dentifrices appeared superior chances of transitioning to healthy gingival tissue. Moreover, the utilize of stabilized SnF2 toothpaste was found to have a useful effect on diminishing dental calculus, plaque, gingivitis, staining, and halitosis. There were also significant reductions in oral bacteria observed when using SnF2 dentifrices compared to control toothpastes. Overall, SnF2 dentifrices emerge as a valuable ally in promoting optimal oral health by effectively addressing problems like gingival inflammation and plaque build-up.

LITERATURE REVIEW

Intended to investigate isolated effect of sodium fluoride toothpaste on gingivitis without any other influences.

A literature review framework was followed for this study. Three authors conducted article searching and scanning on electronic database PubMed for peer reviewed literature with keywords "stannous, fluoride, gingivitis", limited to the years 2018-2023.

Duplicate results were not considered.

After the selection of candidate papers from the search results, publications were analyzed by examining the titles and filtered based on a set criterion.

Inclusion criteria was-RCT and cohort studies. Studies that focused on only changing the populations' toothpaste to SnF2 toothpaste, without changing other aspects of their oral hygiene. Study populations that have gingivitis, articles in English language, age 15-65 years.

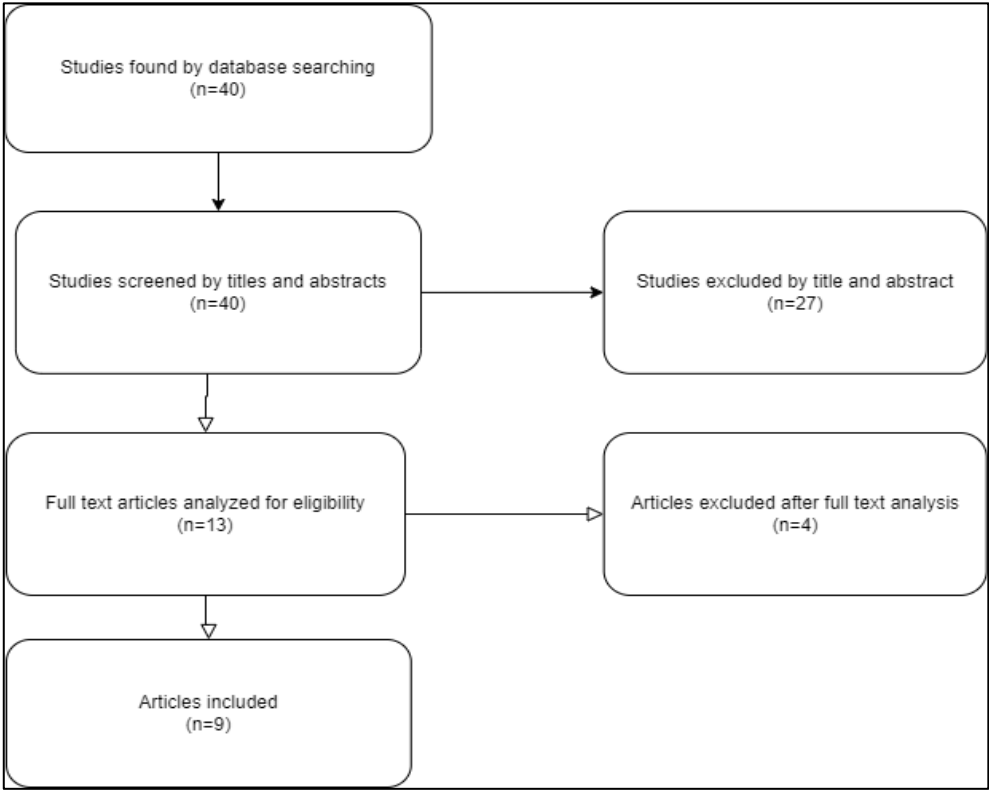


Figure 1: Diagram for new review which included searches of databases, other sources.

Exclusion criteria-studies where full oral hygiene regimen (OHR) was assigned to the population. Articles not in the English language. Study populations that do not have gingivitis. Any studies that have been done before 2018. Flowchart showing the process of study screening and selection for articles included in this review.

