

# Comparison of salivary fluoride levels following use of dentifrices containing different concentrations of fluoride

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## Abstract

Many industrialized countries have reported a decline in caries prevalence over the past few decades. These reductions have been related to the regular use of fluoride dentifrices. Fluoride dentifrices are the most cost-effective and efficient means of caries prevention. However, there have been concerns regarding the risk of fluorosis in children due to the ingestion of dentifrices. This has led to the use of dentifrices with low concentration of fluoride. Salivary fluoride levels after tooth-brushing have been shown to be related to the anticaries efficacy of fluoride dentifrices. The present study was designed to evaluate the effect of the concentration of fluoride in the dentifrice, on the salivary fluoride level in children. Twenty children in the age group of five to six years were randomly selected and divided into two groups using, either 500ppm or 1000ppm fluoride dentifrice (sodium monofluorophosphate). Salivary fluoride levels at 0, 15, 30, 45, 60, minutes after brushing were estimated. The data collected was statistically evaluated using the unpaired t-test. The results showed that salivary fluoride levels following use of 500ppm fluoride dentifrice were significantly lower than 1000ppm fluoride dentifrice. The low salivary fluoride levels may thereby reduce the anticaries efficacy. Hence, the pros and cons of recommending a low fluoride concentration dentifrice must be judiciously considered.

**Key words:** Dental caries, fluoridated dentifrices, salivary fluoride

The widespread use of fluoride has been postulated as the major reason for decline in dental caries in the past few decades. Fluoride dentifrices have been accepted for their effectiveness in caries prevention and are the most cost-effective means for the control of dental caries. Frequently used concentration of fluoride in toothpaste is 1000-1100ppm.<sup>[1,2]</sup> Recently, there have been concerns over the association between dental fluorosis and toothpaste ingestion by children.<sup>[3-5]</sup> This has resulted in recommendations to reduce the amount of dentifrice used or to decrease the concentration of the fluoride in dentifrice, thus reducing the amount of fluoride potentially ingested.<sup>[6]</sup>

Fluoride concentration in whole saliva has been related to the efficacy of caries prevention. The fluoride concentration in saliva and dental caries has been reported to be inversely related.

The aim of the study was to determine the effect of dentifrices containing 1000ppm and 500ppm fluoride on salivary fluoride levels in a controlled clinical setting.

## Materials and Method

Ninety-three children in the age group of five to six years, studying in a municipal school at Mumbai Central were screened for the study. Criteria for inclusion in the study included good general health and dmft / DMFT score less than

one (WHO 1997 criteria).<sup>[7]</sup> Children with physical or mental limitations or having a deeply fissured tongue or irregular mucosal surfaces that might enhance fluoride retention and children undergoing orthodontic or prosthodontic treatment were excluded. Twenty children who fulfilled the selection criteria were selected and enrolled for the study. The parents were explained about the details and purpose of the study and a written informed parental consent was obtained for participation.

The selected children were given a non-fluoridated dentifrice to brush their teeth 10 days prior to and during the experimental period. They were asked to refrain from all other oral hygiene procedures during the study duration. They were also instructed to restrict the intake of foods containing high fluoride content and abstain from drinking tea.

The children were randomly assigned to two groups:  
Group A - Children using dentifrice containing 500ppm of fluoride  
Group B - Children using dentifrice containing 1000ppm of fluoride

The active ingredient in the dentifrice was sodium monofluorophosphate.

The parents were instructed not to give any food or beverage except water, to the children after breakfast on the day of collection of saliva. Baseline saliva sample was collected two hours after breakfast. A "pea-size" amount of toothpaste was dispensed on a toothbrush and the children were instructed

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to brush their teeth for one minute. After brushing the children were instructed to rinse their mouth with 10ml of tap water for 10 seconds.

Whole saliva samples were collected prior to brushing, immediately after brushing and at intervals of 15, 30, 45 and 60 minutes. Saliva samples were collected with the children comfortably seated in a chair. The children were instructed to pool the saliva in the mouth and then expectorate in sterile Eppendorf's tubes. The tubes were sealed and sent to the laboratory for fluoride analysis.

The saliva samples were incubated for three hours at 37°C in the presence of phosphatase enzyme in order to hydrolyze any monofluorophosphate ( $\text{FPO}_3^{2-}$ ) ions to  $\text{F}^-$ . 0.1ml of 5U/ml of enzyme was mixed with 0.1ml of 0.1mol/L of sodium acetate buffer (pH 4.8) and added to 1ml of saliva sample.<sup>[8]</sup> Fluoride ion activity was then measured in the presence of TISAB buffer with fluoride ion-specific electrode (Orion).<sup>[9]</sup> The data was tabulated and analyzed using unpaired 't' test.

## Results

The study comprised 20 children, 10 in each group with equal gender distribution [Table 1].

The mean salivary fluoride levels after brushing with 500ppm and 1000ppm fluoride dentifrice were significantly higher in Group B [Table 2, Figure 1]. The mean salivary fluoride concentrations at baseline were  $0.261 \pm 0.024$ ppm and  $0.259 \pm 0.018$ ppm for group A and B respectively and the difference between the two groups was statistically not significant ( $P > 0.05$ ).

