

METHODS FOR TOOTH DECAY PREVENTION WITH SYSTEMIC AND LOCAL APPLICATION

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Abstract: The effect of caries prophylaxis methods is based primarily on the mechanical cleaning and on auxiliary methods of oral hygiene, but also on the action of local antibacterial substances. Another important component of prophylaxis lies within the carioprophylactic effect of fluorine, the latter being administered both systemically (by fluoridation of water, food or fluorine tablets), and locally (as part of toothpastes, mouth rinses, gels or varnishes), where its effect has been proved to be far more important.

Keywords: carries, prophylaxis, flourine

Rezumat: Acțiunea mijloacelor de prevenire a cariei dentare se bazează în principal pe efectul de curățire mecanică realizată prin periaj dentar și mijloace auxiliare de igienizare orală, dar și pe cel antibacterian al substanțelor ce acționează local. O altă componentă importantă a profilaxiei o constituie efectul carioprotector al fluorului, urmărindu-se administrarea acestuia atât pe cale sistemică (prin fluorizarea alimentelor sau a apei sau prin tablete cu fluor), dar și local (înglobat în paste de dinți, ape de gură, geluri sau lacuri), unde s-a dovedit că acțiunea sa este mult mai eficientă.

Cuvinte cheie: prenire, carie dentară, fluor

INTRODUCTION

Methods of systemic and local fluorine administration

Fluorine helps in the prevention of early tooth decay through several mechanisms. The fluorine that is concentrated in plaque and saliva reduces demineralization of healthy enamel and stimulates demineralization of demineralised enamel.(39) As cariogenic bacteria metabolize carbohydrates and produce acid, fluorine is released from plaque as a response to the decrease of the pH level at the plaque-tooth interface.(39) The released fluorine and the fluorine of saliva are absorbed, along with calcium and phosphates, by the demineralised enamel, resulting in a more resistant crystalline structure of the enamel. The mechanism is based on the absorption of F ions on the surface of the apatite (a reversible phenomenon) or an ion exchange, F replacing the -OH or --CO₃ thus forming fluorapatite.(10) The latter is more acid-resistant and contains more fluorine and fewer carbon radicals.(39) The affinity for fluorine is higher in demineralised enamel than in healthy enamel.(39) These cycles of

demineralization and remineralization take place all through the tooth's lifespan. Fluorine also inhibits the onset of caries by affecting the activity of cariogenic bacteria. As fluorine concentration increases in plaque, it inhibits the metabolization of carbohydrates by bacteria. In vitro studies have demonstrated that when a low concentration of fluorine is constantly present, S. mutans produces less acid.(39)

The action mechanisms of fluorine in caries prevention have basically been known for over 40 years. Although discussions over the individual components of the role of fluorine (increasing the enamel's resistance against acid attack, interference in plaque metabolism, stimulating the remineralization of initial carious lesions) are still underway, there is sufficient data about the clinical use of fluorine.(6)

The most important observations are:

- both by systemic and local administration of fluorine, a carioprophylactic effect can be achieved. Separation of "systemic" and "local" is quite difficult, as, in a systemic administration of fluorine (for example the swallowing of a fluorine pill), there is always a local effect as well (given by the elimination of fluorine through saliva). On the other hand, experts have shown that a significant amount of fluorine is reabsorbed after swallowing a certain quantity of fluorine tooth paste or fluorine gel. These ingested amounts must be taken into account when determining the daily need of fluorine, in order to avoid overdosage.(13)
- In order to obtain a maximum protective effect, there must be an optimal intake of fluorine, especially before teeth erupt, during the maturation stage of enamel. Fluorine intake during the preeruptive phase has a greater role in protecting the approximal and smooth surfaces of the tooth, whilst posteruptive fluoridation helps protecting occlusal surfaces.(17)

In light of these facts, the long controversy on prenatal fluoridation, and especially on its effects on the fetus, loses its importance. The optimal time to begin systemic fluoridation is after birth.

