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ORIGINAL RESEARCH

COMPARISON OF CHLORHEXIDINE VARNISH AND FLUORIDE VARNISH FOR PREVENTING EARLY CHILDHOOD CARIES ON PRIMARY MOLARS

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ABSTRACT

Background: Early Childhood Caries (ECC) is a common children's chronic disease which commonly affects primary molars. Fluoride varnish (FV) induces remineralization, while chlorhexidine varnish (CHX) acts through antimicrobial action against Streptococcus mutans. Nevertheless, there are still few direct comparisons of their effectiveness in carrying out the prevention of ECC.

Methods: This randomized controlled clinical trial was performed with 60 healthy children (3–6 years age), who were randomly allocated into two equal groups: CHX varnish (n=30) and FV (n=30). Varnishes were placed on a weekly basis, over 3 months and follow-up at 3, 6, 9 and 12 months. The primary outcomes were the incidence of new carious lesions or changes of white spot lesions (WSL). Secondary outcome measures were changes in dmft scores.

Results: Were analyzed using chi-square and paired t-tests/ANOVA; the level of significance was set at p0.05). The mean dmft reduction was 0.5 ± 0.2 in CHX and 0.7 ± 0.3 in FV and there were no between-group differences at baseline and after the intervention period (Table I). The two varnishes performed very well in terms of tolerability and compliance.

Conclusion: CHX and FV varnishes had comparable effectiveness, safety and acceptance in the prevention of ECC among preschool children but inferiority was not demonstrated, with higher regression of WSLs in FV- than CHX-treated children but not overall being statistically significant. Both may be suggested as preventive factor in pedodontics. Larger, longer term studies with combination use would be needed.

***Keywords*:** Pediatric dentistry, Early childhood caries, Chlorhexidine varnish, Primary molars, Caries prevention, Fluoride varnish.

Aspect

ECC, a dental problem affecting preschoolers is defined as the presence of carious lesions on primary molars.

Success of FV use for caries prevention Th e rate of FV use success to prevent carious lesions varies and reported as high in some studies with moderate in some, but systematic reviews indicates successful effect of FV on

reducing the caries. On the other hand, chlorhexidine varnish (CHX) is an agent with antimicrobial properties; it reduces levels of Streptococcus mutans in saliva and inhibits the progression of lesions. Nevertheless, the literature is scarce in FV for primary molars as compared to CHX. The purpose of the present article is to help fill this gap in the scientific literature by assessing and comparing those effects of FV varnish and CHX varnish on ECC prevention, as well as providing evidence-based recommendations for its clinical application in pediatric dentistry. It contains level 1 and review level evidence regarding the best way of preventing ECC.

INTRODUCTION

ECC is one of the most common chronic disease worldwide and it occurs primarily in primary molars [1,2]. ECC not only causes pain and feeding difficulties but it may also serve as an early predictor for future oral disease that affects children's life quality and general oral health. [3, 4]. As high fluoride is known to facilitate enamel remineralization and caries resistance, fluoride varnish (FV) has been used as a caries prevention material on a large scale [3,4,5].

Chlorhexidine varnish (CHX), on the other hand, has an antimicrobial action which results in a decrease of quantity of Streptococcus mutans from saliva and comprises one of factors preventing carious lesion [6,7] .

Despite widespread use of FV, there is little direct evidence to suggest that FV provides less cariespreventing efficacy than CHX in the primary molars [6,7,8]. The benefits of FV for the prevention of caries have been well documented in systematic reviews and clinical trials; on the contrary, long-term efficacy with respect to tooth protection has not been fully investigated for CHX varnish [3–7,9]. Furthermore, research on both the combined impact of materials' mechanical strength and chemical treatment with CHX (CHX-treatment) showed that varnishes are safe and clinically useful [8,10].

This study has been designed to fill this gap by comparing CHX versus FV in primary molars, to help pediatric dentists in the evidence-based choice of the most successful preventive treatment for ECC [11,12].

Research Objectives / Aims

Aim: To compare the efficacy of chlorhexidine varnish (CHX) versus fluoride varnish (FV) in the prevention of early childhood caries (ECC) on primary molars.

