

Salivary fluoride levels after toothbrushing with dentifrices containing different concentrations of fluoride

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Abstract

Objective: To determine the salivary fluoride levels after toothbrushing with dentifrices containing 458 ppm and 1000 ppm of fluoride and to compare salivary fluoride levels of two dentifrices at different intervals of time. **Materials and Methods:** In total, 50 children in the age group of 6-12 years were selected. The individuals were randomly divided into two groups using either 458 ppm or 1000 ppm fluoride dentifrice, respectively. Whole saliva samples were collected prior to brushing, immediately after brushing, and at subsequent intervals after brushing into sterile test tubes. **Results:** Data collected were evaluated using unpaired *t*-test. Salivary fluoride level following the use of 458 ppm fluoride dentifrice was significantly lower than the level found following the use of 1000 ppm dentifrice, but the levels were above the baseline values even after 1 h. **Conclusion:** There was considerable salivary fluoride retention after brushing with fluoride dentifrices.

Key words: *Dentifrices, oral health, pregnancy, quality of life, salivary fluoride, toothbrushing*

INTRODUCTION

Toothpastes are daily oral care products, the chemical composition of which is constantly changing due to competition among manufacturers. Toothpastes are recognized as the best source of fluoride, which most effectively protects both deciduous and permanent teeth from caries.^[1] Fluoride dentifrices have been accepted for their effectiveness in caries prevention and are the most cost-effective means for the control of dental caries. The frequently used concentration of fluoride in toothpaste is 1000-1100 ppm. Fluoride concentration in the whole saliva has been related to the efficiency of caries prevention. The fluoride concentration in saliva

and dental caries have been reported to be inversely related.^[2]

The effectiveness of fluoride oral hygiene products can be evaluated with morphological methods. The reaction of enamel concerning surface microhardness in caries-like demineralized enamel depends upon the fluoride ion concentration and increases with increasing fluoride concentration of the applied sodium fluoride gel. Therefore, the effectiveness of fluoride oral hygiene products depends upon the fluoride ion concentration.^[3] Salivary fluoride kinetics depends upon different factors: Flow rates, age, stimulation effects, properties of fluoride-containing products, volume and application time of these products, vehicle of fluoride, and individual characteristics of saliva. The interaction between these factors affects the process of fluoride clearance from the oral cavity.^[4]

Recent concerns over the positive association between fluorosis and toothpaste ingestion by young children have resulted in recommendations from a number of healthcare workers to use pea-sized amount of toothpaste, thus reducing

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the amount of toothpaste that may potentially be ingested.^[5,6] In toothpastes, ionically bound fluoride (sodium fluoride, stannous fluoride, amine fluoride, and covalently bound fluoride) is used. The different forms of fluoride differ in the mechanisms by which they protect against caries. It is thought that monofluorophosphate exchanges with orthophosphate in the enamel and afterward an intracrystalline transposition of F⁻ and OH⁻ takes place, whereby fluorapatite is formed. Therefore, the caries-protective effect is limited by the number of the reactive molecules in the crystal lattice. According to another reaction channel, the monofluorophosphate molecule is hydrolyzed by phosphatases from the oral bacterial flora and saliva. The fluoride, which is released, reacts with dental hard tissue like ionic calcium compounds. Ionically bound fluoride is deposited primarily as a CaF₂ layer on the dental hard tissue during brushing. With time, this reservoir is used up and the fluoride concentration of the enamel and saliva increases.^[7]

The caries-preventive benefits of fluoride are generally accepted by dental researchers and practicing professionals worldwide. The formulation of a fluoride toothpaste and biological (salivary flow rate) and behavioral factors (brushing frequency, brushing time, post-brushing rinsing practices, timing of brushing, and amount of toothpaste applied) can influence the anticaries efficacy.^[6] Fluoride dentifrices are well accepted for their effectiveness in caries prevention. Concerns over the risk of fluorosis in children due to ingestion of fluoride in toothpaste have led to the introduction of toothpaste with low fluoride concentration. Due to the risk of fluorosis, it was recommended that children use toothpastes with a fluoride concentration of 500–550 ppm. Fluoride will likely remain the cornerstone of caries control for the foreseeable future because of its proven effectiveness and safety. However, there remains the need to determine the most effective method of fluoride utilization in children and adults who remain caries-active. No such study has been conducted in Mathura earlier.

Objectives of the present study were as follows:

- To determine the salivary fluoride levels after toothbrushing with dentifrices containing 458 ppm and 1000 ppm of fluoride
- To compare the salivary fluoride levels of two dentifrices at different intervals of time.

MATERIALS AND METHODS

The study population consisted of 50 school children belonging to the age group of 6-12 years who were

conveniently selected from Krishna Public School, Mathura city. Before starting the study, ethical clearance was obtained from the ethical committee of K. D. Dental College and Hospital, Mathura. Before data collection, the purpose and procedure of the study were thoroughly explained to the parents and children and written informed consent was obtained from each subject.

Inclusion criteria for selection

- DMFT score less than one.

Exclusion criteria for selection

- Marked intraoral soft tissue pathology
- Subjects with a history of taking antibiotics 3 months before or during the course of study
- Medically compromised patients
- Children undergoing orthodontic therapy.

The children were randomly assigned to two groups as follows:

Group A: Children using dentifrices containing 458 ppm of fluoride

Group B: Children using dentifrices containing 1000 ppm of fluoride.

Baseline saliva sample was collected 2 h after breakfast. A “pea-sized” amount of toothpaste was dispensed on a toothbrush and children were instructed to brush their teeth for 1 min. After brushing, the children were instructed to rinse their mouth with 10 ml of tap water for 10 s.