- An optimal fluorine intake only during eruption is not sufficient, as the enamel surface, which constantly exchanges ions with saliva and plaque, can not only adsorb, but also lose fluorine ions. Thus, the success

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of a fluorine-based prophylactic measure can only be insured through constant intake, all through a person's life, of the recommended fluorine amounts. The theory of the last years, which states that more frequent local application of low-concentrated fluorine solutions would have a superior prophylactic effect as opposed to administering higher doses over longer intervals, is no longer sustainable.(31)

Methods of systemic fluorine administration

1. Fluoridation of drinking water

Fluoridation of drinking water is a simple, cheap and effective way of systemic fluorine administration. According to recent data, approximately 400 million people benefit from it. The method's disadvantages are the necessity of a central water supply, thus not being applicable to the whole population, and the fluorine intake cannot be individualized, as it depends on water intake. The fluorine concentration of water should be that of 1 mg/l; it is obtained by adding sodium fluoride or sodium silicofluoride to water.(10)

2. Fluoridation of kitchen salt

Along with the fluoridation of water, this method is used in many countries for mass fluoridation. It is recommended especially in mountain areas with water of low fluorine concentration and lack of a central water supply. The fluoridation of salt with 200-250 mg of fluorine per 1 kg of salt insures a convenient daily intake. The method is not suited for infants, as their salt intake is low.(10)

3. Fluoridation of milk

This method is best suited for infants and children, milk being their main food. Considering that the mean milk intake is of ½ l per day, the fluorine amount is 2 mg/l (10 ml of 2.2% NaF solution for 100 l milk).(10) The method's disadvantages are the need for a central milk collection system, the rapid distribution (in a matter of hours) and the fact that casein inactivates F ions.(10,16)

4. The fluoridation of bread has not yielded the expected result, due to individual intake variations.

5. Administering fluorine pills and solutions

Administering fluorine pills has the advantage of individual dosage, according to age, concentration of fluorine in water and food, climate, etc.; in order to be effective, the administration should begin during pregnancy, continued through breastfeeding and then children should be given fluorine pills until 14 years of age [10]. This must be done under strict supervision in order to avoid intoxication or overdosage.

The administration should insure:

- 0.25 mg F / day in infants in their first year of age
- 0.50 mg F / day between the ages of 1-3
- 0.75 mg F / day between the ages of 3-4
- 1 mg F / day after their 4th year

It should be administered continuously, during at least 200-250 days/year, until the age of 12-14.(16) The dose is administered once every day, the pills can be sucked or dissolved in tea, soup or milk.

Fluorine can also be administered as a solution mixed with other fluids. For instance:

Rp: Natrium fluorinide 0.125 mg

Distilled water 240 mg

1/4 teaspoon/ day for children under 2 years

1 ts every other day from 2-3 years

1 ts / day after 3 years

1 ts = 2.75 mg NaF = 1 mg active fluorine

In spite of the simple dosing and the low price, the method has some disadvantages: individual consent is necessary, insufficiently informed parents can be against it, and children can discontinue treatment at their own will.(10)

The use of systemic fluorine administration methods is less widespread today due to studies proving that the local effect of fluorine is more important and involves fewer risks.(11,18,7)

These risks are represented mainly by fluorosis, (24) which occurs when an excessive amount of fluorine is ingested; it can affect both the enamel (in low overdosage) and the skeleton, when large quantities are ingested over a long period of time (2 mg of F / day during several years).(7). In teeth, its clinical signs are small white or brown spots, which can evolve towards opaque areas or even loss of enamel substance, varying from dots to spots about 2 mm in size [10 seen in 18, 30]. In severe cases (an intake of 5 mg F / day), all teeth show major structure defects, the size of the lesions are larger and bone structure modifications can occur, making the skeleton more vulnerable to fractures.(2,7,18)

Fluorosis occurs due to inclusion of excess fluorine in the enamel structure, during its maturation stage, the preeruptive stage; once the tooth has erupted, it is no longer at risk of developing fluorosis. Thus, only children younger than 8 years can be affected by fluorosis.(40)

Methods of local fluorine application

Laboratory and epidemiological studies that have led to a better understanding of the role of fluorine in prevention, indicate that the effect of fluorine is mainly posteruptive and a consequence of local application; it depends on the presence of the right amount of fluorine in the right place at the right time. Fluorine acts mainly after the teeth have erupted, especially when small amounts are constantly present in saliva and plaque.(9) Thus, adults also benefit from the effect of fluorine, not just children as was previously supposed.