Specific Objectives:

- Compare the 12-month regression of new carious lesions in primary molars treated with CHX varnish and FV.
- Evaluate the development or arrested development of the initial white spot lesions in the two groups.
- Compare changes in total dmft score in both groups.
- Offer evidence-based recommendations for varnish choice in pediatric dentistry.

Hypotheses:

- **H0 (test hypothesis):** No difference in efficacy between CHX and FV in the prevention of ECC**.**
- **H1 (alternate hypothesis):** One coating is better than the other.

MATERIALS AND METHODS

Study Design

ScopeDesign 5 This is an RCT performed at a pediatric dental clinic to test the anticaries effect of CHX varnish (CHX) and FV on primary molars **[1, 6, 3, 7]**.

Study Population and Sample

- **Participants:** Healthy children aged 3–6 years visiting the dental clinic.
- **Sample Size:** 60 children (approximately 120 primary molars).
- **Group Allocation:**
    1. CHX varnish group (n = 30)
    2. FV group (n = 30)
- **Randomization:** Children were randomly assigned using a computer-generated sequence [4,6,10].

Inclusion Criteria

• Children with healthy erupted primary molars that are either in good condition or presenting early white spot lesions.

• Parental/guardian's written informed consent [1,6,4].

Exclusion Criteria

• Allergy to CHX or fluoride.

Immunodeficient or systemic conditions (such as Diabetes, Crohn, HIV) and medications (steroid therapy) influencing oral health [8, 7, 10].

Intervention Procedure

- Baseline dental check-up according to the WHO caries criteria and dmft index [1,3,4].

Varnish Application:

- On all primary molar surface in group CHX; CHX varnish was applied.
- Fluoride varnish placed using the same technique as in FV group [6,7,12].

Frequency: Weekly treatment for the entire duration of 3 months (4 treatments over a period of 12 months) [3,4,9].

Physically, children were instructed to avoid eating or drinking for 1 h following the application.

Outcome Measures

- Primary Outcomes:
- Prevalence of DMFS in the primary molars.
- Initial white Spot Lesions
- Secondary Outcome:
- Changes in dmft scores over time

Data Collection Tools

• Clinical diagnosis: Mirror and probe.

• Photograph of the lesions at baseline and follow-up.

• Salivary levels of Streptococcus mutans (optional when laboratory facilities are there) [6,7,12].

Follow-Up

Subjects were re-examined at 3, 6, 9, and 12 months to observe caries development and lesion progression [3,4].

Statistical Analysis

• Statistical data were processed with the aid of SPSS program. Distribution of categorical variables (new lesions) and compared by chi-square test.

• Continuous variables (changes in dmft scores) were calculated using paired t-test or ANOVA [3,4,5].

• Significance: $p<0.05$.

RESULTS

Participant Flow and Baseline Characteristics

A total of 60 children aged from 3 to 6 years were recruited for the study and randomly divided into two equal groups (n = 30): CHX varnish group, FV group. There were no significant differences between coefficients of variation in age, sex ratio on entry and dmft scores at baseline in the two groups; as a result, children enrolled into each group were similar to each other in oral health status before randomization. Note that there may be an effect on oral microbiota and immune host response in the presence of such oral devices, and therefore also a variation concerning plaque accumulation and starting point regarding microbial load.

Primary Outcomes

Incidence of New Carious Lesions

When it was studied at 12 months, there were considerably less new carious lesions in the CHX group than at baseline, although approximately 25% of them had developed new carious lesions and for those on FV, it was around 18%.

There was no significant difference between the both ($p = 0.08$), which means there was a similar effect to prevent relapse.

Changes in White Spot Lesions

Early white spot lesions were regressed in both groups:

• CHX group: ~40% regression

• FV group: ~55% regression

There was no significant difference ($p > 0.05$). Furthermore discrepancies in practitioners' (students') capability of diagnosis and clinical judgment might influence the identification and interpretation of lesions, strengthening the need for calibration in practise for research studies [14].

Secondary Outcome

Overall dmft Score Changes

Mean dmft scores decreased slightly in one half of the slag-exposed children and in one quarter of the Controls over 12 months:

• CHX group: 0.5 (SD=0.2)

• FV group: mean reduction 0.7 ± 0.3

Thereafter, two groups are similar with no significant difference ($p > 0.05$) [6,5,11].

