



## RESEARCH ARTICLE

### EVALUATION OF SUBSTANTIVE FLUORIDE RELEASE FROM 3 DIFFERENT FLUORIDE VARNISHES

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#### ABSTRACT

**Introduction:** Dental caries is the most common childhood illness with nearly half of children aged 2–19 have had dental caries in their teeth. Fluoride varnishes prevents dental caries by increasing remineralization.

**Aim:** To determine substantive fluoride release from 3 different fluoride varnishes over a period of 6 months time.

**Materials and Methods:** Sixty extracted human deciduous anterior teeth were divided into four groups, i.e., Clinpro<sup>TM</sup> XT, Fluoritop SR, Flourprotector and Control group. Fluoride varnishes were applied on 3mm x 3mm window on labial surface of the teeth and then the teeth were immersed and stored in artificial saliva. The concentration of fluoride in ppm was measured for 4 hours, 8 hours, 1 month, 3 months and 6 months. Fluoride release at each time interval for different groups was statistically analyzed using ANOVA and Tukey's Kramer test.

**Results:** All the fluoride varnishes released fluoride for period of 6 months, with greatest release observed during 1st 8 hours Fluoritop SR, Clinpro<sup>TM</sup> XT Varnish released consistently and substantially more fluoride than Fluoritop SR and Flourprotector during 6 months analysis ( $p < 0.05$ ).

**Conclusion:** Over a period of 6 months Clinpro- XT Varnish released consistently and substantially more than other tested products.

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## INTRODUCTION

Dental caries is the most common childhood illness with nearly half of children aged 2–19 have had dental caries in their teeth. Caries progression, as divergent to reversal, consists of a delicate balance between pathological factors- namely, a bacterially generated acid challenge and a combination of demineralization inhibition and reversal by remineralization. It is a particular problem among children and adolescents from families with low incomes. Health professionals are in a position to deliver effective measures that improve the oral health of children throughout the lifespan, especially if they can deal to prevent oral disease. Since oral health and overall health are intertwined, this means that health professionals (e.g., dentists, dental hygienists, physicians, nurses) can have a optimistic influence on the health of children, they serve by ensuring that preventive measures are undertaken introducing early in life (National oral health survey and fluoride mapping, 2004). Fluoride varnish has been used for more than 30 years as a method of professional application of topical fluoride. Topical fluoride therapy refers to the use of systems containing relatively large concentrations of fluoride that are applied

locally to erupted tooth surfaces to prevent formation of dental caries (Tavassoli-Hojjati *et al.*, 2012). The continued deposition of fluoride into enamel during the later stages of enamel formation results in elevated concentrations of fluoride in surface enamel. Fluorapatite and fluorhydroxyapatite are more resistant to acid dissolution so the tooth surfaces are more resistant to the development of dental caries. By providing fluoride varnish application to children whose caries risk levels indicate that they could benefit from this treatment, health professionals have an opportunity to assist in reducing the burden of dental caries and improving quality of life for many children. Maintaining low levels of fluoride release over long periods is important in the inhibition of demineralization and promotion of remineralization.

## MATERIALS AND METHODS

This in vitro study was carried out in the Department of Pedodontics and Preventive dentistry in Bharati Vidyapeeth Dental College and Hospital, Pune. Sixty extracted human Sound primary anterior teeth with intact labial surface with or without resorbed root were divided into four groups, i.e Control, Clinpro XT, Fluoritop-SR, Flourprotector group. Teeth were cleaned and dried with gauze. The tooth surfaces were painted by nail varnish expect for a 3X3 mm window on the facial (labial) surface of crown, where the test material was

