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REVIEW

FLUORIDE VARNISH AS A PREVENTIVE TREATMENT OF PRIMARY TEETH: A SYSTEMATIC REVIEW

Barniz de flúor en el tratamiento preventivo de dientes temporales: Revisión sistemática

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ABSTRACT

Objetive: To identify fluoride varnish as a preventive treatment for primary teeth in patients according to the evidence in the literature.

Materials and Methods: Literature review in the scientific literature, in the following databases: *PUBMED* (19), *BVS* (25), *BBO Odontología* (21). The descriptors selected in Spanish were: *"fluor"*, *"barniz"*, *"odontología"*. Combined in the following search strategy: Spanish: [*"fluor"* AND *"barniz"* AND *"odontología"*]. PICO and SPIDER methodology was used. .

Results: 65 articles were found by selecting by title and abstract. After a thorough reading only 23 articles met the inclusion criteria of being a clinical trial, longitudinal study (quasi-experimental or cohort), duplicate articles and 13 that were not directly related to the topic were not excluded. The final sample totaled seven articles for the systematic review.

Conclusions: Fluoride varnish is a material for preventive use in dentistry that has a wide and successful application in the treatment of the population at all ages and with diverse application in its use.

Keywords: Varnish; Topical fluorides; Fluoride treatment; Dentistry; Disease prevention; Systematic review.

RESUMEN

Objetivo: Resumir sistemáticamente la evidencia disponible con respecto a la plausibilidad de la participación del VEGF en la asociación periodontitis/psoriasis.

Materiales y Métodos: Revisión bibliográfica en la literatura científica, en las siguientes bases de datos: *PUBMED* (19), *BVS* (25), *BBO Odontología* (21). Los descriptores seleccionados en español fueron: *"flúor"*, *"barniz"*, *"odontología"*. Combinados en la siguiente estrategia de búsqueda: español: [*"flúor"* AND *"barniz"*, AND *"odontología"*]. Se utilizó la metodología PICO y SPIDER.

Resultado: Fueron encontrados 65 artículos seleccionando por título y resumen. Después de una lectura minuciosa solamente 23 artículos cumplieron con el criterio de inclusión que fuera un ensayo clínico, estudio longitudinal (cuasi experimental o cohorte), se eliminaron artículos duplicados y 13 que no tenían relación directa con el tema. La muestra final totalizó 7 artículos para la revisión sistemática.

Conclusión: El barniz de flúor es un material de uso preventivo en odontología que tiene una amplia y exitosa aplicación en tratamientos de la población en todas las edades y con aplicación diversa en su utilización.

Palabras Clave: Barniz; Fluoruros tópicos; Tratamiento con fluoruro; Odontología; Prevención de enfermedades; Revisión Sistemática.

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INTRODUCTION

Preventing dental caries is a top priority for health services, as prevention enhances the overall treatment of oral diseases.[1] Beneficial micro-organisms can establish symbiotic relationships that are non-pathogenic or exhibit low pathogenic potential. These symbionts produce active substances that can modify the host's immune response, leading to changes in the microbiota composition through competition among species for space and nutrients. Such microbial interactions contribute to improved oral health. *Streptococcus mutans*, commonly found on tooth surfaces —particularly in the depths of pockets and cracks— is one of the primary micro-organisms res-ponsible for dental caries.

Consequently, eliminating or delaying its colonization can significantly reduce the risk of caries development.[2-4] The aim of this study is to evaluate the efficacy of fluoride varnish as a preventive treatment for primary teeth in patients, supported by evidence from existing literature.

MATERIALS AND METHODS

A systematic review of the scientific literature was conducted using the following databases: *PUBMED, BVS*, and *BBO Odontología*. The inclusion criteria were:

a) Studies published between 1995 and May 2022 in Spanish and English that provided full text on fluoride varnish;

b) Studies focusing on the preventive effects of fluoride varnish in primary teeth and;

c) Studies whose methodological designs included randomized controlled trials (RCTs), cohort studies, quasi-experimental studies, and follow-up studies.

