

CARIES INCIDENCE AFTER PROFESSIONAL FLUORIDE TREATMENT: A SYSTEMATIC REVIEW

Incidência de cárie após tratamento profissional com fluoretos: uma
revisão sistemática

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ABSTRACT

Aim: The purpose of this study was to assess whether individuals with active caries lesions treated with professional topical application of fluoride at high concentrations show a lower incidence of caries than individuals who have not received professional treatment with fluoridated products. **Literature review:** Randomized clinical trials in which patients were followed up for at least 6 months were included. Studies were identified with MEDLINE, Embase, LILACS, SCOPUS, and Cochrane Database of Systematic Reviews. Pairs of reviewers independently conducted study selection, data extraction, and risk-of-bias assessments. Eight trials, which included 5018 children and adolescents, were eligible. Results were evaluated by calculating the preventive fraction to standardize the outcomes. **Results:** Fluoride varnish yielded a better preventive fraction (90.18% to 14.6%) in both primary and permanent dentitions in comparison with methods using gel (22.3% to 6%) and foam (24%) after a mean follow-up period of 20.6 months. Regardless of the product used, increased frequency of application yielded greater benefit. **Discussion:** These results do not agree with previous findings that, in 8 weeks periods, did not observe an additional effect of the professional use of fluorides over the control treatments (biofilm control). The present review indicates the need for long-term monitoring of the effect of treatment, whereby the effects of high fluoride concentrations may appear. **Conclusion:** Professional fluoride treatment proved to be effective in preventing new long-term injuries in both primary and permanent dentition, irrespective of the vehicle used (varnish, gel, or foam). (PROSPERO Register number CRD42021210740). **Keywords:** Dental caries. Fluorides, topical. Dentition, permanent. Tooth, deciduous.

RESUMO

Objetivo: Avaliar se indivíduos com lesões ativas de cárie tratadas com aplicação tópica profissional de fluoretos em altas concentrações apresentam menor incidência de cárie do que indivíduos que não receberam este tratamento. **Revisão da literatura:** Ensaios clínicos randomizados, com acompanhamento de pelo menos 6 meses foram incluídos. Os estudos foram identificados nas bases de dados MEDLINE, Embase, LILACS, SCOPUS e Cochrane Database of Systematic Reviews. Pares de revisores conduziram de forma independente a seleção de estudos, extração de dados e avaliações de risco de viés. Oito estudos, que incluíram 5.018 crianças e adolescentes, foram elegíveis. Os resultados foram avaliados por meio do cálculo da fração preventiva. **Resultados:** O verniz fluoretado apresentou melhor fração preventiva (90,18% a 14,6%), tanto na dentição decídua quanto na permanente, em comparação com os métodos com gel (22,3% a 6%) e espuma (24%) após um período médio de seguimento de 20,6 meses. Independentemente do produto utilizado, o aumento da frequência de aplicação apresentou maior benefício. **Discussão:** Estes resultados diferem de achados anteriores em que, em períodos de 8 semanas, não houve efeito adicional do uso profissional de fluoretos em relação ao tratamento controle. A presente revisão indicou a necessidade de monitoramento a longo prazo do efeito do tratamento, quando os efeitos do fluoreto de alta concentração podem aparecer. **Conclusão:** O tratamento profissional com flúor mostrou-se eficaz na prevenção de novas lesões a longo prazo, tanto na dentição decídua quanto na permanente, independente do veículo utilizado (verniz, gel ou espuma). (Número de registro PROSPERO CRD42021210740).

Palavras-chave: Cárie dentária. Fluoretos tópicos. Dentição permanente. Dente decíduo.