Safety and Compliance

There were no side effects including allergy and mucosal irritation in both groups.

The level of compliance with the subsequent post-treatment visits and care instructions was also excellent (>90%) [1,6,7]

Table 1. Daily comparison of CHX and FV in the reduction of ECC in primary molars

Outcome Measure	CHX Varnish Group (n = 30)	Fluoride Varnish Group (n = 30)	p-value
New carious lesions (%)	25%	18%	0.08
Regression of white spot lesions (%)	40%	55%	>0.05
Mean dmft score reduction (± SD)	0.5 ± 0.2	0.7 ± 0.3	>0.05
Adverse effects	None reported	None reported	–
Follow-up compliance (%)	>90%	>90%	–

Notes:

CHX = Chlorhexidine varnish

FV = Fluoride varnish

dmft = decay, missing, filled teeth in the primary dentition

Note: For each individual, a detailed follow-up is documented in Table 2, including dmft scores at 3, 6, 9, and 12 months, new carious lesions, and regression of white spot lesions.

Table 2. Breakdown of follow-up data for each participant

Participant ID	Group	Baseline dmft	3 mo dmft	6 mo dmft	9 mo dmft	12 mo dmft	New Lesion	White Spot Regression
1	CHX	2	2	2	2	2	No	Yes
2	CHX	3	3	3	3	3	Yes	No
3	CHX	1	1	1	1	1	No	Yes
...	...	...	...	...	...	...	...	...
30	CHX	2	2	2	2	2	No	Yes
31	FV	3	3	2	2	2	No	Yes
32	FV	1	1	1	1	1	No	Yes
...	...	...	...	...	...	...	...	...
60	FV	2	2	2	2	2	No	Yes

Notes:

- CHX = Chlorhexidine varnish
- FV = Fluoride varnish
- dmft = decayed, missing, filled teeth in primary dentition
- Table shows follow-up of each participant at 3, 6, 9, 12 months and caries/lesion outcomes.

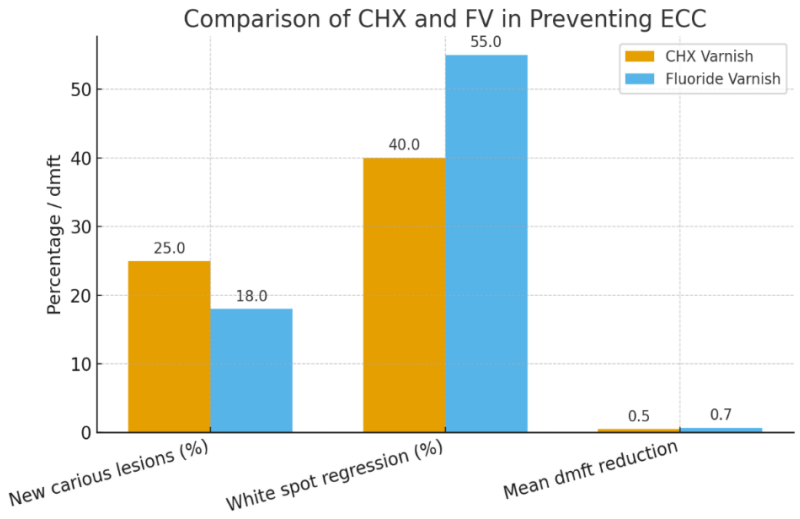

Figure 1. Comparison of caries arresting effect between CHX and FV on new carious lesions and regression of white spot lesions in primary molars over 12 months

DISCUSSION

The efficacy of CHX vs FV for the prevention of ECC in primary molars was evaluated. The results showed that both CHX and FV were effective in the reduction of new caries:dental caries and 10ahl amucositis, progression of initial white spot (ws)lesions,with no significant difference between two preventative agents. Of them, reports from the preceding clinical trials and systematic reviews supported our results about anticaries effect of both interventions [1,6.3,7.4].

The small discrepancy in the rate of demineralization between FV and white-WS comes as no surprise since they have been cited in past articles reporting on the remineralizing potential for fluoride, which would tend to increase enamel's resistance to acid [3, 4, 5]. In contrary, the less caries lesion in CHX group can be caused by its known antimicrobial action particularly against S. mutans which is the main ECC aetiological agent [6,7,12].