OUTCOMES

The following table presents the characteristics of the included studies:

In this literature review, multiple studies were analyzed to evaluate the effectiveness of SnF2 dentifrices in

improving oral health. The studies consistently found that SnF2 dentifrices were more effective than negative or positive controls in reducing bleeding sites, LSGI scores, and plaque scores. Subjects with gingivitis also had better odds of transitioning to healthy gingival tissue when using SnF2 dentifrices. Overall, the literature suggests that SnF2 dentifrices are effective in improving oral health and reducing gingival inflammation.

All of the studies have reported similar findings related to the efficacy of using a dentifrice with SnF2 in enhancing oral health results. However, one study differs in its method, where an OHR was followed instead of only using an SnF2 dentifrice.²⁰

Table 1: Summary of reviewed studies.

Authors	Year	Objective of study	Study design	Conclusions
Johannsen et al ⁴	2019	The study evaluated the efficacy of stabilized SnF2 dentifrice in reducing dental calculus, dental plaque, gingivitis, halitosis, and staining.	Systematic review	Use of SnF2 toothpaste was found to have a positive effect in reducing dental calculus build-up, dental plaque, gingivitis, stain, and halitosis.
Parkinson et al ¹⁴	2020	Conduct a clinical trial using a randomized, double-blind, placebo-controlled design to measure changes in gingivitis indicators, as bleeding index (BI), probing depth (PD), and clinical attachment levels (CAL), among subjects who used dentifrice containing 0.454% w/w SnF2.	RCT	The group using SnF2 0.454% demonstrated a reduced number of bleeding sites compared to the control group.

Continued.

Authors	Year	Objective of study	Study design	Conclusions
Hu et al¹⁸	2019	The study aimed to evaluate changes in gingival bleeding, plaque index, and gingival index after using each dentifrice for several weeks, as well as assessing their safety and tolerability.	RCT	The use of a specific treatment or intervention resulted in a reduction in gingival inflammation and improvement in biofilm control.
Seriwatanachai et al¹⁹	2019	A clinical trial was conducted to compare efficacy of dentifrice containing SnF2 with zinc phosphate to a SnF2 dentifrice that contains Zn lactate and control fluoride dentifrice. Study aimed to evaluate their effectiveness in reducing plaque accumulation and gingivitis	RCT	A study showed that a test dentifrice had a similar efficacy to a commercial dentifrice containing SnF2 in controlling plaque and reducing gingival inflammation.
Zini et al²⁰	2021	The study sought to assess the impact of an OHR over a 24-month period on adults with gingivitis and periodontitis. The study examined changes in clinical indicators such as PD, clinical attachment level, and bleeding on probing.	RCT	The study demonstrated that the use of a regimen of oral care hygiene aids resulted in a reduction of gingival BI-bleeding sites (GBI-BS), modified gingival index (MGI), and probing pocket depth (PPD) when compared to usual routine.
Acherkouk et al³	2021	The study aimed to evaluate the clinical efficacy of a SnF2 dentifrice in improving gingival health within a period of 3 weeks.	RCT	The study showed that prophylaxis can lead to noticeable improvements in plaque control and gingivitis within two weeks. The study also supported the clinical efficacy and tolerability of an anhydrous 0.454% w/w SnF2 toothpaste in promoting gingival health.
Haraszthy et al²¹	2019	A study was conducted to compare the impact of using a toothpaste containing SnF2 versus a dentifrice containing sodium monofluorophosphate during brushing.	Single-site, double-blind controlled clinical trial	After 12 hours of brushing, the SnF2 toothpaste demonstrated reductions in oral bacteria across all microenvironments.
Malgorzata Klukowska et al²²	2021	The aim of the study was to compare the effectiveness of a novel bioavailable SnF2 dentifrice against a negative control in treating gingivitis and preventing plaque.	Randomized, controlled, double-blind clinical trial	The study found that the novel SnF2 dentifrice resulted in significant improvement in gingival health as early as one week, and this improvement continued to increase throughout the trial.
Biesbrock et al²³	2019	The study aimed to assess the effectiveness of the SnF2 dentifrices in reducing plaque and gingivitis compared to the negative and positive controls.	Meta-analysis	The results of a meta-analysis demonstrated that the use of bioavailable gluconate chelated 0.454% SnF2 dentifrices significantly reduced gingivitis, as indicated by a reduction in gingival bleeding, when compared to negative control dentifrices.