The data search was carried out by two research authors JEOC and RNGS between May 8 and July 6, 2022, with the following words and Boolean operators selected. In Spanish: *"flúor", "barniz", "odontología"*, in English: *"fluoride", "varnish", "odontology"*; combined in the following search strategy: Spanish: [*"flúor"* AND *"barniz"* AND *"odontología"]*; English: [*"fluoride"* AND *"varnish"* AND *"odontology"]*. This search strategy was used in the same way in all the databases.

PICO Methodology

a) Types of participants (P): Publications that meet inclusion criteria;

b) Type of intervention (I): Fluoride varnish;

c) Comparison (C): Prevention and carious cavities;

d) Results (O): Dental prevention.

SPIDER Methodology

a) Sample, (S): Publications that meet inclusion criteria;

b) Phenomenon of interest, (PI): Fluoride varnish as a preventive method;

c) Study design, (D): Randomized Controlled Clinical Trial, cohort, quasi-experimental, follow-up studies;

d) Evaluation (E): Information collection instruments on oral health knowledge and attitudes;

e) Type of research, (R): Quantitative

Data Analysis and Processing

The selected studies were analyzed, and data extraction was performed using an Excel spreadsheet. The quality of the articles was evaluated using the scale proposed by Jadad *et al.*,[4] which employs a systematic method based on responses to five questions.

To ensure the quality of the research, only articles that answered more than three questions affirmatively were included.

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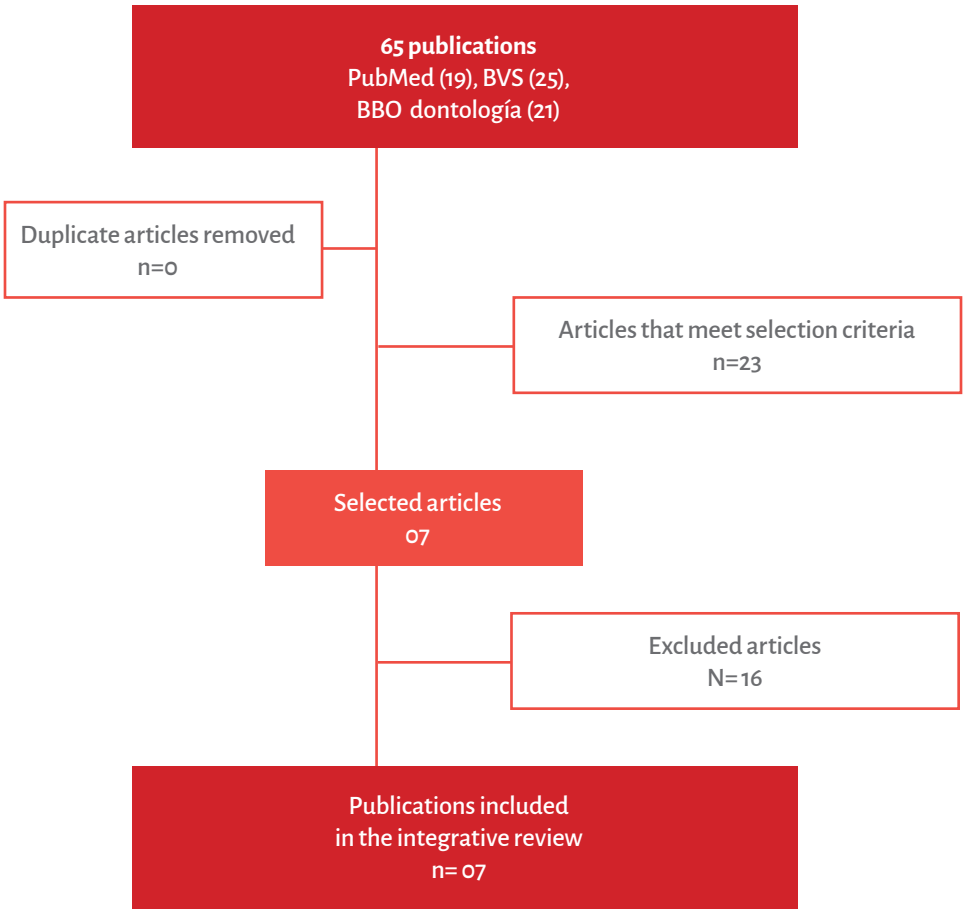
Figure 1. Flowchart of systematic review protocol.



