Committee on Nutrition

Fluoride Supplementation

Since publication of the previous statement on fluoride, which was issued by the Committee on Nutrition in 1979,1 further information has emerged regarding the mode of action of fluoride in preventing caries.2-7 There has also been growing recognition of the narrow therapeutic range of fluoride and the danger of excess fluoride ingestion which results in dental mottling (fluorosis).8 This statement reviews some of the newer information about fluoride and offers guidance on the optimal use of fluoride supplements.

MODES OF ACTION

Fluoride has both systemic and topical actions that are of importance in dental health. Systemically, fluoride acts on teeth prior to their eruption by being built into the crystal structure of the enamel and making it resistant to decay. In addition, fluoride limits enamel demineralization and encourages its remineralization into a stable structure.9 The result is to reduce the likelihood of tooth decay.2-4 The mineralization of primary teeth begins in utero, and this has led to the suggestion that fluoride supplements be given in pregnancy. However, there is little evidence of the effectiveness of fluoride supplementation in pregnancy.7 The permanent first molars start mineralization of their crowns shortly after birth.10 Mineralization of permanent teeth continues up to 6 years of age. Thus, the systemic effects of fluoride are exerted during this period.10 Conversely, excess fluoride ingestion during this period can cause fluorosis.11 The optimal systemic fluoride dosage to prevent caries appears to be 0.05 to 0.07 mg/kg/d.12 The narrowness of the therapeutic range is emphasized by the fact that mild fluorosis has been seen with oral intakes greater than 0.1 mg/kg/d.13 Thus, it is important to examine carefully the data on the age at which fluoride supplementation is started and its relationship to caries prevention. At present, there is no evidence that starting fluoride supplementation earlier than 1 year of age results in any further caries prevention in permanent teeth.10 On the other hand, starting fluoride supplementation prior to 1 year of age does provide additional protection for deciduous teeth.10 This becomes a pediatric issue because most dentition occurs at such an early age.

Preeruptive excess fluoride intake affects dental enamel mineralization and results in mottling of the teeth (fluorosis). For the permanent teeth, the most critical period of vulnerability to excess fluoride occurs at approximately 2 years of age. Because enamel formation is virtually complete by age 5 to 6 years, systemic effects of fluoride are, for the most part, accomplished by this time. Topical effects, however, remain important.

Fluoride acts topically (ie, directly on erupted teeth) by promoting remineralization and, in addition, possibly through antibacterial effects.2 These topical effects appear to be significant mechanisms for the prevention of tooth decay. It is likely that regular exposure of the tooth surface to low doses of fluoride may be more critical to preventing caries than the amount of "systemic" fluoride ingested during tooth formation.14 The amounts of fluoride ingested from eating tooth paste can be an important source because tooth paste contains 1 mg of fluoride per gram. Precautions should be observed.

The relative roles of topical versus systemic effects of fluoride are still being debated.15 It is clear, however, that the presence of fluoride during the period of tooth formation alone will not prevent tooth decay as effectively as the combination of systemic fluoride plus regular topical application of fluoride to erupted teeth. To be effective, topically applied fluoride must be used regularly,6,14 as the high level of fluoride found in enamel shortly after topical application is maintained for less than 1 month.

METHODS OF PROVIDING FLUORIDE

The best method of providing fluoride is by adding fluoride to the local water supply. When fluoride is added to water, it acts as a regular source of topical fluoride to the teeth while it is also available systemically. The decision to fluoridate water to
the proper level is made locally, and the practice of fluoridation varies considerably across the country.

Other methods of providing fluoride include fluoride-containing drops, tablets, mouthwashes, gels, and dentifrices. Several available preparations contain both fluoride and vitamins. Their combined use is necessary only in infants who require supplemental vitamins. Parents should be aware of the dangers of fluoride overdose and should be cautioned not to exceed the prescribed amount. Although effective, the success of these alternative methods is heavily dependent upon the motivation of the parents to ensure that the preparations are taken daily in a proper dose. Studies have shown that parents are frequently unable to devote their attention to fluoride administration, and as a community measure, none of these methods is as effective as fluoridation of the water supply.\textsuperscript{16,17}

On the other hand, for children living in areas without water fluoridation, toothpastes containing fluoride are a particularly important source of fluoride. Virtually unknown 25 years ago, these products now command more than 90% of the market and may account for the observed decline in dental caries prevalence in populations not otherwise receiving fluoride supplements.\textsuperscript{18,19}

\section*{USE OF FLUORIDE FOR YOUNG INFANTS}

In the 1979 statement, the Committee discussed the literature for and against introducing fluoride supplementation at 2 weeks of life \textit{v} delaying supplementation until 6 months of age.\textsuperscript{1} The increasing realization of the important role that topical fluoride plays in the prevention of dental caries\textsuperscript{14} and the realization that early systemic fluoride ingestion will not prevent dental caries in permanent teeth, unless there is continued exposure to fluoride, has led to a reexamination of the use of fluoride before 6 months of age. An additional concern regarding the use of fluoride supplements prior to 6 months is the possible effect on transiently high levels of fluoride, which might occur if infants were given fluoride supplements on a once-a-day basis.\textsuperscript{5,7,14,18} In experimental studies, peaking of plasma fluoride levels in animals has resulted in fluorosis.\textsuperscript{13,20,21} However, present data suggest that the current fluoride dosage\textsuperscript{1} would not be sufficient to cause fluorosis. It is also important to realize that, from the time of birth, fluoride is incorporated into the deciduous teeth and reduces caries in these teeth.\textsuperscript{10} The issue of fluorosis is further complicated by the variation in infant-feeding patterns occurring during this time.