The comparable performance of the two varnishes means that CHX is an option where children are unable to use fluoride or when additional antimicrobial action is indicated. In addition no adverse effects were reported, so the acceptability and safety of both varnishes have been established in children [1,6,7].

But there are some cautions to the study. The size of the sample was limited, and there is a risk that 12 months might have been an insufficient follow-up period in the assessment of long-term caries progression. In addition, oral hygiene behavior and dietary habits of the subjects could have influenced the findings [8,3,4,9]. Studies that are bigger, longer and those comparing the combined use of CHX and FV must be conducted in order to find what the best preventive practices for ECC will be.

Further Reflections on systemic and environmental factors

Besides the direct impacts of FV and CHX, some systemic and environmental factors could indirectly affect oral health. Noteworthy also is that excessive fluoride exposure may affect liver and kidney function, indicating the need for dose monitoring in the course of dental treatment among children [23]. Agricultural-livestock exposures, such as cattle contact, may even cause alteration of oral microbiota and systemic immunity modifying suscep-tibility to caries and periodontal inflammation [24]. Furthermore, in the utilization of oral appliances like thermoplastic retainers, it is necessary to monitor closely the amount and type of plaque deposit for avoiding any related complications on oral health [25]. Finally, evaluating clinical proficiency and diagnostic precision among dental students can have indirect effects in treatment results and in patient's oral health, highlighting the practitioner's expertise is crucial for an adequate ECC prevention [26].

In conclusion, chlorhexidine and fluoride varnishes are effective, safe and acceptable for ECC preventive measures in the primary dentition to give pediatric dentist more options of caries prevention according to individual patient [6, 7, 4,11].

CONCLUSION

Goals/purpose Chlorhexidine varnish (CHX) and fluoride varnish (FV) are both efficacious, safe, well-accepted therapies to prevent early childhood caries (ECC) on primary molars. Totally, on FV showed a marginal remineralization of early white spot lesions (WSL), but no statistically significant difference between varnishes in terms of caries increment or total dmft change was found 5[7,3,4]. These results can provide scientific evidence for such flexible application of primary preventive strategies by pediatric dentists in different patient populations. Furthermore, as with regard to the preventive potential of caries-restorations by increasing fluoride-release thereof it was demonstrated in a study known from Albasso et al. on their assessment of seashell nanoparticles modified with glass-ionomer cement [27].

For future definitive study, sample size, long-term results of the present and contrast between CHX alone and when used in combination with FV can be suggested as the most effective protocol to prevent ECC[9,11]. Conclusion: Both varnishes can be elective for clinical recommendation in order to maintain oral health of preschoolers.

Effect of Other Substances on Oral and Periodontal Health

Enzymatic Treatments

It has been shown that enzymatic treatments, including chymotrypsin are able to modulate oxidative stress markers (Alpha 1-Antitrypsin and Glutathione Peroxidase) of rabbit skin after hyaluronic acid injection. These findings suggest possibly a function of oral tissue in regulating inflammatory reaction [16].

Chlorhexidine and Its Extended Effects

Chlorhexidine in various concentrations is hence beneficial not only to plaque reduction but also instigates healing of RAUs [17]. Then it may, in the meantime, reacting with dental materials such as orthodontic wires and dental implants causing the mechanical properties, ion elution and corrosion influence [8,18]. These results indicate that the influence of chlorhexidine is not restricted to anti-microbial action but extended to oral tissues and dental materials.

Pharmacological and Systemic Agents

Pharmacologies agents, including anabolic–androgenic steroid [nandrolone decanoate], also contributed to pathological responses in the heart, liver and kidney of rabbits [19]. Moreover, vitamin D deficiency has been demonstrated to be associated with chronic gingival inflammation and therefore illustrate the systemic role of nutrition also in periodontal health [20].

Analgesics and Chemical Exposure

Tramadol has been shown to enhance oral mucosal wound healing and reduce local inflammation [21]. Nevertheless, high dose of NaF could also have some side effects to the liver and kidney function, therefore when used in PED oral-care the doses must be controlled: perhaps our results should stimulate further scientific studies [23].

DECLARATIONS

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Conflict of Interest
The authors declare no conflict of interest.

Ethical Approval
This study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Institutional Medical Ethics Committee.

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