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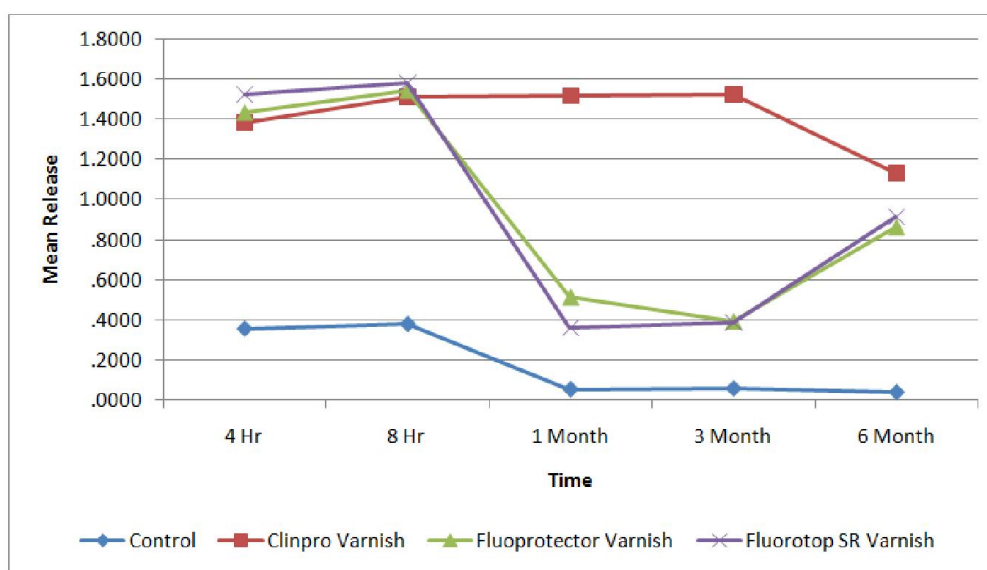
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applied. The teeth were randomly divided into 4 groups of 15 teeth each. Three groups correspond to test products and Fourth group comprises of untreated controls. In each group, the test material was applied following manufacturer's instructions. Clinpro XT varnish was mixed and applied on the tooth and then light cured for 20 seconds. The teeth were then placed in individual bottles containing of artificial saliva (Wet mouth) at room temperature. The teeth were then placed in fresh artificial saliva sequentially at 4 hours, 8 hours, 1 month, 3 months And 6 month after the application of fluoride varnish. After the transfer, the solution from preceding bottles were added to 0.2 ml of TISAB III for fluoride analysis. Fluoride ion concentration will be measured by ion selective electrode, calibrated with TISAB III and fluoride concentration standards in parts per million (ppm) in solution.

minimal. Each of the investigated fluoride varnishes had a fluoride release profile, which was significantly different from the other products. Clinpro-XT Varnish demonstrated sustained fluoride release feature when compared to Fluoritop-SR and Fluorprotector varnishes. Fluoritop-SR varnish showed the more fluoride release in the first 4 hours after application of the varnish, while fluoride release was comparatively better for Fluorprotector varnish after 8 hours.

## DISCUSSION

Fluoride varnishes were originally developed to prolong the contact time between fluoride and tooth enamel. Application of varnish on tooth surfaces was shown to promote the uptake of firmly bound fluoride by enamel, which was considered



Graph 1. Mean release of varnishes over period of time

Table 1. Repeated measures ANOVA (analysis of variance) indicated significant differences in the fluoride release of all the varnishes over a period of time. (F=153, p<0.0001)

Group	N	Time				
		4 Hr	8 Hr	1 Month	3 Month	6 Month
Control	15	0.36	0.38	0.05	0.06	0.04
Clinpro Varnish	15	1.38	1.51	1.51	1.52	1.13
Fluoprotector Varnish	15	1.43	1.54	0.51	0.39	0.86
Fluoritop SR Varnish	15	1.52	1.58	0.36	0.38	0.91
F-Value		269.85	287.70	1469.80	1332.90	754.30
P-Value		<0.0001*	<0.0001*	<0.0001*	<0.0001*	<0.0001*

Table 2. The pair wise comparison of the test varnishes using Tukey Kramer Test

Pairwise Comparison	Control	Clinpro Varnish	Fluoprotector Varnish	Fluoritop SR Varnish
Control	-	<0.0001*	<0.0001*	<0.0001*
Clinpro Varnish	<0.0001*	-	0.77	0.026
Fluoprotector Varnish	<0.0001*	0.77	-	0.223
Fluoritop SR Varnish	<0.0001*	0.026	0.223	-

## RESULTS

Fluoride release for different group was assessed by repeated measures ANOVA and The pair wise comparison of the test varnishes using Tukey Kramer Test. All the test products showed a decline in the rate of fluoride release over the time period of study. The fluoride ion concentration in the control specimens ranged from 0.02-0.4 ppm and did not show variation with time. Fluoride release from control group was

important at that time (National oral health survey and fluoride mapping, 2004). For a fluoride varnish to be effective, frequency of fluoride varnish applications should be based on an individual caries risk assessment. Use of fluoride varnish to be effective in the prevention of early childhood caries and reduce caries by 25-45% (Autio-Gold and Courts, 2001). The most frequently prescribed regimen has been a semiannual application of varnish. Several protocols have been developed for risk assessment. The National Institutes of Health 13