According to the review, using a toothpaste containing stabilized SnF2 was found to have a beneficial impact on

decreasing the accumulation of dental plaque, dental calculus, gingivitis, halitosis, and staining. The review

revealed that toothpastes containing stabilized SnF2 showed a tendency towards a more significant impact when compared to toothpastes that did not contain this ingredient. Nevertheless, the review also indicates that additional well-designed randomized trials are required to provide comprehensive support for these results. Therefore, while the use of stabilized SnF2 toothpaste may be beneficial in reducing oral health issues, more research is needed to confirm these findings and provide more robust evidence.⁴

The study screened 129 participants, with 98 randomly assigned to one of the treatments. Ninety participants completed the study. The study's outcomes revealed significant statistical distinctions in favor of the dentifrice with 0.454% SnF2 in comparison to the negative control dentifrice for all assessment criteria, including MGI, BI, number of bleeding sites, and plaque index (PI), at both 12 and 24 weeks ($p < 0.0001$). After 24 weeks, 71% of participants in the 0.453% SnF2 treatment group exhibited less than 10% of bleeding sites. These findings suggest that the 0.454% SnF2 dentifrice was effective in reducing the effect of gingivitis and improving periodontal health compared to the negative control dentifrice over a 24-week period.²⁴

The study was completed by 98 participants. At the 3- and 6-month follow-ups, both the control and test groups displayed notable decreases in gingival inflammation and enhancements in the control of plaque. Nonetheless, the test dentifrice exhibited significantly more substantial reductions in all indices when compared to the control dentifrice ($p < 0.001$). According to the results, the test dentifrice was more efficient in diminishing gingival inflammation and enhancing plaque control in comparison to the control dentifrice during the 6-month study period.¹⁸

The study was completed by 135 participants, and notable reductions in gingival inflammation and improvements in plaque control were observed in all groups at the 3- and 6-month follow-up. Both SnF2 dentifrices exhibited substantial reductions in all indices, indicating that SnF2 dentifrices may be more effective in managing periodontal health and reducing gingival inflammation compared to standard control dentifrices ($p < 0.001$). In contrast to the other SnF2 dentifrice, the test dentifrice demonstrated somewhat greater but not significant improvements in the plaque and gingival indexes. The results suggest that both SnF2 dentifrices were effective in reducing gingival inflammation and improving plaque control, but the test dentifrice may have provided slightly better results compared to the other SnF2 dentifrice.¹⁹

In this study, a total of 107 individuals were enrolled, out of which 87 completed the study. The objective of the study was to assess the impact of an OHR compared to standard care on periodontal health over a duration of 24 months. The findings indicated that the mean values for

PPD, MGI, and GBI-BS were substantially lower for the OHR group when compared to the standard care group at each visit ($p \leq 0.0009$). The decrease in the median number of PPD loss events with a depth of ≥ 2 mm for the OHR group was significantly greater than the usual care group by 74% at the 24-month mark. Based on these results, it can be inferred that the OHR was successful in enhancing periodontal health and decreasing the incidence of PPD loss events compared to standard care over the 24-month study period.²⁰

In this study, at both week 2 and 3, There was a statistically significant ($p < 0.0001$) decrease in the Test group's BI score ($n=65$) in comparison to the control group ($n=65$). In addition, the Test group demonstrated statistically significant decreases from the control group in terms of overall TPI score, interproximal TPI score, MGI score, and number of bleeding sites (all $p < 0.0001$). The mean differences in these parameters were statistically significant in both week 2 and 3. The reductions ranged from 33.0% to 14.1%. Both toothpastes were generally well tolerated. These results suggest that the test toothpaste was more effective in reducing gingival inflammation and improving plaque control compared to the control toothpaste over a short period of time.³

In this study, the effectiveness of a test toothpaste in reducing oral bacteria was compared to a control toothpaste. According to the outcomes, the test toothpaste produced more substantial reductions in bacteria compared to the control toothpaste 12 hours after brushing, with reductions ranging from 14% to 27% at the 4-week evaluation. After eight weeks of brushing, these reductions rose to 27% to 41%. Similarly, for those who finished the study, there were more significant decreases in bacteria at the 4-week evaluation, which ranged from 22% to 59% 4 hours after brushing with the test toothpaste, and at the 8-week assessment, from 33% to 61%. These findings suggest that the test toothpaste was more effective in reducing oral bacteria compared to the control toothpaste over a period of 8 weeks.²¹