RESULTS

A total of 65 articles were identified through title and abstract screening. After a thorough review, 23 articles met the inclusion criteria, while 16 were excluded for not addressing the relevant phenomenon. Ultimately, the final sample consisted of 7 articles for the integrative review (Figure 1).

The seven studies reviewed have varying durations, ranging from the shortest, such as that of Pariona Miraya *et al.,*[6] which lasted only seven days, to the longest, that of Flamee *et al.,*[9] which lasted twenty-four months. Some studies perform analyses at various stages during the study, including at least initial and final measurement points. The sample sizes are also very variable, from the smallest number of participants, such as that of Johnson *et al.,*[8] with only fifteen participants, to the largest, that of Stecksen-Blicks *et al.,*[1] with three hundred and two participants.

The age of the participants spans a broad range, from two to five years, as in the study of Pariona Miraya *et al.,*[6] and the widest range, that of Johnson *et al.,*[8] which includes participants from forty-five to eighty-nine years. It is worth noting that the study of Brailsford *et al.,*[7] mentions older adults but does not specifically state the age of the participants (Table 2).

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Table 1. Characteristics of the studies included in the systematic review.

Authors, Country, Year	Objective	Method	Results
Salazar *et al.*,[5] Chile, 2017	To evaluate the immediate and mediate effectiveness (after 2 weeks) of a fluoride varnish (Flúor Protector®) used in the study.	The study consisted of an uncontrolled clinical trial. The sample involved 30 patients, regardless of gender, aged between 20 and 60 years, treated at the dental clinics of the Faculty of Dentistry at Universidad Andres Bello, whose diagnosis was DH (Dentin Hypersensitivity), in at least one tooth, with gingival recession of at least 2 mm, which presented exposed dentin from the cementoenamel junction, and who also responded to 3 or more points on the Numeric Scale (NS), when the evaporative stimulus was applied. The data were collected in a form designed for the study, which included patient data and 9 NS, with which the patients' pain perception was quantified when faced with 3 stimuli: evaporative, tactile and thermal.	Statistically significant results ($p<0.05$) were observed in the almost complete reduction in DH immediately after treatment (median<3), in addition to the sustained reduction in DH in the follow-up session 2 weeks after therapy
Pariona Minaya *et al.*,[6] Brazil, 2016	To compare the amount of residual fluoride (F) in saliva after application of 5% sodium fluoride varnish and 5% tricalcium phosphate fluoride varnish in children aged 2 to 5 years.	Unstimulated saliva was collected from 24 children who had daily access to fluoridated salt and used children's toothpaste containing 550 ppm F. The first salivary sample was collected a baseline, and subsequent samples were taken at different time intervals following fluoride varnish application (15, 30, and 60 minutes, as well as 24, 48, 72, 96, and 168 hours). A total of 216 samples were obtained, consisting of 96 samples from Duraphat® varnish, 96 from Clinpro™ WV varnish, and 24 baseline samples. Laboratory analyses were conducted at the Department of Biochemistry, Bauru School of Dentistry (FOB), University of São Paulo. An Orion 9409 electrode and a microelectrode coupled to an Orion EA 940 potentiometer were used to analyze the samples after diffusion using the Taves method.	The concentration of fluoride ions showed statistically significant differences between both products at 24 hours ($p<0.001$), with similar results at 48 hours ($p=0.003$), 96 hours ($p<0.001$), and 168 hours ($p<0.001$). The statistical analysis was performed using the Shapiro-Wilk test and Student's t-test. Both varnishes showed an increase in residual fluoride levels in saliva at 15, 30, and 60 minutes. However, after these time points, fluoride levels were not significantly different from the baseline.
Brailsford *et al.*,[7] England, 2002	To compare the clinical effects of a fluoride-containing varnish (Fluor protector) in combination with a chlorhexidine-containing varnish (Cervitec) on existing root caries lesions in a group of frail elderly subjects.	A randomized, double-blind longitudinal study was conducted. Subjects (n=102) were randomly assigned either to the Test group or to the Placebo group. All dentin and root caries lesions of all subjects were coated with Fluor-Protector, while lesions in the Test group were also coated with Cervitec, and lesions in the Placebo group were coated with a placebo varnish. Treatments were repeated five times over a 12-month period. Clinical parameters associated with root caries, measurements of individual lesions, and salivary levels of caries-associated bacteria were assessed at intervals.	The clinical severity of the lesions in the test group did not change significantly over the 12-month study period. In the placebo group, mean lesion width and height, as well as exposed root length, increased significantly and lesions were significantly closer to the gingival margin. There were no significant changes in salivary levels of caries-associated microorganisms after 12 months, although in both groups there was initially a significant reduction in salivary levels of *Streptococcus mutans*.
Johnson *et al.*,[8] Sweden, 2003	To evaluate the effect of non-restorative cariostatic treatment on the progression of active superficial root caries lesions.	Pilot study. Setting: Department of Cariology, Institute of Dentistry, Karolinska Institutet, Huddinge. Subjects: 15 physically dependent patients. Intervention: Patients were assigned to one of the following groups. Group 1, professional dental cleaning and application of tap water flavored with eucalyptus oil; Group 2, professional dental cleaning and application of Cervitec, (1% chlorhexidine in thymol-containing varnish); Group 3, professional dental cleaning and application of Cervitec and Fluor Protector (0.1% fluoride-containing varnish). Every three months for 18 months, each subject received the treatment twice at a 10-day interval. Measurements: The status of the 56 root caries lesions was assessed every six months using a root caries index based on visual and tactile criteria. The examiners were blinded to which treatment group the patients belonged.	In most subjects (14 of 15), progression of root caries lesions was halted. No statistically significant differences were observed between the three treatment groups. However, regardless of the treatment regimen, there was a statistically significant difference between the greater number of subjects who did not show progression of root caries lesions and those who did, at 6 months ($p=0.022$), 12 months ($p=0.006$) and 18 months ($p<0.001$).