published recommendations for the most helpful and consistent risk indicators in practice, which are: (1) past caries experience (2) inadequate previous or current exposure to fluoride (3) any physical or mental illness and any oral appliance or restoration that compromises the maintenance of optimal oral health (4) frequent fermentable carbohydrate consumption (5) lower salivary flow, associated with certain medical conditions and therapies (6) high mutans streptococci levels (7) gingival recession, especially in elderly populations (8) lower index of socioeconomic status. Various studies has been carried out to evaluate fluoride release from different fluoride varnishes over different period of time. Studies showed that the fluoride uptake, reaction and release in the enamel are strongly dependent on the duration of contact with the fluoride agent. There is no distinct difference in the caries-preventive effects of concentrate fluoride solutions, gels or varnishes. However, as fluoride varnishes adhere to tooth surfaces preventing immediate loss after application, they may be optimal in this respect. Study conducted by Castillo *et al.* to evaluate the fluoride released from 2 fluoride varnishes duraphat and duraflor. Results showed from week 4 to end of study, duraphat released more fluoride than duraflor. Duraflor continued releasing fluoride until week 19, while duraphat released until week 28. Finally they concluded that both varnishes released fluoride for 5-6 months. However, the two products exhibited difference in their release kinetics. (Jorge I. Castillo and Peter Milgrom, 2004) Another study by Comar *et al.* to analyse the amount of fluoride released into water and artificial saliva from experimental TiF<sub>4</sub> and NaF varnishes, with different concentrations, for 12 h. The fluoride release was analysed after ½, 1, 3, 6, 9 and 12 hours. TiF<sub>4</sub> varnishes released more amount of fluoride than NaF during first ½ hour regardless of concentration. 4 % TiF<sub>4</sub> varnish released more amount of fluoride than NaF varnish for the first 6 hours. The peak fluoride release occurred at 3 hours and there was a better dose-response relationship among the varnishes exposed to water than to artificial saliva (Comar *et al.*, 2014). Ritwik *et al.* compared the rate of fluoride release from fluoride varnishes over a 48 hour period and ascertain the time at which a plateau occurred. Four commercially available fluoride varnishes, Premier Enamel Pro Varnish (EP), Colgate Prevident (CP), Omni Vanish (OV) and Omni Vanish XT (OVXT) were used in the study. Conclusion was CP, EP, and OV released maximum rate of fluoride release in the first 4 hours whereas OVXT did not have plateau. The studied varnishes released different concentrations of fluoride despite the fact that they all contained 5% sodium into water and artificial saliva fluoride. (Ritwik *et al.*, 2012)

The present study showed higher amount of fluoride release for Clinpro-XT varnish than other two varnishes which might induce greater fluoride uptake by enamel. These finding might help explaining best anticaries effect. It is suggested that the maintenance of low levels of fluoride in saliva for long term periods can control the carious lesions progression. The increase of salivary levels after the application of a topical fluoride agent may be indicative of the fluoride available for interaction with the tooth surfaces. Low salivary fluoride level, around 0.04 ppm, has been shown to be correlated with a significant protective effect on dental caries, therefore salivary fluoride level are considered important parameters to predict the effectiveness of fluoride agent. 15 sample studied under control group, Clinpro XT, Fluorprotector, Fluoritop-SR group. Mean is calculated by measuring the individual observation and dividing them by number of observation. However, they had

significantly different fluoride release profiles ( $p < 0.0001$ ) (Table 1). Hence, there are inherent differences in the carrier for the sodium fluoride in the commercially available fluoride varnishes, which affects the rate of release of fluoride. Clinpro XT is a glass ionomer based extended release fluoride varnish. Manufacturers recommend light curing for 20 seconds after application. The extended release feature of this product was confirmed in our study. It was the only varnish to exhibit a sustained release of fluoride, although the initial rate of release in the first 4 hours was lower than Fluorprotector and Fluoritop-SR varnish (Graph 1/Table 2). An artificial saliva (AS) which reacts with the test material in a manner similar to that of natural saliva is a basic requirement of an artificial oral environment (DeLong and Douglas, 1983), It is well understood that duplicating exactly the properties of human saliva is impossible due to the inconsistent and unstable natural saliva itself inappropriate for use in standardized invitro studies. The fluoride release in artificial saliva however, does not follow the same pattern as a deionised water. These differences may be related to the absence of a well defined concentration gradient in artificial saliva. chemical species, such as sodium, hydrogen, phosphate, calcium and carbonate contained in the laboratory artificial saliva, have the potential to react with fluoride or to be absorbed by the material (Rezk-lega *et al.*, 1991). These ions may act as a barrier to reduce fluoride availability. In a clinical scenario, it is important to determine fluoride release plateau after an application of fluoride varnish since it can be a parameter to be applied to compare efficacy of different product. Furthermore, it is also important to establish critical time point considering the instructions that should be given for the patient after professional fluoride application.

### Limitation

We have to keep in mind that there are differences between the laboratory study and clinical trials. Oral functions-such as salivation, swallowing and chewing-in addition to brushing and flossing are not present in-vitro. It also did not study the fluoride uptake by enamel. So the fluoride release and the return to the baseline levels may be faster in a clinical setting. Therefore fluoride release pattern from the experimental varnishes should be confirmed in-vivo.

### Conclusion

Fluoride varnishes are one of the means of professionally applied fluorides, which are applied by painting the varnish over the teeth. The ease of application of fluoride varnishes has led to its popularity in the pediatric dental practice. Recent studies have shown that the use of fluoride varnishes to be effective in the prevention of early childhood caries, and it reduces caries by 25-45%. Since recommended regimen for fluoride varnish application is every 6 months, the amount of fluoride available in saliva may influence demineralization – remineralization process. On basis of our study clinician should use newly marketed fluoride varnishes over traditional materials

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