

Salivary fluoride concentration after professional topical fluoride applications

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Summary

The aim of the study is the evaluation of the fluoride ions concentration retained in the whole saliva after the use of a topical fluoridated agent – „Fluocal Gel”.

Material and methods

The study group consisted of 20 children aged 13 years old. Their parents were informed about the importance of the professional topical fluoridation. The fluoride agent was applied in individual trays, for 4 minutes, with salivary aspiration. The paraffin-stimulated saliva was collected first before the fluoridation and then after 5 minutes and 1, 2, 12, 24 and 48 hours. The fluoride ions concentration in the salivary samples was assessed with a fluoride-sensitive electrode.

The results show that fluoride concentration in saliva has important levels in the first 24 hours after the use of the fluoride agent, at the same time the salivary pH being kept at a neutral level along this period.

Conclusion. The increase of the fluoride concentration in saliva through the use of fluoridated concentrated agents is a very efficient method to prevent dental caries by several mechanisms, the most important being the inhibition of the enamel demineralization and the stimulation of the remineralization of the incipient caries.

Introduction

The importance of the fluoride agents for topical professional applications is well established, based on the main role of the fluoride ions, that is decreasing the demineralization and enhancing the remineralization of enamel, even in patients with high carious risk [1, 4, 6].

The absorption of the fluoride ions from the oral fluids in the sound enamel is low and limited at a neutral pH. If the fluoride ions are present in the mouth at the time when the pH is decreasing and the carious lesion is starting, their effect is to inhibit the demineralization of the enamel by promoting the remineralization [2, 5, 7, 8].

Therefore the presence of a low but constant concentration of fluoride in saliva and plaque fluid is the most effective method to control initial dental caries [5,6,8].

Because the fluoride concentration in the oral fluids is decreasing by swallowing, this theory implies a continuous addition of fluoride in

the saliva, a discontinuity making the enamel vulnerable to demineralization. For complete prevention of dental caries, the fluoride should be present in the oral cavity for the whole life.

This is the reason why several studies support the idea of frequent use of fluoride agents for topical application (gels, solutions, varnishes) and give a distinct importance of the salivary retention of the fluoride ions after these applications.

Even the use of a method depends to a certain extent on the patient's preferences. It is the responsibility of the clinician to prescribe the best method for each patient, depending on several elements, the most important being the individual carious risk.

In order to choose the most appropriate fluoridation method for a certain patient, the practitioner must know for each method the extent of effectiveness as to the increase of fluoride concentration in saliva.

On the other hand, the increase in the availability and usage of concentrated fluoridated

agents requires the cancellation of the risk of chronic fluoride intoxication or of the dental fluorosis.

All of the above represent arguments for a most accurate cognition of the fluoride retention in saliva, after applying the most used fluoridated products in dental offices.

The aim of the present study is the measuring of the fluoride concentration in saliva after the application of a concentrated fluoridated agent – “Fluocal Gel” – produced by Septodont, France. (Figure 1)



Figure 1

Material and method

20 children aged 13 years old have been comprised in the study, being selected according to the degree of oral hygiene, status of dental health and rate of salivary secretion. The batch included only subjects with good oral hygiene, without cavitary carious lesions and with normal salivary rate.

In order not to distort the results of the experiment, the use of toothpaste has been forbidden for 12 hours before and 48 hours after fluoridation.

The application of fluoridated gel was performed in the morning, 2 hours after breakfast, in similar conditions for all the subjects.

The fluoridated gel was applied in individual trays made after the imprint of the dental arches. (Figure 2)



Figure 2

The marginal closing of the trays was verified, in order to prevent the flowing and the swallowing of an increased quantity of gel. An amount of 0.5 g gel (14 drops) was applied in each tray. The introduction in the oral cavity of the trays filled with gel was accompanied by the salivary aspirator. The trays were maintained in the oral cavity for 4 minutes. (Figure 3).

After removing the trays, the dental surfaces were cleaned with gauze in order to prevent the swallowing of a great amount of gel. The patients were asked to spit for 10 seconds, after that the salivary aspirator was introduced for 5 minutes. After that, the first samples of saliva were collected. The patients were not allowed to consume food and beverages for 2 hours after the fluoridation. The fluoride concentration was measured in the salivary samples collected before the fluoridation and after, at 5 minutes, 1 hour, 2h, 12h, 24h, and 48h.



Figure 3



Figure 4

The concentration of fluoride in saliva was computed with a fluoride-selective electrode (Cole-Palmer® Fluoride Electrodes, Cole-Palmer Instrument Company, Illinois, USA), following the directions regarding the measuring of light ionized solutions, using a calibration curve obtained through the standard method of addition (the lower limit is 0.01ppm) (Figure 4). At

least 10 minutes were allowed for the electrode to stabilize before reading the values.