INTRODUCTION

The use of fluorides in their diverse forms has been the primary factor contributing to the decline in both the prevalence and severity of dental caries in economically developed countries¹. The presence of fluoride (F), mainly local, in the oral environment, is essential to interfere with de- and remineralization events^{2,3}. When hard dental tissue is exposed to high concentrations of fluoride vehicles (>100 ppm), the reaction of biological hydroxyapatite with fluoride yields has two effects: (1) incorporation of fluoride ions into hydroxyapatite (fluorohydroxyapatite) and (2) deposition of calcium fluoride⁴ on the dental surface. Calcium fluoride deposits are formed when fluoride reacts with the mineral in the dental structure^{5,6}. These deposits gradually dissolve, releasing F ions into the oral environment and maintaining the effect for weeks or months after application⁴.

On the basis of this mechanism of action of fluoride in the dental structure, several studies have evaluated topical methods for professional F application, proving its effectiveness, in the form of highly concentrated solutions⁷, foam^{8,9}, gels, and varnishes¹⁰.

Delbem et al.¹¹ conducted an *in vitro* study comparing the topical application of acidulated phosphate fluoride (APF) gel and neutral sodium fluoride gel with fluoride toothpaste and concluded that fluoride application using gels (acidulated or neutral) or frequent fluoride application at low concentrations (dentifrice) were both efficient for tooth decay control.

In an *in situ* study, Maltz et al.¹² noted that topical application of APF gel had an additional effect on the control of enamel lesions (white spot lesions) in comparison to the effects obtained with fluoridated toothpaste, promoting an increase in surface microhardness and fluoride content in relation to demineralized blocks.

These findings suggest that enamel (treated surfaces) with a high concentration of fluoride would be more resistant to future demineralization processes. However, two clinical trials performed by Ferreira et al.¹³ and Bonow et al.¹⁴ that included topical fluoride application as well as other disease/hygiene control methods did not show additional benefits after treating incipient carious lesions with topical fluoride application, suggesting that supervised weekly brushing may have accounted for the equivalence of the results obtained in the previous studies.

Considering these conflicting findings in the literature, the present systematic review of the literature aims to assess whether professional topical application of fluoride at high concentrations is effective for preventing new long-term injuries in both primary and permanent dentition.

LITERATURE REVIEW

Inclusion criteria for this review

Types of studies

Randomized clinical trials (RCTs) with at least 6 months of follow-up

Types of participants

Adolescents and children without restriction of age, gender, or ethnicity of the sampled individuals

Studies assessing both primary and permanent dentitions

Presence of enamel and/or dentin caries lesions at the beginning of the study.

Types of interventions

Topical fluoride application (varnish, gel, foam, or highly concentrated solution)

Types of outcome measures

Caries incidence, which can be measured by DMF - T/S, dmf -T/S, or ICDAS, including non-cavitated and cavitated lesions. We also assessed the caries preventive fraction (PF).

Search methods for identification of studies

A systematic review of the literature was outlined and reported according to the guidelines established by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). Search was conducted until February 2022. The following terms, combined in search blocks, were adapted for each database (Table 1):

P: Individuals with deciduous and permanent dentition (permanent dentition, permanent teeth, secondary dentition, deciduous dentition, primary dentition, deciduous dentition);

I: Topical fluoride application (topical fluorides, fluoride varnishes, cariostatic agents, topical fluorides dental, Acidulates phosphate fluoride, Silver diamine fluoride, Sodium fluoride, Fluoride gel, Fluoride foam, Fluoride solution).

C: No intervention or use of fluoridated toothpaste.

O: Caries incidence (dental caries, dental caries susceptibility, caries increment, caries risk, caries incidence).

Databases used for electronic searches

Identification of studies was based on a search strategy for each electronic database (Medline via PubMed, Embase, LILACS, Cochrane Central Register of Controlled Trials, ClinicalTrials.gov) (Table 1). Free terms and Mesh terms previously recognized in each database were used in English. Neither authors nor journals were blinded to reviewers. There were no restrictions regarding the journal, year of publication, and language.

Other resources

A manual search was carried out in the bibliographic references of selected articles after complete reading.