Authors, Country, Year	Objective	Method	Results
Flamee *et al.*,[9] Greece, 2015	To evaluate the caries-preventive effect of chlorhexidine varnish when applied topically during the eruption period of permanent molars.	The study group consisted of 189 patients, aged 5 to 14 years, with an erupting first or second permanent molar. After stratification by molar type and eruption stage, patients were randomly assigned to either quarterly topical applications of an antibacterial varnish (Cervitec Plus; CV group) or biannual applications of a fluoride varnish plus biannual treatments with a placebo varnish (Fluor Protector; FV group). The study duration was 2 years. The primary endpoint was the incidence of caries (initial and cavitated) in erupting molars, and the secondary outcome was the count of *Streptococcus mutans* in saliva.	The groups were balanced with respect to socioeconomic status, oral hygiene, dietary habits and caries experience at baseline. The dropout rate was 11.6%. The incidence of caries was low (<10%) in both groups and there were no significant differences between the CV and FV groups with respect to the development of occlusal caries in erupting molars (relative risk 1.08; 95% CI 0.94–1.25). Significantly lower levels of *Streptococcus mutans* in saliva were revealed in the CV group at the end of the study ($p<0.05$).
Stecksen Blick *et al.*,[10] Sweden, 2007	To evaluate the efficacy of topical fluoride varnish applications on white spot lesion (WSL) formation in adolescents during treatment with fixed orthodontic appliances.	The study design was a randomized, double-blind, placebo-controlled trial with two parallel arms. Subjects were 273 children aged 12 to 15 years who were referred for treatment of the maxilla with fixed orthodontic appliances. Patients were randomly assigned to either a test group or a control group, receiving topical applications of a fluoride varnish (Flúor Protector) or a placebo varnish every 6 weeks during the treatment period.	Outcome measures at the end of treatment included the incidence and progression of WSL in the maxillary incisors, canines, and premolars, scored from digital photographs by two independent examiners. The dropout rate was 5%. The mean number of varnish applications was 10 (range 4–20) in both groups. The incidence of WSL during fixed appliance treatment was 7.4% in the fluoride varnish group compared with 25.3% in the placebo group ($p<0.001$). The mean progression 4 score was significantly lower in the fluoride varnish group than in the placebo group, (0.8 to 2.0 versus 2.6 to 2.8 ($p<0.001$). The absolute risk reduction was 18%, and the number needed to treat was calculated to be 5.5.
Turska Szybka *et al.*,[11] Poland, 2021	To examine the caries-preventive effect of 2 fluoride varnishes in preschool children with caries, and then compare the results with a control group without varnish.	Following screening, 180 preschool children aged 36–71 months with at east one non-cavitated lesion were enrolled and randomly assigned to 3 parallel groups, namely A: 1.5% ammonium fluoride varnish (Flúor Protector S), B: 5% NaF varnish (Duraphat), and C: professional dental cleaning. All children were recalled every 3 months for the intervention and their parents were instructed to brush their teeth with a 1000 ppm fluoride toothpaste toothpaste twice daily. Caries were recorded at baseline and after 12 months by a calibrated examiner and incidence was graded at the non-cavity (d2) and cavity (d3) level. Differences between groups were tested with chi-square and two-sided t tests.	One hundred seventy-two children (95.6%) completed the trial and 56 (32.6%) and 35 (19.2%) developed new d2 and d3 lesions, respectively. Both varnishes reduced the incidence of caries compared with the control group, but there were no significant differences between group A and group B. Compared with group C, the relative risk of developing cavitated lesions was 0.39 (95% CI: 0.22–0.62) in group A and 0.26 (95% CI: 0.14–0.50) in group B. The total fraction prevented (Δd2d3mft) for group A and group B was 19.9 and 22.5% ($p < 0.05$), respectively.

