

# Fluoride in caries prevention – methods and techniques

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## Introduction

Dental caries is an infectious transmissible disease, with multiple factors, and it affects a major part of the population of the entire world, especially in the countries with a poor economy. In our country, both prevalence and gravity of dental caries reach high degrees and that is the reason why methods of prevention and control are strongly requested. A very important role is played by the education and awareness of the population, parents, educators and the cooperation with medical staff with other specializations than dentistry. General physicians and nurses in school offices, polyclinics, community offices and private offices could have a main contribution in the attempt of changing the individual behavior and attitude towards each other's health.

General or local administration of fluorides, along the dietary habits, oral hygiene and sealing of pits and fissures constitute matters of high significance among the methods of prevention and control of dental caries. Fluorides are looked upon as a major determiner factor in decreasing the dental caries in industrialized countries, and its main characteristics (efficiency, availability of large offers of fluoride products, insignificant secondary effects if it is properly used, accessible costs) give credit for the future use.

## General considerations concerning fluoride as a caries preventive factor

Fluoride, the element with the highest electro-negativity in the Mendeleev table, is naturally largely spreaded in the environment (water, air, soil). Fluoride easy forms stable compounds in combination with electro positive elements like sodium and calcium. Into the human body, its affinity towards calcium causes it to mix especially with calcium-rich tissues (teeth, bones).

Fluoride capacity of decreasing or halting the initiation or even the evolution of dental caries is very well known and largely used today; use of drinking water fluoridation with controlled concentration has dated since 1945 in the USA and Canada.

In the beginning, fluoridated drinking water of a concentration higher than 1 ppm F was the major source of fluoride. Other fluoride products, such as: fluoride dentifrices, fluoride mouth rinses, fluoride supplements, gels, foams and varnishes developed later. Fluoride could as well be provided in small amounts, in foods and beverages made of fluoridated water.

The present availability of the sources of fluoride explains the decrease of dental caries observed in the late decades in developed/ industrialized countries, but also a tendency towards the medium dental fluorosis as a reverse side of favorable action of fluoride. Moderate dental fluorosis defined as opaque spots on the enamel due to the excess of fluoride in the pre-emptive period is not considered a real health problem but one of cosmetic interest, which could be treated or accepted as it is.

## Occurrence of dental caries and the fluoride interaction with this process

Dental caries are caused by the cariogenic bacteria colonized on the surface of teeth which form a dental plaque, the evolution of untreated dental caries is approximately following the next steps: dissolving the mineral surfaces of teeth by the action of the acids produced by the bacteria, the attack of dentine, penetration of pulp soft tissue. Dental caries means loss of dental structure, pain, loss of teeth and sometimes general acute infections.

Dental plaque cariogenic bacteria metabolize sugars or other dietary fermentable carbohydrates and the resulted acids begin to

melt the surface of the adjacent enamel crystal (demineralization phase). There are losses of calcium, phosphate, fluoride, carbonate ions in the tooth structure and these elements are taken and concentrated in the dental plaque due to the acid environment of the tooth-dental plaque interface, then the fluoride in the plaque is released and taken by demineralized enamel together with the fluoride in saliva and calcium and phosphate ions in order to form new crystalline dental structures (remineralization phase), with better properties, more resistant to acid attack, which contain more fluoride and less carbonate.

Demineralization-remineralization processes occur almost concomitantly and continue all along the tooth life, the fluoride having an active contribution to the decrease of the demineralization phase and acceleration of remineralization phase. Affecting activity of cariogenic bacteria through decreasing the metabolism of carbohydrates which implies the

production of acid in the oral cavity is another way of inhibiting dental caries due to fluoride.

## Fluoridation methods used in dental caries prevention

### 1. Drinking water fluoridation

Since 1940 it was settled that 1 ppm F constitutes the optimum concentration in dental caries prevention. These doses can vary with the climate between 0.5 and 1.2 ppm F. Under these conditions epidemiological studies revealed severe decrease in dental caries prevalence and an acceptable prevalence (10-20%) of moderate form dental fluorosis.

### 2. Administration of fluoride containing tablets

**Table 1.** Scheme of daily administration of fluoride containing tablets, by the level of fluoride in the drinking water and child's age (Fluoride supplementation for children: interim policy recommendation. Pediatrics 1995)

Age	Drinking water fluoride concentration		
	<0.3 ppm F	0.3-0.6 ppm F	>0.6 ppm F
0-6 month	-	-	-
6 months-3 years	0.25 mg/day	-	-
3-6 years	0.50 mg/day	0.25 mg/day	-
6-16 years	1.0 mg/day	0.50 mg/day	-

Note: 1 ppm (one part per million) F = 1 mg F/l

In order to increase the topic effect of the fluoride containing tablets it is recommended

that it is administered through chewing and sucking for 1 or 2 minutes before swallowing.

**Table 2.** shows the level of total daily-recommended fluoride, by age and weight (Dietary reference intakes for calcium, phosphorus, magnesium, vitamin D and fluoride. Washington, DC National Academy Press, 1997)

Age	Weight (kg)	Adequate dose* (mg/day)	Maximum admitted dose** (mg/day)
0-6 months	7	0.01	0.7
6-12 months	9	0.5	0.9
1-3 years	13	0.7	1.3
4-8 years	22	1.1	2.2
≥ 9 years	40-76	2.0-3.8	10.0

\* Adequate dose = the dose that reduces the most the presence of dental caries, without undesirable secondary effects (dental fluorosis).

