

Variation of the Salivary Fluoride Concentration after Using a Fluoride-containing Sealant

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Abstract

Aim. The aim of the present study was to evaluate the variation of salivary fluoride concentration after using a fluoride-containing sealant.

Materials and methods. The study was made on 10 volunteer subjects, aged between 7 and 9 years, with at least one lower 6-year molar fully erupted and without caries, with deep and retentive pits and fissures. The whole saliva was collected using the same standard method (drainage method) at the same hour (10.30) for all subjects, before and also after (30 minutes, 24 hours, 48 hours and 1 week) using the sealant. Salivary fluoride concentration was determined by the method of dose titration of thorium fluoride salts in the presence of sodium alizarin sulphonate. The ethical advises for making the study and the informed-written consent of the subjects were obtained. Statistics used SPSS 19.

Results. The analysis of the salivary fluoride variation after using a fluoride-containing sealant showed a rapid increase just after sealing (30 minutes) at a maximum value (4.357 ± 0.363 ppm F), followed by a first stage of decreasing in the following 24 hours (1.256 ± 0.271); after this period, the salivary fluoride concentration is decreasing slowly but it is maintaining at significant higher values ($p < 0.05$; t-test) than the initial ones even after a week from using the sealant.

Conclusion. These values show that the use of fluoride-containing sealants provides constant and high fluoride concentrations in saliva for long periods (minimum one week).

Keywords: *fluoride, sealant, saliva.*

Introduction

The mass spreading of dental caries, its appearance at young ages, the increase of the carious disease rate and of cases with multiple cavities surging, the impossibility of therapeutic procedures to achieve a significant reduction of caries morbidity, make caries prophylaxis to constitute a public health problem (1-4).

The increased prevalence of occlusal caries in children (with all its train of sufferings), the impossibility of perfect mechanical cleansing of occlusal surfaces and also the limited benefit obtained at this level by means of fluoride, required finding new methods particularly effective in protecting these areas with increased cariogenic potential (3, 5-7).

Such conditions have required the method of sealing the pits and fissures of posterior teeth with different adhesive materials, method included in the World Health Organization strategy for the prevention of dental caries. Sealing of pits and fissures of permanent young teeth is a modern method of preventing dental caries on occlusal surfaces of the molars and premolars and oral surfaces of the upper incisors (1-6; 8).

Non-invasive, readily accepted by children and with favorable results in time, sealing has few disadvantages, establishing itself in the recent years not only in the prevention of dental caries, but also in the therapy of simple occlusal caries therapy.

It is conceivable that sealing of pits and fissures contribute substantially at increasing the resistance of dental hard structures to cariogenic acid attacks, being a method whose effectiveness increases by using fluoridated sealants, given the essential role of fluoride in the remineralization of

initial enamel lesions (9-13).

The salivary fluoride concentration of fluoride reach similar values to those in plasma, i.e. 0.01 ppm; the fluoride levels in saliva are less than the levels from other fluids that wash the teeth - e.g. tea and fluoridated water, but they are increasing after fluoride ingestion or topical applications of the substances (14-17).

Because of the remineralization effect of the salivary fluoride on the initial enamel lesions (1-17), the increase of the salivary fluoride concentration is a research topic of great interest in preventive dentistry.

In this context, **the aim** of the present study is the evaluation of the salivary fluoride concentration after using a fluoride-containing sealant.

Materials and methods

The study was made on 10 volunteer subjects, aged between 7 and 9 years, with at least one lower 6-year molar fully erupted and without caries, with deep and retentive pits and fissures and with similar profile regarding the general and oral health (good general health state, without any medication in the last three months, normal salivary flow, DMFT and dmft indices under value of 3, the absence of any complicated carious lesions and of any chronic periapical processes).

The clinical stages of the study (saliva collection, sealing of the teeth) were made in the Department of Preventive Dentistry, Faculty of Dental Medicine, "Ovidius" University, Constanța.

The stage of biochemical analysis of saliva was made in the Department of Chemistry and Biochemistry of Oral Cavity, Faculty of Dental Medicine, "Ovidius" University, after maximum 30 minutes after the saliva collection.

Ist stage. The saliva collection

For saliva collection a standard methods was used, the drainage method (*Figure 1*), consisting in the collection of saliva that is flowing over the lower lip for 5 minutes, in subjects with plucked nostrils and who are breathing on their mouth (18).

The saliva collection was made at the same hour (10.30) for all subjects; they were restricted from consuming any food or beverages two hours before each saliva collection (19) and they did not use fluoridated products (toothpastes, mouthwashes, gels or solutions, etc.) one week before starting the study and also in the study period (1 week).

Figure 1. Saliva collection



Saliva collection was made as follows:

- Before sealing the teeth;
- 30 minutes after the sealing;
- 24 hours after the sealing;
- 48 hours after the sealing;
- One week after the sealing.