Table 1 – Search strategy for each database

	Terms	Results	Date/Time
Medline (PubMed)	“Dental Caries”[Mesh] OR “Dental Caries Susceptibility” OR “Caries Increment” OR “Caries Risk” OR “Caries Incidence” AND “Topical Fluorides”[Mesh] OR “Fluoride Varnishes” OR “Varnishes,Fluoride” OR “Cariostatic Agents” OR “Topical Use of Fluorides” OR “Acidulated Phosphate Fluoride” OR “Silver Diamine Fluoride” OR “Sodium Fluoride” OR “Fluoride Gel” OR “Fluoride Foam” OR “Fluoride Solution” AND “Permanent Dentition”[Mesh] OR “Permanent Teeth” OR “Dentition,Permanent” OR “Secondary Dentition” OR “Deciduous Dentition” OR “Deciduous Teeth” OR “Primary Dentition”	1138	10/11/2020 17:43:38

Table 1 – Search strategy for each database

	Terms	Results	Date/Time
Embase	'Secondary Dentition'/Exp OR 'Permanent Tooth'/Exp OR 'Adult Teeth' OR 'Adult Tooth' OR 'Dentes Permanentes' OR 'Permanent Teeth' OR 'Permanent Tooth' OR 'Secondary Teeth' OR 'Secondary Tooth' OR 'Tooth, Permanent' OR 'Primary Dentition'/Exp OR 'Deciduous Tooth'/Exp) AND 'Topical Fluorides' OR 'Fluoride Varnish'/Exp OR 'Duraphat' OR 'Fluoride Varnish' OR 'Fluorides, Topical' OR 'Fluorine Varnish' OR 'Miraflur' OR 'Mirafluorid' OR 'Varinishes, Fluoride' OR 'Anticaries Agent'/Exp OR 'Anticaries Agent' OR 'Cariostatic Agent' OR 'Cariostatic Agents' OR 'Topical Use Of Fluorides' OR 'Acidulated Fluorophosphate'/Exp OR 'Acidified Phosphated Fluoride' OR 'Acidulated Fluorophosphate' OR 'Acidulated Phosphate Fluoride' OR 'Fluorophosphate, Acidulated' OR 'Silver Diamine Fluoride'/Exp OR 'Fluoride Tray'/Exp OR 'Fluoride Gel Tray' OR 'Fluoride Tray' OR 'Fluoride Foam' OR 'Fluoride Solution') AND ('Dental Caries'/Exp OR 'Caries' OR 'Caries, Dental' OR 'Cariogenesis' OR 'Cariou Dentine' OR 'Cariou Teeth' OR 'Dental Caries' OR 'Dental Caries Susceptibility' OR 'Dental Decay' OR 'Dental Fissure' OR 'Dental Fissures' OR 'Fissure, Tooth' OR 'Root Caries' OR 'Tooth Caries' OR 'Tooth Decay' OR 'Tooth Fissure' OR 'Caries Incidence' OR 'Caries Risk' OR 'Carie Increment')	466	10/11/2020 18:27:47
LILACS	"Dental caries" AND "topical fluorides"	173	10/11/2020 13:40:32
Scopus	"Dental Caries" OR "Dental Caries Susceptibility" OR "Caries Increment" OR "Caries Risk" OR "Caries Incidence" AND "Topical Fluorides" OR "Fluoride Varnishes" OR "Cariostatic Agents" OR "Topical Use of Fluorides" OR "Acidulated Phosphate Fluoride" OR "Silver Diamine Fluoride" OR "Sodium Fluoride" OR "Fluoride Gel" OR "Fluoride Foam" OR "Fluoride Solution" AND "Permanent Dentition" OR "Permanent Teeth" OR "Secondary Dentition" OR "Deciduous Dentition" OR "Deciduous Teeth" AND (LIMIT-TO (SUBJAREA , "DENT"))	1878	10/11/2020 14:34:45
Cochrane	"Dental caries" OR "Dental Caries Susceptibility" OR "Caries Increment" AND "Topical Fluorides" OR "Fluoride Varnishes" OR "Cariostatic Agents" AND "Permanent Teeth" OR "Deciduous Teeth" OR "Permanent Dentition"	229	30/06/2019 21:05:19

Studies selection

The selection of the studies was performed by four reviewers (AGR, BTS, HFM, and JJ), and disagreements were resolved by two expert reviewers (BBS and JJ).