\subsection*{Infants Who Consume Only Milk}

The amount of fluoride consumed by the infant fed only milk is difficult to determine. Human milk contains 16 ± 5 \(\mu\)g of fluoride per liter,\textsuperscript{22} a small amount. The amount of fluoride absorbed is unknown but is probably equivalent to absorption from other milks (65%).\textsuperscript{23} The amount of fluoride in human milk is related only slightly to the amount of fluoride in the mother's diet.\textsuperscript{24} There may be other elements, such as strontium, acting together with fluoride to reduce caries.\textsuperscript{25} It is of interest to note that, in areas that use water fluoridation, infants fed only human milk and not receiving fluoride supplements had caries rates comparable to those of formula-fed infants.\textsuperscript{26} Therefore, it may not be necessary to give fluoride supplements to breast-fed infants who are living in an area where the water is adequately fluoridated. The pediatrician must determine whether there is a need for fluoride supplementation, ie, for infants receiving breast milk only (no water, juice, or solid foods).

The manufacturers of infant formula now make their products with defluoridated water so that the fluoride content is <0.3 ppm. This simplifies the calculation of an infant's total intake of fluoride.

\subsection*{Infants Who Consume Fluoride and Solid Foods}

Although most infant foods have a low level of fluoride, some contain appreciable amounts. The fluoride intake of 6-month-old infants in the United States has been estimated to vary from 0.207 to 0.541 mg/d (0.03 to 0.07 mg/kg/d).\textsuperscript{27} Although large amounts of fluoride have been obtained from formulas and water, dry cereals and vegetable products have also contributed significant amounts. Data on fluoride intake in Canadian infants show that intake varies considerably but is similar to that of infants in the United States.

Solid foods are commonly added to the diet after 4 months of age, and by 6 months of age many infants are consuming a varied diet. Although large amounts of solid foods are not likely to be consumed at any one sitting, and thus peak blood levels are unlikely to be a problem, the total amount of fluoride added to the diet may be appreciable. However, the intake of solid foods reduces fluoride absorption to about 60% of intake.\textsuperscript{28,29} Total fluoride intakes with the supplementation doses suggested below have been calculated to not exceed the optimal dosage range of 0.05 to 0.07 mg/kg/d.

\section*{FLUORIDE SUPPLEMENTATION}

The fluoride content of the water supply varies locally. Thus, any dosage regimen must take into consideration the local conditions. In addition, the fluoride content of processed foods and carbonated beverages must be taken into account in considering a child's total intake of fluoride.\textsuperscript{30} At present, data on the fluoride content of processed foods and
beverages are insufficient to allow adjustment of dosage schedules for children in areas in which supplemental fluoride is recommended. Dosage regimens are based on the age of the child, as well as the fluoride content in the local water supply, with the intention of providing sufficient fluoride for caries prevention, while at the same time avoiding an excess that may cause dental mottling. Ideally, the fluoride content of the local water supply in all communities should be adjusted to a level between 0.7 and 1.0 ppm. In communities that have insufficient fluoride in the local water supply, fluoride supplementation should be used according to the dosage schedule shown in the Table. This dosage schedule is identical with that presented in the Committee statement of 1979.1 The fluoride can be provided in the form of drops or tablets.

There is some concern that children 2 to 4 years of age who are using fluoride-containing dentifrices or mouthwashes may swallow them instead of spitting them out.14,18,31-32 This may well lead to excessive fluoride intake (up to 1 mg of fluoride per day from the dentifrices alone) and could result in mild cases of fluorosis. For these reasons, the Committee recommends that, if a fluoride-containing dentifrice is used by a toddler, only a very small amount of toothpaste should be placed on the brush. In addition, parents should be advised to teach their children not to swallow the toothpaste.

Because many children do not see a dentist for the first few years of life, the pediatrician should assume responsibility for overseeing proper fluoride usage as follows: (1) determine the fluoride concentration of the local water supply for all of your patients, (2) know and use the fluoride supplementation schedule appropriately, and (3) counsel parents with regard to the proper use of fluoride-containing dentifrices (toothpastes and gels).

**SUMMARY**

This statement reviews the rationale for the use of fluoride supplements for infants and children. The concept of fluoridation of water supplies as an effective and cost-beneficial method of reducing caries prevalence in the general population is strongly supported. In the absence of an adequately fluoridated water supply, fluoride supplements should be given to all children. This should begin at about 2 weeks of age; the dosage will depend on the concentration of fluoride in the local water supply. Fluoride-containing dentifrices are an important source of topical fluoride, but it is essential that parents be aware of the danger of excessive fluoride intake and that they teach their children to avoid swallowing toothpaste.

**REFERENCES**

Fluoride Supplementation

*Pediatrics* 1986;77;758

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