After collection, the saliva containers were closed tightly, stored in special containers and transported to the Department Chemistry and Biochemistry of the Oral Cavity, in order to analyze their fluoride concentration.

The IInd stage. Sealing the teeth

A single lower 6-year molar of each subject was sealed using the same fluoride-containing (maximum 2.5% NaF) material, Fissurit FX (*Figure 2*).

Figure 2. The material used for sealing (Fissurit FX)



The sealings were made using the classical method, respecting the producer indications (www.voco.com) and the following clinical steps (1-3; 8):

- cleaning the dental surfaces;
- the relative isolation of the tooth;
- preparing the enamel surfaces (demineralization with phosphoric acid 37% for 30 sec.);
- washing the dental surfaces for 1 minute;
- drying the dental surfaces;
- restoring the isolation of the tooth;
- the sealant application (*Figure 3*);
- the sealant polymerization (*Figure 4*);
- verifying the sealant (*Figure 5*);
- checking of the occlusal relationships.

Figure 3. Sealant application



Figure 4. Sealant polymerization



Figure 5. Verifying the sealing



The 3rd stage. Evaluation of the salivary fluoride concentration

The salivary fluoride concentration was evaluated by the method of fluoride dose titration with thorium salts in the presence of sodium alizarin sulphonate, which in a strongly acidic medium forms thorium-alizarin lake, colored in yellow-pink.

The used reagents were as follows:

- 0.1N hydrochloric acid;
- 0.1N sodium hydroxide;
- calcium chloride, supersaturated solution;
- thorium solution;
- sodium fluoride stock solution: 0.2 mg F/L;
- sodium fluoride working solution: 0.02 mg F/mL;
- sodium alizarin sulphonate solution.

Working mode:

a. Preparing the solutions for comparison.

In two Erlenmeyer glasses (A) and (B) of 100 mL each, 50 ml of deionized water are introduced then 1 mL of saturated calcium chloride solution and 1 mL solution of sodium alizarin sulphonate are added; it is neutralized with 0.1 N hydrochloric acid solution until obtaining the yellow lemon color, then followed by addition of an excess of 0.1 N hydrochloric acid solution.

In (A) glass 1,9 mL thorium solution is inserted and in (B) glass 2 mL thorium solution are inserted.

Both Erlenmeyer vessels are allowing to stand 10 minutes for the formation of thorium-alizarin lake with yellow-pink color of different color intensities, depending on the amount of added thorium; these solutions can be used up to maximum 6 hours after preparation.

b. Establishing the thorium solution titre.

In an Erlenmeyer glass of 100 mL, 48 mL deionized water, 2 mL working sodium fluoride solution, 1 mL calcium chloride solution and 1 mL sodium alizarin sulphonate solution are introduced. The mixture is neutralized with hydrochloric acid until lemon yellow color is obtained and then an excess of 2.5 mL solution of hydrochloric acid is added; the solution is then titrated with thorium solution to equalize the color with the solutions for comparison (A) or (B).

The titre of thorium solution expressed in fluoride is calculated using the following formula:

$$T = \frac{0,01}{V_1 - V_2}$$

Where:

V_1 = the quantity of thorium solution used to equalize the color with the solutions for comparison (A) or (B) in mL;

V_2 = the quantity of thorium solution introduced in glass (A) or (B) which was used for comparison, in mL;

0.01 = the fluoride quantity, in mg, which is corresponding for 2 mL working sodium fluoride solution.

c. Evaluation of the salivary fluoride concentration.

The collected saliva is introduced in an Erlenmeyer glass of 100 mL. Deionized water is added until a volume of 50 mL. Then 1 mL calcium chloride solution, 1 mL sodium alizarin sulphonate solution and hydrochloric 0.1N acid solution are added until the yellow-lemon color is obtained, and then an excess of 2.5 mL hydrochloric acid is added.

Afterwards it is titrated with thorium solution to equalize the color with the solutions for comparison (A) or (B). The salivary fluoride concentration is then calculated with the following formula:

$$\text{mg / L Fluor (F)} = \frac{(V_1 - V_2)T}{V} 1000$$

Where:

V_1 = the quantity of thorium solution used to equalize the color with the solutions for comparison (A) or (B) in mL;

V_2 = the quantity of thorium solution introduced in glass (A) or (B) which was used for comparison, in mL;

T = the titre of thorium solution, expressed in fluoride;

V = the quantity of analyzed saliva, in mL.

The results were expressed in mean values \pm standard deviation.

Ethics approval

Ethical permission to conduct the study was given by the Professional Ethical Committee of Ovidius University, Constanta. Free-written informed consent was obtained from all the participants. Participation was optional, and the time for thinking (express the consent or refusal) was 48 hours.

Statistical analyses

These were made using SPSS 19 for Windows (descriptive statistics, t-test for testing the between-groups variation).

