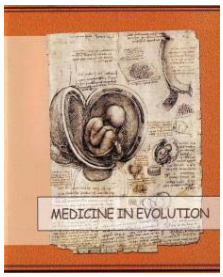
Evaluation of fluoride release into saliva after topical application: an in vitro experiment



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Abstract

Fluoride is the most important element in caries prevention and control. Topical fluoride therapies, self-applied or professional procedures, are frequently used such as dentifrices, mouthwashes, varnished, gels etc. The most important thing for a topical fluoride therapy irrespective of type of substance, method, concentration or frequency of application is fluoride concentration in oral fluid or in dental plaque. This study is an in vitro experiment developed on extracted teeth. Teeth were fluoridated with tin fluoride gel (0.4%) after they were cleaned with an ultrasonic scaler, water and immersed in a hypochlorite solution for 10 minutes. Afterward, the concentration of fluoride released from the teeth enamel was measured at 24, 48, and 72 hours using HI-729 Fluoride Low Range Handheld Colorimeter device. The amount of fluoride released between 48 hours and 24 hours from fluoridation (0.22 – 0.37 ppm) was a higher than the one released between 72 and 48 hours from fluoridation (0.15 – 0.18 ppm). The amount of fluoride released from the teeth enamel decreases in time after the topical fluoridation.

Keywords: fluoride release, topical applications, in vitro evaluation

INTRODUCTION

The use of fluorides is the most common and effective method for caries prevention. The fluoride is involved in mineralisation, maturation and preeruptive stages of tooth development, improves enamel remineralisation and has antibacterial effect. Fluoridation can be systemic (water, salt, milk) or topical (self-applied or professional procedures) [1,2,3]. Fluoride is present in saliva and on teeth surfaces after topical therapies were used. Thereby, the fluoride will be adsorbed on the enamel surface, it will reduce the demineralization when the pH rises above the critical level (5.5), and forms fluorhydroxyapatite. The fluoride can also interfere with the physiology and several bacterial mechanisms, such as enzymes activity (ex: glycolytic enzymes, H+ATPases). This is one of the fluoride antibacterial effects [4].

Different types of fluoride agents are used and reported to be effective in preventing dental caries, namely remineralsing early caries lesions and arrest dentine caries. There are various methods, concentrations, frequencies of applications and fluoride substances used in the topical therapies such as sodium fluoride, tin fluoride or acidulated phosphate fluoride (APF) [3,5,6].

Fluoride concentration in dental plaque and oral fluid is very important for topical therapies. The remineralization process and the antibacterial effects of fluoride are present when the fluoride concentration is optimal.

Aim and objectives

The scope of this study is to find how fluoride is released from teeth enamel after topical application using an in vitro experiment developed on extracted teeth and in which a special device is used.

MATERIALS AND METHODS

12 extracted teeth, 6 lateral and 6 frontal were used in this experiment. First, the teeth were cleaned using an ultrasonic scaler. All calculus deposits and extrinsic discolorations were removed in order to obtain cleaned enamel surfaces for a maximum fluoride uptake (figure no. 1). Afterward, the teeth were immersed in a hypochlorite solution for 10 minutes. The rationale of this experiment is to evaluate the fluoride released from the enamel only. Therefore, to exclude the cemetum, the teeth roots were covered with nail polish (figure no. 2, a & b).

Figure 1. Cleaning the extracted teeth with ultrasonic scaler

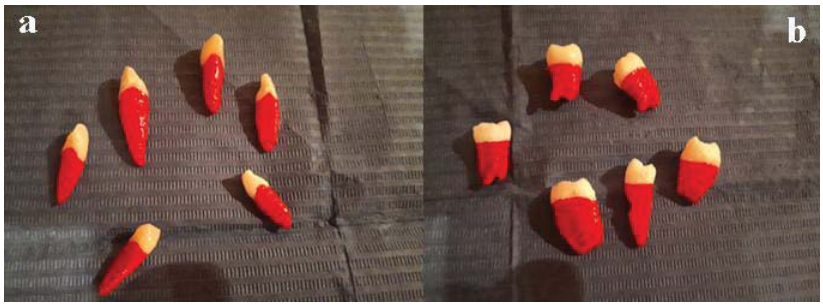

Figure 2. Extracted teeth with roots cover with nail polish; a – frontal teeth, b – lateral teeth

An amount of approximate 0.3 ml of 0.4% tin fluoride gel were put on teeth crowns using a small brush (applicator). After 1 minute, the excess of gel was removed and the teeth were washed with clean water. Then, the teeth were put in two plastic sterile bottles full with deionized water, one for lateral teeth and one for frontal teeth (figure no. 3, a & b, and figure no. 4).

The fluoride released from the teeth was measured using HI-729 Fluoride Low Range Handheld Colorimeter, Checker®HC device (figure no. 5). The device uses SPANDS method and it has:

- range 0.00 to 2.00 ppm
- ± 0.05 ppm ± 5% of reading
- 0.01 ppm resolution
- light source – LED 575 nm
- light detector – silicon photocell
- environment: 0 to 50°C (32 to 122°F); RH max 95% non-condensing
- 2 sample cuvettes with caps
- reagents for 6 tests (re-ordering information HI-729-26 x 20 tests)
- syringe with tip
- 1 x 1.5V AAA battery

Figure 3. Teeth in plastic containers
a – frontal teeth, b – lateral teeth


Figure 4. Teeth in deionized water

Figure 5. HI-729 Fluoride Low Range Handheld Colorimeter, Checker®HC device

2 ml of special reactive was combined with 8 ml of deionized water for each measure. It was 3 measurements of fluoride concentration: at 24, 48, and 72 hours for both containers.