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Table 2. Description of the studies .

Study	Duration	Sample	Age
Tuska-Szybka *et al.*[11] 2021	12 months	220	3 to 6 years
Stecksen-Blicks *et al.*[10] 2007	6 weeks	302	12 to 15 years
Johnson *et al.*[8] 2003	6 to 18 months	15	45 to 89 years
Flamee *et al.*[9] 2015	24 months	189	5 to 14 years
Salazar *et al.*[5] 2017	2 weeks	30	20 to 60 years
Pariona Miraya *et al.*[6] 2016	7 days	24	2 to 5 years
Brailsford *et al.*[7] 2002	12 months	121	Older adult

DISCUSSION

Characteristics of the studies

The study conducted by Salazar *et al.,*[5] examines the use of fluoride varnish to reduce or eliminate dentin hypersensitivity, based on the hydrodynamic theory proposed by Brannstrom, which explains the cause of dental sensitivity. Some of the treatments used in the dental field include pulp desensitizing agents. Mechanisms that use these substances are the occlusion of dentinal tubules, thereby reducing dentin permeability. The application of topical fluorides to treat dentin hypersensitivity has become widespread, creating barriers through the precipitation of calcium fluoride, on the exposed surface of the dentin, thus reducing dentin permeability.[5]

The resins that contain fluoride varnishes provide an additional mechanical barrier for the sealing of dentinal tubules. Pariona Minaya *et al.,*[6] note that varnishes with sodium fluoride and resin-based formulations do not remain adhered to the dental surface for twenty-four hours; they also point out that varnishes with calcium phosphate release a greater amount of fluorides in the dental enamel.

Stecksén-Blicks *et al.,*[10] suggests that fluoride varnishes release their content gradually and over a long period of time, ensuring low concentrations at the plaque-liquid enamel interface. This can help balance the caries process by decreasing demineralization and promoting remineralization; although it does not completely prevent the formation of white spots that are precursors to caries.

The frequency and mode of application of varnishes depends on various factors such as caries experience, oral hygiene control, treatment phase, age, and chronology of tooth eruption. Annual reapplication has not been shown to be effective, while biofilm control is essential for ensuring treatment success. It has also been shown that the use and application of varnishes are linked to motivation and education strategies to monitor oral hygiene control and help prevent the appearance of new lesions.