\*\* Maximum accepted /admitted dose = total daily dietary intakes which do not trigger adverse effects in the general health, valid for almost every person.

In the developing of dental fluorosis in superior central incisors there is a range considered of maximal risk in the period of permanent teeth formation.

That is the reason why the administration of fluoride containing tablets is recommended to stop between: - 15-24 months in boys  
- 21-30 months in girls

The administration of fluoride containing tablets in pregnant women is no more recommended, because the child's benefit is not significant. Also fluoride-containing tablets are not recommended in children with growing difficulties (metabolic disturbances, dyspepsia, inadequate diets).

### **3. Salt fluoridation**

It was implemented for the first time in 1950 in Switzerland, subsequently this method spread to many countries. Presently it is used in Germany, Hungary, Romania, etc. It has the advantage of the individual's freedom of choice. It is generally considered that an adult consumes an average quantity of 6 g of salt daily, and that lead to adding 200-250 mg NaF to a kilo of salt.

### **4. Fluoridated dentifrices**

The fluoride is directly taken over by the dental plaque and demineralized enamel through using fluoridated dentifrices. Saliva fluoride concentration increases up to 1000 times immediately after brushing, but decreases until the initial level in approximately 2 hours. Studies conducted through a period of 2-3 years showed a decrease in caries experience with 15-30%, in children who used fluoridated dentifrices.

In children up to 6 years old, the swallowing reflex is not very well controlled and that is the reason why variable quantities of used dentifrices will be swallowed.

Applying the dentifrice on all active surfaces of the toothbrush means applying a quantity of 0.75-1.0 g of dentifrice, and each gram of dentifrice contains approximately 1 mg fluoride. Considering that a child up to 6 years old swallows an average percentage of 30% of this quantity, by summing the quantities from several daily brushings we could reach an ingestion of undesired quantities of fluoride, which might lead to dental fluorosis. That is why the exclusive use of dentifrices with concentration between 250-500 ppm is recommended to children up to 6 years old.

### **5. Fluoridated mouth rinses**

They are available in concentrations of 0.05% NaF for daily rinses or 0.2% NaF for weekly rinses. They are recommended to children over 6 years old in order to avoid accidental swallowing. They were largely used since the 60 's in Scandinavian countries in caries prevention

programs in schools. There were achieved decreases of about 30% in dental caries. Presently their use is recommended in children communities with high risk of dental caries.

The use of fluoride mouth rinses does not entail fluorosis risk, considering that they are recommended after 6 years of age.

The oro-dental diseases preventive program is currently carried on in Romania, based on weekly oral rinses with Fluorostom (fluoridated mouth rinse 90.2% NaF) in children in the I<sup>st</sup> to IV<sup>th</sup> form. This program was implemented in 1999 in five pilot towns in our country (Bucuresti, Iași, Constanța, Timișoara, Târgu-Mureș,) and the program is being carried on only in three university centers: Iași, Constanta, Timișoara, in 2002. The decision of our discipline to support this national oral rinses project with NaF 0.2% is based on data from the international literature and on the accumulated experience in this field. The longitudinal epidemiological study carried on between 1992-1998 and awarded by IADR in Warsaw in 2002, shows once more the efficiency of weekly rinses with NaF solution, in the conditions of a proper health education.

## **Fluoridated compounds with professional application**

### **1. Fluoridated gels and foams**

Clinical surveys show that dental caries reduces with 26% in permanent teeth due to fluoridated gels application, twice a year. Fluoridated gels are available under these guises:

- acidulated phosphate fluoride (1.23% F);
- sodium fluoride-gel or foam (0.9% F);
- stannous fluoride-gel (0.15% F).

The time of application is 1 to 4 minutes in prefabricated casts. Professional brushing is not needed before application. It is especially recommended to individuals with carious high risk.

### **2. Fluoridated varnishes**

Fluoridated varnishes are available as sodium fluoride (2.26% F) or di-fluoride silan (0.1% F). They are applied directly on tooth surface and it provides high concentrations of fluoride for several hours. Fluoridated varnishes have been used in Europe and Canada since 1970, providing results similar to applying fluoridated

gels. Their application is recommended twice a year. In USA the use of fluoridated varnish as anti-caries agents is not approved due to the lack of consistent results regarding its efficiency. That's why they are used only as desensitizers for exposed dental surfaces or as a liner under the filling materials. They do not involve dental fluorosis risk, not even if they are used in children under 6 years old.

### **3. Fluoridated dentifrices with professional application**

They are currently used in dental offices, but they are not a real substitute for fluoridated gels.

Their fluoride concentration is 4,000-20,000 ppm.

### **Conclusions**

The personal physician is very important in health education of the patients. If a mother is getting correct information about her oral and dental health and her child's as well, then she will be encouraged to adopt a preventive attitude. We addressed dental practitioner colleagues but also general physicians because we consider that our theoretical and practical studies in the field of fluoride prevention will be useful and our recommendations will be made differently for each case.

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