Results

The results of the experiment show that the salivary retention of the fluoride after the application of “Fluocal Gel” in individual trays passes through 2 phases (Figure 5, Figure 6): a one-hour initial phase, during which the concentration of salivary fluoride decreases very fast from the peak value registered at 5 minutes after application (19.2 ppm) to a value of 1.157 ppm; a secondary phase, prolonged up to 48 hours, during which the concentration of salivary fluoride decreases very slowly, reaching 0.3298 ppm, value that is however higher than that registered before fluoridation (0.073 ppm).

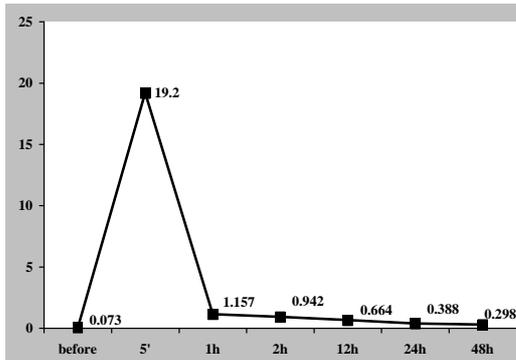


Figure 6. Variation of concentration of salivary fluoride in time

Discusions

All the methods of topical fluoride applications have, as a common base, the increasing of the fluoride in the dental hard tissues [1, 3, 8]. The latest studies show that just a small part of the ionic fluoride is incorporated in the enamel at the moment of application, the directly clinical effect and the incorporation of the fluoride in the sound enamel being of little importance [2, 4, 6, 7].

The model of the fluoride levels variation in this study is similar to other studies and is

explained by the CaF₂ formation [5, 8], which represents the major product of the reaction between fluoride with enamel, and which precipitates wherever the dental hard tissues are exposed to a high concentration of fluoride, inhibiting the enamel demineralization and enhancing the remineralization.

The first stage of rapid decreasing is due to the topical application of fluoride, and the second stage – of the slow release of the fluoride ions by the CaF₂ reservoirs made in the first stage in saliva and in the dental plaque.

CaF₂ is relatively stable at a neutral pH. When the pH is decreasing CaF₂ dissociating and fluoride ions are released and adsorbed in enamel. The dissolution of the CaF₂ formed on the teeth surfaces, in saliva and in the dental bacterial plaque is the key of the preventive effect of the topical applications of fluoride gels.

The amount of the CaF₂ formed on the teeth surfaces after the use of fluoride applications is increasing at the same time with the fluoride concentration in the used agent and with the decreasing pH.

In this study the important fluoride concentrations maintained in saliva for more than 48 h are correlated with the high concentration of F⁻ in the used gel (10.000 ppm, neutral pH), and show the utility of the topical fluoride applications. The preventive effect of fluoride is unquestionably connected by the fluoride ions reserve in saliva and dental plaque in the periods when the pH is decreasing in the oral cavity.

The important salivary retention after the use of concentrated gels is extremely useful in high-risk patients (patients with xerostomia, patients with fixed orthodontic appliances or patients which cannot control the sucrose consumption and the dental plaque formation).

Conclusions

1. The salivary fluoride concentrations are higher than the physiological levels (0,01 – 0,1 ppm) at least two days after the application of the concentrated gels, even at neutral pH.

Time period	Before	5min	1h	2h	12h	24h	48h
Concentration of salivary fluoride	0.073	19.2	1.157	0.942	0.664	0.388	0.298

Figure 5. The concentration of salivary fluoride

2. The model of the fluoride level variation in saliva shows in a first stage a fast decreasing from the peak value registered at 5' after the application, at a level of 1,157 ppm in the first 60'. After this period, the salivary fluoride levels are decreasing slowly, in 48 h the mean fluoride concentration value being 0,298 ppm.

3. The important values of the salivary fluoride concentrations are correlated with the fluoride concentration in the applied gel, which promotes the CaF₂ formation in the oral cavity.

4. These values shows that the topical application of the fluoride concentrated gels gives constant and raised concentrations of fluoride in saliva for relatively long periods, and longer

elimination periods than the use of other fluoridated agents, with lower fluoride concentrations.

5. The high salivary concentration of the fluoride after the application of the concentrated gels is extremely useful to the high-risk patients, and also for the patients that cannot use frequently the fluoridated toothpastes.

6. The effects of the fluoride applications – the inhibition of the enamel demineralization, the enhancement of the remineralization and the inhibition of the enzymatic activity of bacteria – are generally recognized, and the topical fluoride applications as a method for decreasing the caries risk of the patients is an important stage of an modern and conservative odontal treatment.

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