There are relatively few studies that evaluate the efficiency of fluorine-containing tooth pastes, gels or mouth rinses on adults. Such studies were conducted mainly on children, due to their increased susceptibility to dental caries. Still, teeth remain at risk of developing decay for the whole of life, and locally applied fluorine could be effective in preventing caries at any age.

The aim of methods of local fluorine application is increasing tooth tissue resistance and the possibility of increasing fluorine concentration within the superficial layers of enamel after tooth eruption.

The widest used methods of local fluorine

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administration are fluorine toothpastes, mouth rinses, varnishes or gels.

Fluorinated toothpastes

The decrease of tooth decay in well industrialized countries is linked, according to most researchers, to an increase of fluorine-containing toothpaste use; during the 90s, these made up for more than 90% of the market share in the US, Canada, Germany or other developed countries.(5,25)

Most people state that they brush their teeth at least once a day,(39) but a more frequent use offers increased protection. Brushing one's teeth twice a day is a reasonable social habit, that is both effective and convenient for the daily routine of most people; this has become a basic recommendation for caries prevention. There is no sufficient data to prove that tooth brushing three times a day would lead to a decrease in tooth decay. Health risks can be excluded, given a correct use of fluorinated toothpaste, but such can contribute to the risk of developing fluorosis, as the swallowing reflex in under 6 year-olds is often not under adequate neurological control, especially in under 3-year-olds.(37) This possibility occurs in an long-term overdosage, during the enamel development phase (which lasts until 8 years of age for front teeth). The condition is, that during this period of time, significant amounts of toothpaste be ingested, especially when children like the taste of toothpaste with different aromas.(6,39)

A children's toothbrush is covered with approximately 0.75-1 g of toothpaste. At a concentration of 0.1% F, every gram of paste contains about 1 mg of F.(6,39) Children under 6 years ingest approximately 0.3 g of toothpaste during every brushing,(39) or, exceptionally, even as much as 0.8 g.(26) As a result, repeated brushing with fluorine- containing toothpaste can lead to an excessive ingestion of fluorine. That is why a toothpaste with high fluorine concentration (1500 ppm) is generally not recommended for those under 6-year-olds. Using a pea-sized amount (about 0.25 g) of toothpaste drastically reduces the risk of developing fluorosis.(34)

Fluorine-containing mouth rinses

These are concentrated solutions for daily or weekly use. As in toothpaste, fluorine from mouth rinse is retained in saliva and plaque.

The method has a long-standing tradition, especially in Scandinavian countries. Results vary, according to the use being supervised or not, the fluorine concentration, or the fluorine-containing substance.(6) When rinsing for only 2 minutes during a visit to the dentist (with an average frequency of 3 times a year),(22) there was a noticed decrease of new carious lesions by 25%.(38) There was even a reported decrease by over 50% after daily rinsing with a 0.05 % NaF solution.

A new generation of mouth rinses contains a combination of amino fluoride and stannous fluoride. The clinical importance lies within the anti-inflammatory and anti-plaque properties, especially of stannous fluoride.(6) Thus, this combination has not only a carioprophylactic role, but also helps prevent periodontal disease, offering a

great advantage over NaF solution.(6) These products should also be used with care in patients whose swallowing reflex is not well-defined.

Professionally-applied fluorine-containing gels, varnishes and solutions

These products emerged during the 50s and 60s as a result of the efforts to increase the effectiveness of local fluorine applications and to reduce caries incidence while decreasing frequency of applications.

Most market products have a 10-25 time higher concentration than toothpastes; they can be used as such or combined with other fluoridation means.(6)

Professional brushing with an amino fluoride and NaF gel (1.25% F, every two weeks can result in a decrease in new caries by about 40%.(15,32) Combined with the daily use of a fluoride toothpaste, effectiveness can reach 50%. The effectiveness of a gel containing only NaF, applied under similar conditions is lower.