Results

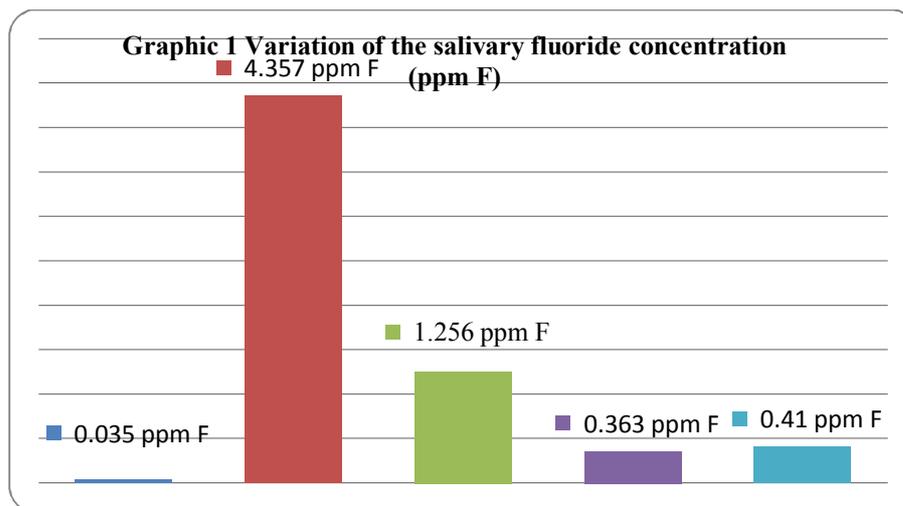
The results regarding the salivary fluoride concentration both before using the sealant and also after 30 minutes, 24 hours, 48 hours and 1 week after sealing the teeth are presented in *Table 1*.

Table 1. The salivary fluoride concentration (ppm) before and after the sealing

No. of sample	Saliva type	initial	30 minutes	24 h	48 h	1 week
1	unstimulated	0.031	4.020	1.121	0.321	0.048
2		0.020	4.085	1.102	0.283	0.032
3		0.035	4.312	1.382	0.352	0.036
4		0.032	4.308	1.312	0.312	0.038
5		0.065	5.320	1.981	0.634	0.082
6		0.028	4.311	1.138	0.268	0.024
7		0.045	4.313	1.113	0.341	0.048
8		0.033	4.412	1.139	0.382	0.041
9		0.039	4.382	1.141	0.396	0.036
10		0.029	4.107	1.132	0.346	0.034
Mean \pm S.D.		0.035\pm0.0122	4.357\pm0,363	1.256\pm0.271	0.363\pm0.103	0.041\pm0.015

The comparison of the initial salivary fluoride concentrations (before using the sealant) with the levels obtained at 30 minutes, 24 h, 48 h and 1 week after sealing the teeth showed statistically significant increases ($p < 0.05$; t-test) for all subsequent determinations (30 minutes, 24 h, 48 h), including at 1 week after using the sealant.

The variation of the salivary fluoride concentration in all five determinations is shown in *Graphic 1*.



Discussion

Currently clinical dentistry is using a variety of fluoridated products for the prevention and control of dental caries (11-17).

The most cariostatic fluoride activity depends on the concentration of fluoride in oral fluids. Exposure to fluoridated products causes a slight increase in the usual concentration of fluoride in oral fluids (0.01 ppm F in subjects with a normal diet and living in areas with 0.02 ppm F in drinking water), mainly in saliva and plaque fluid; subsequently fluoride is absorbed or integrated into tooth enamel (20-23).

The results of the present study resemble with the results of the similar studies from the scientific literature, regarding the variation of the salivary fluoride after using fluoride-containing sealants (6, 20-24).

Even if the sudden increase of the salivary fluoride levels after sealing is followed by return to normal values after about 7 days, its permanent presence in saliva throughout this period has an essential role in maintaining the integrity of the enamel under the action of various acids in the mouth.

In the present study the fluoride concentrations maintained in saliva for a long time are correlated with high concentration of fluoride in the used sealing material and demonstrate the usefulness of applying fluoride-containing sealants, while the cariostatic effect of fluoride is indisputably linked to the availability of fluoride ion in saliva and plaque during periods of pH decreasing in the oral cavity (6; 9-12).

Conclusions

1. The salivary fluoride level is maintaining over the physiological level for at least 48 hours after using a fluoride-containing sealant.

2. The model of the salivary fluoride level variation after using a fluoride-containing sealant shows a sharp increase immediately after sealing (30 minutes) to a peak value followed by a first phase of rapid decrease in the next 24 hours; after this period, the concentration of salivary fluoride decreases more slowly, remaining at levels significantly higher levels than the initial ones even 1 week after achieving a single sealing.

3. These values demonstrate that using the fluoride-containing sealant provide constant and increased fluoride levels in saliva for a long period (minimum 1 week).

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