**Table 1: Distribution of the children according to gender and groups**

Group	Gender		Total
	Boys	Girls	
A	5	5	10
B	5	5	10

**Table 2: Comparison of mean salivary fluoride concentrations at different collection intervals between the groups**

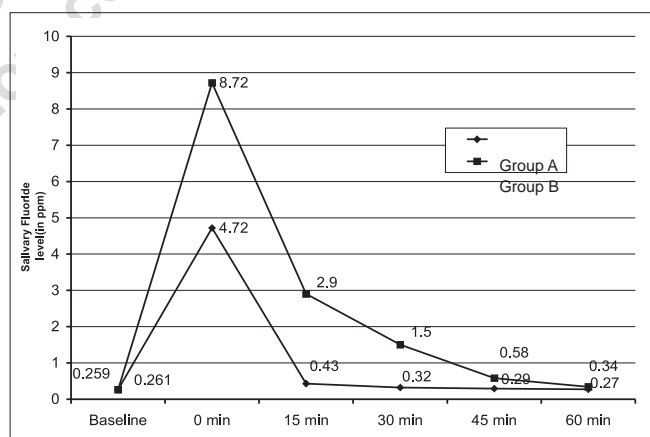
Duration	Mean salivary fluoride level (in ppm)				Unpaired t-test	
	Group A (500ppm)		Group B (1000ppm)		T-value	Significance
	Mean	S.D	Mean	S.D		
Before brushing (baseline)	0.261	0.024	0.259	0.018	0.202	Not Significant ( $P = 0.421$ )
Immediately after brushing (0 min)	4.72	0.025	8.72	0.061	190.045	Significant*
15 min	0.43	0.022	2.9	0.068	108.61	Significant*
30 min	0.32	0.020	1.5	0.07	50.37	Significant*
45 min	0.29	0.021	0.58	0.022	29.66	Significant*
60 min	0.27	0.022	0.34	0.032	5.64	Significant*

\*P value < 0.0001

Peak salivary fluoride levels occurred immediately after brushing in the two groups and was  $4.72 \pm 0.025$  and  $8.72 \pm 0.061$ ppm for group A and group B respectively. The difference in the mean salivary fluoride levels between the groups immediately after brushing was statistically significant ( $P < 0.0001$ ). The mean salivary fluoride levels after use of dentifrice containing 500ppm fluoride were approximately half of those after use of dentifrice containing 1000ppm fluoride at 45 minutes interval after brushing. The mean salivary fluoride levels following use of dentifrice containing 1000ppm fluoride were significantly higher as compared with 500ppm fluoride dentifrice. The mean salivary fluoride level gradually declined in both the groups and at 60 minutes interval the levels had reached the baseline levels.

## Discussion

Concern over the amount of fluoride ingested by children and the related risk of fluorosis has resulted in recommendations for use of dentifrices containing low concentrations of fluoride. The salivary fluoride levels are related to the anticaries efficacy of the fluoridated dentifrice. Fejerskov et al,<sup>[10]</sup> Ekstrand et al<sup>[11]</sup> and Featherstone et al<sup>[12]</sup> concluded



**Figure 1: Comparison of mean salivary fluoride concentrations at different collection intervals between the groups**

that the prolonged elevated levels of fluoride after single application of fluoridated dentifrice in oral fluids would be beneficial for optimum anticaries protection.

Dentifrices containing 500ppm fluoride have been recommended to overcome the risk of ingestion of high doses of fluoride; hence in the present study, salivary fluoride levels after use of dentifrices containing 500ppm and 1000ppm of fluoride were compared.

The children were given a non-fluoridated dentifrice 10 days prior to the test period to wash out the residual fluoride to get uniform baseline salivary fluoride levels. Consumption of foods/beverages high in fluoride content, e.g. tea, increases the salivary fluoride levels and hence children were instructed to abstain from foods / beverages containing high concentration of fluoride.

The salivary fluoride levels after application of fluoridated dentifrice are also affected by the rinsing procedure. Collins et al,<sup>[13]</sup> Richards et al<sup>[14]</sup> and Duckworth et al<sup>[9]</sup> have shown that the rinsing procedure as determined by the type of solution, amount and duration of the rinse affect the oral fluoride retention. To maintain uniformity in rinsing after tooth-brushing all children were instructed to rinse with 10ml of tap water for 10 seconds.

The results of the present study show a positive correlation between the salivary fluoride levels after brushing and the fluoride concentration of the dentifrice. The mean salivary fluoride levels after use of dentifrice containing 500ppm fluoride were significantly lower as compared to dentifrice containing 1000ppm fluoride. Several studies evaluating the salivary fluoride levels after tooth-brushing with different concentrations of fluoride have shown that there is an increase in salivary fluoride levels with increase in concentration of fluoride in the dentifrice.<sup>[15,16]</sup> The results of the present study also show that for a brief interval after tooth-brushing the salivary fluoride levels are relatively high. This was similar to the observations of Duckworth RM and Morgan SN (1991).<sup>[16]</sup>

The reason for the abrupt decrease in the salivary fluoride levels after the peak levels following tooth-brushing is mainly due to clearance of fluoride from mouth by swallowing.

Even though the salivary fluoride levels following use of dentifrice containing 500ppm of fluoride were significantly less than the dentifrice containing 1000ppm of fluoride an important aspect which needs to be studied further is the effect of long-term use of dentifrices containing 500ppm and 1000ppm of fluoride on baseline salivary fluoride levels.

## Conclusion

Reducing the fluoride concentration of the dentifrice to reduce the risk of fluorosis is appropriate for very young children. However, when the child is able to expectorate properly, the benefits of higher concentration of fluoride, which raises the salivary fluoride levels significantly, may outweigh the risk of fluorosis.

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