RESULTS

The results for the 6 measurements were graphically exposed in the figures no. 6 and 7, and in table no. I.

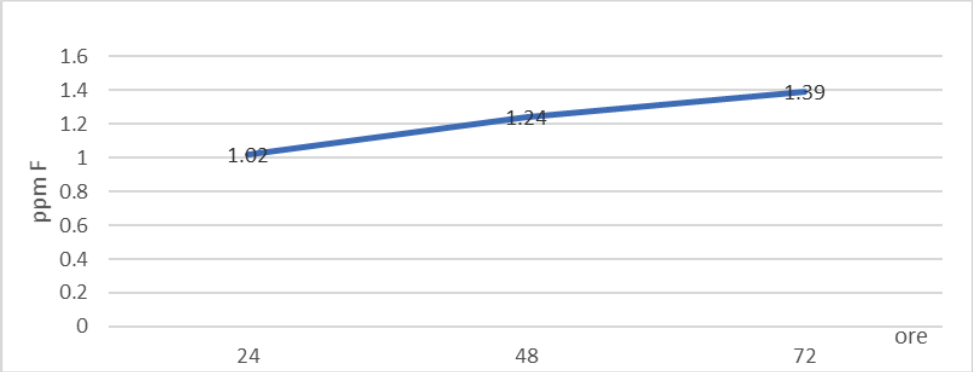

Figure 6. Fluoride concentration released from the anterior teeth

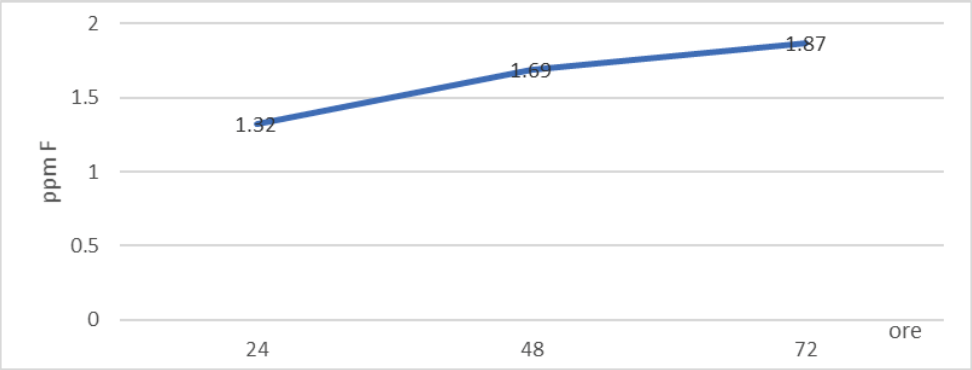

Figure 7. Fluoride concentration released from the posterior teeth

Table I. The amount of fluoride released from the teeth

Teeth	Fluoride released in the first 24 hours	Fluoride released between 48 and 24 hours	Fluoride released between 72 and 48 hours
Anterior	1.02 ppm	0.22 ppm	0.15 ppm
Lateral	1.32 ppm	0.37 ppm	0.18 ppm

DISCUSSIONS

Our study shows that the amount of fluoride released from the frontal teeth is lower than from the lateral teeth, which may seem logical given that they have thinner enamel. On the other hand, the amount of fluoride released from both lateral and frontal teeth is higher at 24 hours after fluoridation compared with that released between 48 hours and 24 hours after fluoridation, which is also higher than the amount of fluoride released in the last 24 hours (at the final point of the experiment – 72 hours after fluoridation). Thus, we can say that the amount of fluoride released from the enamel in a fluid is high at the beginning but decreases in time after the fluoridation.

The major limit of our study is that we used deionized water instead of saliva. Our study is an in vitro experiment and did not include human participants. We had in mind to create a mechanism of fluoride release similar to that in the oral cavity but oral fluoride

kinetics in the oral cavity depends on many factors such as saliva secretion, dietary fluoride sources or topic fluoride therapies [7]. Oral hygiene habit is also very important for fluoride level in saliva, especially brushing time and frequency or the amount of fluoride from the dentifrice, high fluoride toothpaste being considered to be responsible for a high saliva fluoride level as against regular toothpastes [7,8]. All these cannot be reproduced in an in vitro experiment.

Agents used in topical therapy provide different levels of fluoride in saliva. Sodium fluoride and aminofluorides for example, provide high concentration of fluoride in saliva [7]. Fluoride varnishes also release high amounts of fluoride in saliva. One study shows that even was added calcium glycerophosphate in some fluoride varnishes and therefore, the amount of fluoride in saliva increased, this did not lead to greater preventive effect against enamel demineralization [9].

Chewing gum is another donor of fluoride. The amount of fluoride released in saliva by the fluoride-containing chewing gum is almost ten times higher than in case of regular chewing gum [10].

CONCLUSIONS

Our experiment showed that fluoride is released in saliva at 24, 48, and 72 hours after topical fluoride therapy but the rate of release is decreasing. Even so, this is very important because the presence of fluoride in saliva is essential for caries prevention and control.

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