In this study, 100 subjects completed the trial and were assigned to use either a novel SnF2 dentifrice or a negative control. According to the findings, those who took the SnF2-containing dentifrice showed a statistically significant decrease in bleeding sites and a lower LSGI score compared to the negative control as early as week 1 ($p < 0.001$). Over the course of the study, the advantages of using the dentifrice with SnF2 continued to increase, resulting in a 33.4% decrease in bleeding sites and a 16.5% lower LSGI score at week 12 in comparison to the negative control ($p < 0.001$). Participants who had localized or generalized gingivitis (with $\geq 10\%$ bleeding sites) and used the dentifrice containing SnF2 for 12 weeks were six times more likely to transition to generally healthy gingival tissue (less than 10% bleeding sites) compared to those who used the negative control. The SnF2 dentifrice also demonstrated statistically

significantly lower plaque scores compared to the negative control at week 12 (p less than 0.001). These findings suggest that the novel SnF2 dentifrice was effective in reducing gingivitis, plaque, and exhibited an enhancement in periodontal health when compared to the negative control over a duration of 12 weeks.²²

In this study, 2,890 participants participated in 18 RCTs to assess the effectiveness of SnF2 paste compared to a negative or positive control in reducing bleeding sites. The results showed that on average, the number of bleeding sites were reduced by 51% compared to the negative control and 31% compared to the positive control. The typical difference in the amount of bleeding sites was -16.3 (95% CI: -27.8, -4.9) compared to the negative control and -3.6 (95% CI: -5.4, -1.8) compared to the positive control. Participants who had generalized or localized gingivitis had 3.7 times higher likelihood (95% CI: [2.8, 5.0]) of transitioning to a generally healthy state when using the dentifrice containing SnF2 compared to the negative control, and 2.8 times better odds (95% CI: [2.1, 3.9]) of transitioning to a generally healthy state using SnF2 versus a positive control. Risk of bias in all categories of study was considered low. These findings suggest that SnF2 paste effective in reducing bleeding sites and improving periodontal health compared to both negative and positive controls with low risk of bias.²³

DISCUSSION

Based on studies reviewed from 2018 to 2023, the available literature on the subject consistently provides evidence supporting the effectiveness of toothpastes containing SnF2 in treating gingivitis. The research question of this literature review focused on evaluating the effectiveness of SnF2 in the treatment of gingivitis. The studies reviewed consistently found that SnF2 toothpastes were more effective than negative or positive controls in reducing bleeding sites, LSGI scores, and plaque scores. Patients with gingivitis also had a better chance of having healthy gingival tissue when they used SnF2 toothpastes.

The results were consistent across multiple studies, which strengthens the conclusions drawn from this literature review. However, a study conducted by Avraham Zini and colleagues in 2021 differed in its method from the other studies reviewed. Instead of just using SnF2 toothpaste, the study implemented an oral hygiene program. Despite this difference, the study still found that using SnF2 toothpaste was effective in reducing gingivitis. Overall, the literature suggests that SnF2 dentifrices are effective in improving oral health and reducing gingivitis. These findings have important implications for dental professionals and patients seeking to prevent and treat gingivitis. More research is needed to examine the long-term effects of SnF2 toothpastes on oral health outcomes and to compare their effectiveness to other treatment options. Additionally, future studies could investigate the

optimal concentration and frequency of use of SnF2 toothpastes for maximum efficacy.

CONCLUSION

In conclusion, based on the reviewed studies, there is robust evidence supporting the efficacy of dentifrices containing SnF2 in the treatment of gingivitis. The consistent findings across multiple studies provide confidence in the conclusions of this literature review. Dental professionals and patients can use this information to make informed decisions about the management of gingivitis. Although the available evidence suggests that SnF2 dentifrices are effective in treating gingivitis, more research is required to thoroughly investigate their long-term effects and to determine the optimal use of these products. Such studies could help to elucidate the appropriate frequency and duration of use, as well as any potential adverse effects or contraindications associated with the use of SnF2 dentifrices. Therefore, further research is needed to provide a more comprehensive and nuanced understanding of the benefits and risks of these products in the management of gingivitis.

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