Fluorine-gels applied in trays

Data from literature varies so widely according to frequency of application, substance concentration and other parameters, that no conclusive comparisons to other methods could be made. Critically analyzing the data, one could conclude that if applied 2-4 times a year, a decrease in caries incidence by 20-40% can be achieved.(1) For toxicological reasons (when applying the tray, some 100 mg F are being inserted into the mouth, part of which is being ingested), this method should only be used in exceptional cases.

Fluorinated varnishes are applied directly onto the tooth surface, as they have the property of sticking to the tooth, insuring a tight seal, especially in pits and fissures. Varnishes have high F concentration, and the method has its advantages: the varnish is applied easily; it has no taste or smell and allows for a lower amount of fluorine than in gels to be used.

For the most-used product in Germany, applied only twice a year, a decrease in caries by 40-50% has been noticed.(6)

No single prophylaxis program can be conceived without a set of fluoridation measures that offers results in a relatively short time, but for it to be most effective, they have to be combined. Still, before recommending a fluoridation method or combination of methods, a person's or group's caries risk has to be assessed, the fluoride intake has to be determined, as well as the safety margin towards the probable toxic dose, the toxic dose and the measures to be taken in case of intoxication.(7)

The carioprophylactic dose is 1 mg F per day – it represents the amount with the highest carioprophylactic effect and the lowest risk of developing fluorosis; generally, it is considered that an intake of 0.1 mg F / kgc doesn't involve any side effects.(36)

Other local protection methods

Sealing

Right after their eruption, molars present a primary morphology with fissures and deep pits; these are areas where food particles accumulate and microorganisms initiate the carious lesion.

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The main indications of sealing are the pits and fissures of molars (occlusal, buccal and oral), bicuspid and permanent incisors; sealing should be performed as soon as possible after the eruption of these teeth, provided these anatomical formations are retentive.

Abnormal pits and fissures or those that are adjacent to those being restored constitute another indication of sealing.

Sealings are recommended for patients with moderate carioactivity, their efficiency is highest in children and teenagers.

The widest used sealing materials are fluorine releasing composite resins and glass-ionomer cements.

The sealing with composite resin technique includes the following steps:

- cleaning of the tooth surface
- isolation of the tooth
- rinsing and drying
- etching the area to be sealed
- applying the sealing material
- checking the quality of the sealing, checking occlusal relation
- periodic check-ups

Tooth brushing

Removing plaque and preventing it from accumulating on teeth and adjacent gingival surfaces is an essential condition for the well-being of the gums, periodontium and teeth. In individuals with healthy periodontium, removing plaque prevents periodontal disease, in those undergoing treatment, it speeds up healing and in those whose treatment is finished, and it prevents recurrence. The result of any periodontal treatment, no matter how complex and sophisticated, is compromised if the patient doesn't follow a correct hygiene programme.(12)

The aims of gingival and dental brushing are removing plaque and soft deposits from accessible dental surfaces and adjacent gingival areas, as well as stimulation of blood flow and normal keratinisation of gums and increase of functional tonus.

The mandatory brushing is done in the evening, after dinner, right before going to bed. During the day, vigorous rinsing of the mouth followed by use of dental floss or toothpicks are enough to maintain a good oral hygiene. Gingival and dental brushing in the morning, before breakfast acts as a massage on the gums, stimulates their tonus and normal blood flow and keratinisation.

Tooth brushing techniques differ from one individual to another. A correct brushing takes 3-5 minutes, if the technique is properly mastered.

Gingival and dental brushing must be done daily, the brush should be washed under an abundant water spray after use and water is removed from it by vigorous shaking. It is recommended that everyone has two brushes to use alternately, as a dry brush is easier to check for imperfections or softening of the hairs; when these occur, the brush should be replaced.

Guidance of the patient can be done on plaster casts, on which the correct brushing movements can be

demonstrated. Revealing plaque by staining it makes it easier for the patient to perfect his technique.(12)

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