Data extraction and management

Data extraction was performed independently by 3 evaluators (BTS, JJ AGR). Using a table in Excel software (for Windows), the following items were collected: author names, year of publication, country of origin, follow-up time, age of the participants, caries experience at the beginning and end of the studies, type of intervention, method of comparison, results found, and p values with statistical significance found in the study.

Preventive fraction

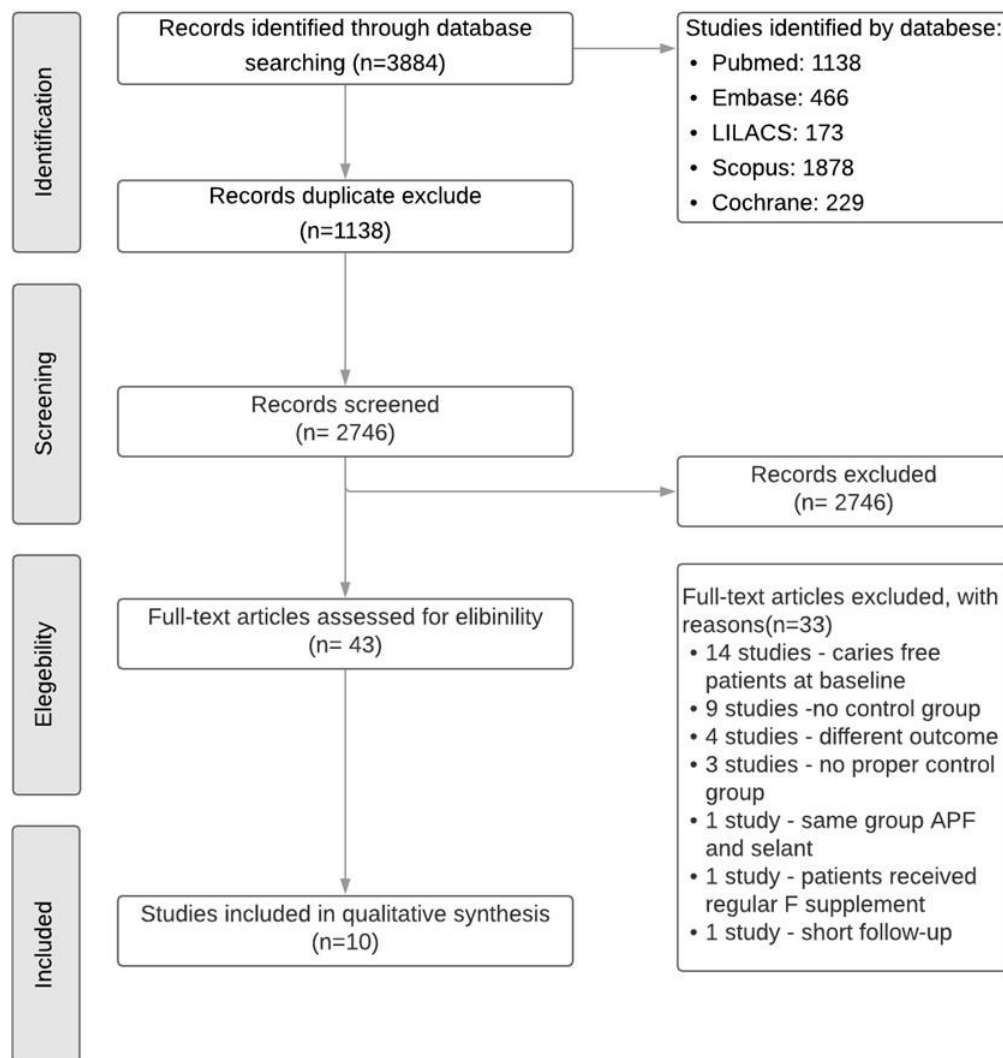
The PFs were derived by calculating the difference between the incidence of DFS in the placebo group (μ_c) and the incidence in the treatment group (μ_t), divided by the incidence of DFS in the placebo group ($PF = 100 [\mu_c - \mu_t] / [\mu_c]$)¹⁵.