Additionally, its application in combination with chlorhexidine has had an increased cariostatic effect, compared to using either treatment separately, particularly in controlling bacterial infections and promoting the remineralization of hard tissues in the mouth, which are essential for maintaining balance and supporting both restorative treatments and biofilm control.[12]

Varnishes containing calcium triphosphate are water-based fluoride varnishes that promote the absorption of fluoride ions, depending on the

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type of caries, fluoride concentration, and type of calcium triphosphate used. Although these varnishes are considered more effective, the results are not yet conclusive.[12]

The combined use of fluoride varnish with chlorhexidine significantly reduces the rate of recolonization of healthy surfaces by micro-organisms such as *Streptococcus mutans*.[6] Additionally, it has documented that using a 40% chlorhexidine varnish and a 5% sodium fluoride varnish at three-month intervals for twelve months can reduce the development of root caries. However, varnishes with chlorhexidine and thymol, with or without fluoride, did not show any additional benefit. Nonetheless, their supplementary use alongside fluoride varnish may still be a valuable complement in the control of root caries.[7]

Brailsford *et al.*,[7] suggest that age is an important consideration when using fluoride varnish: in younger patients, the use of fluoride varnish is preventive, while in older ones, it is more curative because the oral health of this group is usually poor. Older people have high levels of coronal caries particularly at the root level, which is an area of difficult access for treatment. Additionally, they exhibit high rates of plaque accumulation and periodontal diseases (gingivitis and/or periodontitis), caused in some cases by pros-theses and poor oral hygiene, triggering conditions such as stomatitis and angular cheilitis.
Therefore, the use of effective treatments for the prevention and management of oral health in older adults is essential, especially given the aging trend observed in the general population of different countries.

In pediatric patients, fluoride varnish is an effective preventive method and is the first choice for children with caries, provided that the teeth meet the clinical criteria for such treatment, since it does not require continuous application unlike some antibacterial varnishes. In addition, the use of this type of antibacterial agents should be approached with caution, as caries is not a typical infectious disease, but the result of a complex interaction between com-mensal microbiota, host susceptibility, and envi-ronmental factors.[8]

Future prevention strategies should be directed at specific oral pathogens adopting an ecological approach aimed at modifying the structure and development of the biofilm.[8] Clinicians are increasingly looking for non-invasive treatments, particularly in patients with systemic diseases or disabilities, who also present a high caries activity, can hardly practice independent self-care, and may lack motivation for their oral hygiene.[7] Differences in the composition and characteristics of fluoride varnishes may affect their anticaries properties; However, there is little evidence to make direct comparisons to support decision-making. Most fluoride varnishes are considered effective in significantly reducing the incidence of caries.

Treatment is successful when the clinician complies with the treatment protocol, but there are concerns regarding patients' compliance with home care instructions. Despite this, considering the cost and direct and indirect benefit that this treatment provides, it should be considered in local and even national contexts to decide whether to use it in specific caries prevention programs for treating pediatric patients.[10]

CONCLUSION

Fluoride varnish is the preferred material for preventive use in dentistry, particularly for pediatric patients. However, it is also widely and effectively applied across all age groups for various conditions, including cervical caries and dental sensitivity.

A specific protocol for its application and indications should be followed both in the dental office and at home by patients. Fluoride varnish can be used in conjunction with other preventive materials or substances to enhance oral health. To strengthen the evidence in the literature, a greater number of randomized controlled trials and follow-up studies are needed, as the current availability of such studies in the reviewed databases is limited.

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CONFLICT OF INTERESTS

None declared.

ETHICS APPROVAL

Study protocol approved by the institutional ethics committee CEI-04A/2020.

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AUTHORS' CONTRIBUTIONS

José Orellana-Centeno: Conceptualization, Writing – original draft, Writing – review and editing.
Roxana Guerrero Sotelo: Conceptualization, Writing – original draft, Statistical Analysis, Writing – review and editing.
Verónica Morales Castillo: Conceptualization, Writing – original draft, Writing – review and editing.
Mauricio Orellana-Centeno: Conceptualization, Writing – original draft, Statistical Analysis, Writing – review and editing.

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