Standardization of the saliva collection technique

- The subject did not eat or drink (except water) 1–2 h before collection
- The subject did not perform any physical exercise before collection
- The saliva was collected over a period of 5 min.

Whole saliva samples were collected prior to brushing, immediately after brushing, and at intervals of 15, 30, and 60 min, respectively [Figure 1]. 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 a sterile test tube. The tubes were sealed and sent to laboratory for fluoride analysis.

The saliva samples were incubated for 3 h at 37°C in the presence of phosphatase enzyme in order to hydrolyze

any monofluorophosphate ions to F⁻. Then, 0.1 ml of 5 U/ml of enzyme was mixed with 0.1 ml of 0.1 mol/l of sodium acetate buffer (pH 4.8) and added to 1 ml of saliva sample. Fluoride ion activity was then measured in the presence of total ionic strength adjustment buffer (TISAB) with a fluoride ion-specific electrode. The statistical analysis was performed using SPSS version 15. The mean and standard deviation of scores were calculated; comparison between groups was done using unpaired *t*-test, and a two-tailed *P* value of ≤0.05 was considered statistically significant.

RESULTS

The study population consisted of 50 school children belonging to the age group of 6-12 years who were



Figure 1: Saliva collection procedure

Table 1: Groupwise distribution of children according to gender

Group	Gender		Total
	Boys	Girls	
A	25	25	50
B	25	25	50

Group A = Children using dentifrices containing 500 ppm of fluoride,
Group B = Children using dentifrices containing 1000 ppm of fluoride

conveniently selected from a school of Mathura city. There were 25 children in group A and the same number of children in group B. Table 1 shows that among 50 children, boys and girls numbered 25 each. Children belonging to group A used dentifrices containing 458 ppm of fluoride and those in group B used dentifrices containing 1000 ppm of fluoride. The mean salivary fluoride concentrations at baseline were 0.269 ± 0.039 ppm and 0.258 ± 0.019 ppm in group A and group B, respectively, and the difference between the two groups was statistically non-significant, whereas immediately after brushing, the fluoride concentrations were 3.652 ± 0.588 ppm and 7.745 ± 0.757 ppm for group A and group B, respectively, and the difference between the groups was statistically significant. The mean salivary fluoride concentrations of group A and group B subjects after 15, 30, and 60 min of brushing were 0.48 ± 0.089 ppm and 3.406 ± 0.594 ppm, 0.382 ± 0.071 ppm and 0.602 ± 0.205 ppm, and 0.338 ± 0.092 ppm and 0.380 ± 0.050 ppm, respectively. The mean salivary fluoride levels following use of dentifrice containing 1000 ppm fluoride were significantly higher as compared with the levels following use of 500 ppm fluoride dentifrice [Table 2].

DISCUSSION

In the present study, a total of 50 school children belonged to the age group of 6–12 years participated and were assigned to two groups, i.e. Group A and Group B using dentifrices containing 458 ppm and 1000 ppm, respectively, with equal gender distribution. On the contrary, the study conducted by Nagpal and Damle^[3] consisted of 20 students assigned into two groups, i.e. Group A and Group B, with equal gender distribution and the same sample size was shown in the study of Ananda *et al.*^[8]

In this study, the difference between the baseline salivary fluoride concentrations in the two groups was not statistically significant. The result is similar to those reported by Nagpal and Damle,^[3] Duckworth

Table 2: Distribution of study subjects according to mean salivary fluoride concentration at different collection intervals between the groups

Duration	Mean salivary fluoride level in ppm				Unpaired <i>t</i> -test	
	Group A (458 ppm)		Group B (1000 ppm)		<i>t</i> -value	Significance
	Mean	SD	Mean	SD		
Baseline (before brushing)	0.269	0.039	0.258	0.019	0.790	0.439 (NS)
Immediately after brushing	3.652	0.588	7.745	0.757	13.494	0.00 (S)
15 min after brushing	0.480	0.089	3.406	0.594	15.389	0.00 (S)
30 min after brushing	0.382	0.071	0.602	0.205	3.203	0.005 (S)
60 min after brushing	0.338	0.092	0.380	0.050	1.268	0.022 (NS)

S = Significant, NS = Nonsignificant, SD = Standard deviation

and Morgan,^[9] and DenBesten and Ko^[10] wherein the difference between the baseline salivary fluoride concentrations in both groups was not statistically significant.

In the present study, the difference between the salivary fluoride concentrations after 15 min and 30 min in both the groups was statistically significant. The result is similar to those reported by Nagpal and Damle,^[3] Duckworth and Morgan,^[9] and DenBesten and Ko^[10] wherein the difference between the salivary fluoride concentrations after 15 min and 30 min in both groups was found to be statistically significant.

In this study, the difference between the salivary fluoride concentrations after 60 min in the two groups was not statistically significant. The result is similar to the results reported by Nagpal and Damle,^[3] Duckworth and Morgan,^[9] and DenBesten and Ko^[10] wherein the difference between the salivary fluoride concentrations after 60 min in both groups was not statistically significant.

In the present study, to maintain uniformity in rinsing after toothbrushing, all participants were instructed to rinse with 10 ml of tap water for 10 s. The study conducted by Duckworth and Morgan,^[9] has shown that the rinsing procedure, as determined by the type of solution and the amount and duration of the rinse, affects the oral fluoride retention. In the present study, toothbrushing with fluoridated toothpastes resulted in increased salivary concentrations of fluoride, which had an anticariogenic effect. The results were in accordance with the study conducted by Campus *et al.*,^[11] wherein the fluoride concentration in saliva could be maintained to an optimal therapeutic level with the regular use of fluoridated products.

Based on the results of the present study, it can be concluded that 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, benefits of higher concentration of fluoride which increases the salivary fluoride level significantly may outweigh the risk of fluorosis.

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