RESULTS

Search and included studies

After removing 1119 duplicates, we screened 2463 titles and abstracts. Of these, 43 full texts were evaluated, and eight studies were eventually included in this review (Fig. 1).

Figure 1. Flowchart of the study



Characteristics of the included studies

These 8 clinical trials were published between 1973 and 2016 and conducted in 6 countries (Table 2). Average follow-up period for the trials was 20.6 months, while the minimum follow-up period was 9 months¹⁶. Two clinical trials involved 12 months of follow-up^{15,17}, while 4 of them performed evaluations over 24 months^{9,18-20} and the longest follow-up was 36 months²¹. The studies were carried out in children and adolescents ($N_{\text{people}} = 5018$). Three trials were performed on the primary

dentition and four on the permanent dentition. The average percentage of patients who were followed up during the study was $78.9\% \pm 0.15\%$ ($N_{\text{people follow-up}} = 3954$).

Five trials tested the use of fluoride varnish in comparison with different methods, including a fluoride-free placebo varnish in three trials, a fluoride mouth rinse in one trial, and caregiver counseling with and without the use of fluoride varnish in the fifth trial. Two trials compared the use of APF gel to placebo. One trial compared fluoride foam with the placebo.

Table 2 - Studies included in the review

Autor, year	Country	Age	Sample	Follow-up	Number of applications	Lost follow-up	DMF	
							Group	
							<i>Test</i>	<i>Control</i>
Arruda et al., 2011	Brazil	7-14 years	(n = 379) • Test: Fluoride Varnish 5% NaF (n = 198) • Control: Fluoride Varnish Placebo (n = 181)	12 months	2 (baseline and 6 months)	44.6%	•Baseline S: 6.15 •Final S: 10.76	•Baseline S: 5.59 •Final S: 13.31
Olliver et al., 1992	Canada	6 years	(n = 488) • Test (APF Gel): (n =248) • Control (Placebo): (n = 240)	24 months	4 (Every 6 months)	11.7%	•Baseline S: 0.59 •Final S:2.94	•Baseline S: 0.74 •Final S: 3.24
							<i>Test</i>	<i>Control</i>
Trubman et al., 1973	USA	8-12 years	(n = 1143) • Test (APF Gel) • Control (Placebo)	36 months	12 (Every 3 months)	66%	•Baseline S: 2.28 T: 1.46 •Final: S: 5.55 T: 2.72	•Baseline S: 2.29 T: 1.44 •Final: S: 6.5 T: 3.11
							<i>Test</i>	<i>Control</i>
Keller et al., 2016	Denmark	6-12 years	(n = 1018) • Test: Fluoride mouth rinse 0.1% (n = 512) • Control: Fluoride Varnish fluoretadoa (n = 506)	24 months	• Test: 104 (1 time/week - 2 minutes) • Control: 4 applications of Fluoride Varnish (semiannual applications)	5.6%	•Baseline S: 0.56 •Final S: 0.91	•Baseline S: 0.54 •Final S:0.95

Table 2 - Studies included in the review

							<i>Test</i>	<i>Control</i>
Autio-gold & Courts, 2001	USA	3-5 years	(n = 183) • Test: Fluoride Varnish 5% (n = 68) • Control: Placebo (n = 115)	9 months	2 (baseline and 4 months)	19.1%	•Baseline S: 2.51 T: 1.63 •Final: S: 3.05 T: 1.68	•Baseline S: 2.58 T: 2.07 •Final: S: 4.05 T: 2.57
							<i>Test</i>	<i>Control</i>
Memarpour et al., 2015	Iran	12-36 months	(n = 140) • Test: Fluoride Varnish (n= 35) • Control: Varnish Placebo (n = 35)	12 months	4 (Every 4 months)	12.9%	•Baseline T: 0.14 •Final T: 0.3	•Baseline T: 0.37 •Final T: 2 ± 2
							<i>Test</i>	<i>Control</i>
Lawrence et al., 2008	Canada	6 months - 5 years	(n = 1275) • Test: Fluoride Varnish 5% + Caregiver counseling (n = 915) • Control: Caregiver counseling (n = 360)	24 months	•Test: 4 (6-month intervals over a 24-month timeframe) •Control: 2 (12- and 24-month follow-up visits)	10%	•Baseline S: 12.89 T: 7.19 •Final: S: 10.08	•Baseline S: 11.80 T: 6.52 •Final: S: 13.47
							<i>Test</i>	<i>Control</i>
Jiang et al., 2005	China	3-4 years	(n = 392) • Test: Fluoride Foam (1.23% FFA) (n = 209) • Control: Placebo (n = 183)	24 months	4 (Every 6 months)	18.9%	•Baseline S: 2.4 T: 1.6 Increment: 3.8	•Baseline S: 2.8 T: 1.7 Increment: 5.0

Risk-of-bias assessment

Information to judge most domains was often complete (Figure 2). No information for a domain was judged to be the most serious methodological issue, and some studies had issues with risk of bias in some domains. Four studies showed a low risk of bias for all domains analyzed^{9,15,17,20}.

Lawrence et al.¹⁹ demonstrated a higher risk of bias in the domains of allocation concealment and blinding of participants and personnel (selection bias). In the study by Truman and Crellin²¹, the risk of bias for the domains of performance bias (blinding of participants and personnel) and detection bias (blinding of outcome assessment) was unclear. In the study by Keller et al.¹⁸, the domain of detection bias (blinding of outcome assessment) showed a high risk of bias, and risks of bias for the domains pertaining to performance bias (blinding of participants and personnel) were unclear. In the study by Autio-Gold and Courts¹⁶, the only unclear risk of bias was in the domain of allocation concealment.

Figure 2. Risk-of-Bias Assessment

Study	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Arruda et al., 2012	+	+	+	+	+	+	+
Autio-Gold & Courts, 2001	+	?	+	+	+	+	+
Jiang et al., 2005	+	+	+	+	+	+	+
Keller et al., 2016	+	+	?	-	+	+	+
Lawrence et al., 2008	+	-	-	+	+	+	+
Memarpour et al., 2015	+	+	+	+	+	+	+
Olivier et al., 1992	+	+	+	+	+	+	+
Truman & Crellin, 1973	+	+	?	?	+	+	+

Effects of interventions on tooth type

Primary dentition

We identified four studies reporting the effectiveness of interventions in reducing the increase of caries in the primary dentition (Table 3). Two compared varnish to placebo and presented PF values of 63.3%¹⁶ (semiannual to 9 months of follow-up) and 90.18%¹⁷ (4–12 months follow-up). When comparing the use of fluoride varnish plus caregiver counseling to caregiver counseling alone, semiannual application of fluoride varnish yielded a PF of 18.3%¹⁹. One trial compared the use of fluoridated foam with placebo, and yielded a PF of 24%⁹ (semiannual to 24 months follow-up).

Table 3: Studies according to fluoride application method, follow up period and prevention factor. Primary dentition.

Topical Fluoride Application Method	Authors	Follow up period	Prevention Factor
Test: Fluoride Varnish 5% NaF Comparison: Fluoride mouth rinse 0.1%	Keller et al., 2016	24 months	14.6%
Test: Fluoride Varnish 5% NaF Comparison: Fluoride Varnish Placebo	Arruda et al., 2011	12 months	1 x year: 31% (24.5–37.5%) 2 x year: 49% (31.7%–66.3%) 1-2 x year: 40% (34.3–45.7%)
Test: Fluoride gel 1.23% FFA Comparison: Placebo	Truman et al., 1981	4x/year 36 months	22,3%
Test: Fluoride gel 1,23% FFA Comparison: Placebo	Olliver et al., 1992	24 months	6%

Permanent dentition

Four studies reported the effectiveness of interventions in alleviating caries in the permanent dentition (Table 4). Two studies evaluated the use of fluoride varnish

and two studies evaluated APF gel. Arruda et al.¹⁵ compared semiannual application of fluoride varnish with a placebo varnish and demonstrated that the PF for fluoride varnish use was 49% (12-month follow-up). However, in a comparison of the semiannual application of fluoride varnish to weekly mouthwash with 0.1% NaF, varnish use yielded a lower PF of 14.6%, as demonstrated by Keller et al.¹⁸ (24 months of follow-up). When applied every 3 months, fluoride gel yielded to a PF of 22.3% in comparison with the placebo²¹, while the corresponding PF with application of fluoride gel every 6 months (semiannual application) was 6%²⁰ (24 months of follow-up).

Table 4: Studies according to fluoride application method, follow up period and prevention factor. Permanent dentition.

Topical Fluoride Application Method	Authors	Follow up period	Prevention Factor
Test: Fluoride Varnish 5% NaF Comparison: Placebo	Autio-gold & Courts, 2001	9 months	63.3%
Test: Fluoride Varnish 5% NaF Comparison: Placebo	Memarpour et al., 2015	12 months	90.18%
Test: Fluoride Varnish 5% NaF + Caregiver counseling Comparison: Caregiver counseling – semiannual	Lawrence et al., 2008	24 months	18,3%
Test: Fluoride foam 1.23% FFA Comparison: Placebo foam - semiannual	Jiang et al., 2005	24 months	24%

DISCUSSION

The results of this review and the conclusions inferred from them can be considered reliable because most of the trials were judged to be adequate in terms of risk of bias, risk of random errors, reporting quality, and methodological quality.

The results of this systematic review of the literature do not agree with previous findings^{13,14} that did not observe an additional effect of the professional use of fluorides over the control treatments with respect to the control of the biofilm

formed on the dental surfaces. The literature shows us that mechanical control of the biofilm on the dental surface is sufficient to reverse the activity of carious lesions^{22,23} over a short period of observation, as described in these clinical trials. In the short period of 8 weeks, the use of fluoride at high concentrations does not seem to make a difference when it is associated with a series of measures to control the disease. However, the results of our review indicate the need for long-term monitoring of the effect of treatment, whereby the effects of high fluoride concentrations may appear.

In the studies conducted on the deciduous dentition, application of fluoride varnish yielded PF values of 90.18%¹⁷ to 63.3%¹⁶ when compared to the use of placebo. This reduction in the incidence of carious lesions corroborates the findings of randomized controlled studies conducted by Weintraub et al.²⁴ and Holve²⁵, who evaluated the effectiveness of bi-annual application of 5% NaF varnish in the primary dentition and showed reductions of 50% and 35% in the DMFS index, respectively, over a 2-year period. Nevertheless, when comparing the use of these methods with caregiver counseling, the functionality of professional fluoride usage showed an average 4-fold reduction (18.3%)¹⁹. However, these findings were repeated when the use of fluoridated foam in relation to placebo showed an average reduction of 3 times in the PF (24%) in comparison with the average results of the PF of the fluoride varnish. The lower values found in this review on other methods of applying fluorides can be explained, as described by Marinho et al.¹⁰ in their systematic review of the literature published in the Cochrane. The effects of topical fluoride vary according to the type of control group used, type of topical fluoride therapy used, mode/setting of use, initial levels of caries, and intensity of topical fluorides.

In permanent dentition, the use of fluoride varnish compared to placebo showed an average PF value of 40% for the use of fluoride varnish in bi-annual applications. This reduction for the incidence of caries lesions corroborates the study by Zimmer et al.²⁶, who reported a 37% reduction in the increase in decayed and restored surfaces in the permanent dentition, with biennial application of varnish with fluoride, after 4 years of follow-up. However, if the same frequency of application of fluoride varnish is compared to the weekly use of mouthwash containing 0.1% NaF, the PF values of the preventive fraction decrease 3 times on average (14%¹⁸). Moreover, the observed results of using APF gel compared to placebo are even less

than the use of fluoride varnish compared to placebo. They ranged from 22% to 6% in the studies by Trubman and Crellin²¹ and Olivier et al.²⁰, respectively. Values were 50% to 85% lower than the PF values of the gel compared to the varnish when both are compared to their respective placebos. These results corroborate those described by Urquhart et al.²⁷ in a systematic review and network meta-analysis of nonrestorative treatments for caries, who stated that the use of fluoride varnish was most effective for arresting or reversing noncavitated occlusal, approximal, and non-cavitated and cavitated root carious lesions with moderate-certainty evidence.

The frequency of use of professional vehicles seems to make a difference in the PF. This can be observed with the use of APF gel in permanent dentition and fluoride varnish in the primary dentition. The study by Truman and Crellin²¹ evaluated the use of APF gel every 3 months and observed almost 4-fold higher PF values for this vehicle in comparison with the use of the same type of fluoride in the study by Olivier et al.²⁰. The study by Memarpur et al.¹⁷ evaluated the use of fluoride varnish with 4-month applications between consultations in primary dentition and showed values 1.5-5 times higher than the PFs with semiannual and annual applications in the same type of dentition. These results corroborate the findings from in-situ studies²⁸, which demonstrate that increased exposure to fluoride products produces a larger reservoir of fluoride, increasing the mineral content.

The populations that were studied had a low caries experience; the mean \pm standard deviation of the DMFS/dmfs in the studies involving permanent and deciduous dentition were 2.3 ± 2.3 years (6-12 years) and 2.3 ± 0.3 years (6 months to 5 years), respectively. The results shown in this review are for populations that have the same profile of disease occurrence. A single study evaluated the effect of controlling caries disease in a population with high caries experience at the beginning of the study (12.3 ± 0.8)¹⁹. The relatively low PF for the use of varnish in this study cannot be evaluated in isolation, since the treatment of the disease in this population was more comprehensive, including caregiver counseling.

Regardless of the type of dentition that is treated with professional application of topical fluorides, the vehicle that presents better long-term PF values for less caries experience in populations after treatment is fluoride varnish, as shown by the results of this study. These findings agree with the results described in the

literature²⁷. Assessing the price perspective of products in low-income countries, such as Brazil, the cost of each application of fluoride varnish is around 8.0 EUR and that of APF gel is 0.03 EUR (price calculated by the authors themselves based on the price descriptions used by Schwendicke and Stolpe, 2017²⁹). In high-income countries such as Germany, the material cost of treatment, per individual, per application, using fluoride varnish is estimated to be EUR (mean [range]) 1.42 (0.86/2.72), and we are already using the fluoride gel for EUR 0.74 (0.54/1.26)²⁹. However, although there was a difference in the costs of the treatments, the cost-effectiveness of applying fluoride varnish will depend not only on the costs of the product, but also the possible savings associated with averted caries increment³⁰.

CONCLUSION

Professional fluoride treatment is effective for preventing new long-term injuries in both primary and permanent dentition. Of the vehicles used, the varnish showed the highest PF (90.18 to 14.6%). Regardless of the product used (gel or varnish), the increased frequency of F applications yields greater benefits.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

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