

Fluoride supplement-induced dental fluorosis: case reports

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Abstract

Two cases are presented which exhibit classical dental fluorosis in the permanent dentition which is most logically explained by the excessive intake of fluoride. The cases emphasize the narrow therapeutic range of systemic fluorides in children and the need for analyzing samples of local drinking water before caries-preventive fluoride therapy can be initiated.

The potential for induction of fluorosis has been increased significantly because of the widespread use of fluoride-containing products as documented in this report. Topical and systemic use of fluoride including dietary fluoride supplements, when used appropriately, are essential components of the prevention of dental caries. However, it is important to recognize the narrow therapeutic range of fluoride for the prevention of caries and the potential of dental fluorosis that results from excess fluoride ingestion. This report describes two cases of mild to moderate dental fluorosis which resulted from fluoride over-supplementation. In one case, no systemic supplement was required; in the other case, the fluoride dosage was excessive.

Literature Review

Systemic fluoride supplements have long been recommended as safe and effective means for the prevention of caries in children who are life-long residents in fluoride-deficient areas (ADA Council on Dental Therapeutics 1979). The benefit to the teeth of children of a fluoride intake of approximately the amount that would be obtained from fluids in optimally fluoridated areas has been shown to parallel that obtained from consuming optimally fluoridated water (Aasenden and Peebles 1974; Driscoll et al. 1979). Several different dosage schedules have been proposed.¹ Aasenden and Peebles

¹ AAP Committee on Nutrition 1972; Ripa 1974; Nikiforuk 1975; Wei et al. 1977; Parkins 1977; Driscoll and Horowitz 1978.

(1974) found that the then currently recommended dosage by the American Academy of Pediatrics (AAP), namely 0.5 mg F from birth, was associated with fluorosis. The regimens recently recommended by the AAP Committee on Nutrition (1986) and those previously recommended by the ADA Council on Dental Therapeutics (1984) and the American Academy of Pediatric Dentistry are identical (Table). The schedule allowed for differences in age and in the fluoride concentration of the local water supply.

TABLE 1. Recommended Daily Dosage of Fluoride Supplements According to Age and Natural Contents of Water Supplies

Age of Child (years)	Natural Fluoride Ion Content in Existing Water (ppm)		
	<0.30	0.31-0.70	>0.71
	Dosage in mg/day		
2 wk-2*	0.25	0.0	0.0
2-3	0.50	0.25	0.0
3 and older†	1.00	0.50	0.0

* The AAP Committee on Nutrition recommended initiating fluoride supplements at 2 weeks of age in breast-fed babies (0.25 mg F/day) and in formula-fed babies in nonfluoride areas.

† The suggested cut-off age for supplementation—13 years (Nikiforuk 1985; American Academy of Pediatric Dentistry; ADA Council on Dental Therapeutics 1984) 16 years (American Academy of Pediatrics 1986).

More recently, there have been conflicting opinions as to the current levels of fluorosis in fluoridated and nonfluoridated communities. Leverett (1986) reported that dental fluorosis has become three and one-half times more prevalent in nonfluoridated communities and twice as prevalent in fluoridated communities. He suggested that an increase in fluoride in the food chain is a potential cause (Leverett 1982). Driscoll et al. (1986) reported that three per cent of children residing in communities with negligible fluoride concentrations in their drinking water and 14.6% of children residing in optimal fluoride communities had fluorosis. Driscoll et al. (1986) concluded that "findings do not support the contention that definite increases in the prevalence of fluorosis are occurring in communities with negligible

and optimal water-fluoride concentrations, because of increased total fluoride consumption from various sources." It is a matter for concern, however, that 22% of six- to eight-year-old children residing in a nonfluoride area had fluorosis in their permanent teeth which may be due to prior use of systemic fluoride supplements (Oldak and Leverett 1984).

In a recent case-control study, 645 eight- to 10-year-old children in nine elementary schools in the Borough of East York, Ontario, were screened for dental fluorosis using the Thylstrup and Fejerskov (1978) index (Osuji 1987). A questionnaire interview with parents of 67 children with fluorosis (cases) and 80 without fluorosis (controls) revealed the sources of fluoride to which the children were exposed during the period the affected (cases) and unaffected (controls) teeth were developing.

The most important sources were brushing teeth with fluoride toothpaste from an early age and infant formula powder mixed with fluoridated water. After adjusting for the mother's education and the duration of infant formula feeding, the study showed that brushing with fluoride toothpaste before the age of 25 months was associated with 11 times the likelihood of dental fluorosis compared to those who started later than that age. It also was shown, after adjusting for the mother's education and the age brushing started, that children who were fed formula for longer than 13 months were 3.5 times more likely to have fluorosis than children who were fed the same formula for a shorter period. The use of fluoride supplements, fluoride mouthrinses, and the professional application of topical fluoride to their teeth were not associated with fluorosis in children residing contemporaneously in this community with water fluoridated at the level of 0.95 ppm.

Specific cases of dental fluorosis have been published in the literature. Newbrun (1978) reported a case of fluorosis which resulted from ingesting 0.5 mg F/day from birth in an area with 0.1 ppm in the drinking water. A similar case described by Corpron and Burt (1978) ingested 1 mg F/day from the age of four months to six and one-half years of age. In an area with 0.2 ppm F, that amounted to four times the recommended dose. Messer and Walton (1980) reported 19 cases of dental fluorosis that had a history of ingesting fluoride supplements early in life in areas with optimal and suboptimal water fluoride concentrations.

Presentation of Cases

Case 1

A six-year-old girl was referred to the dental clinic of Toronto's Hospital for Sick Children by her dentist for an evaluation of suspected dental fluorosis.

The patient's medical history did not reveal any major medical problems. She had a normal, full-term birth without complication. There was no history of

medical conditions often associated with enamel opacities such as infancy hypocalcemia, chicken pox, or measles. She had an eye operation at one year of age, her only hospitalization.

The patient was in the mixed dentition stage. The primary dentition was morphologically normal. The main clinical defect was the chalky discoloration of all the permanent incisors and the first permanent molars, indicative of dental fluorosis (Fig 1). The anterior teeth



FIG 1. Intraoral photograph of case 1 showing almost normal appearance of the primary dentition and fluorosis of the permanent dentition. Note the irregular white flecks and corrosion-like lesions at the incisal edges and interproximal areas.

displayed visible perikymata, white flecks, and mild crazing of corrosion-like lesions at the incisal edges and interproximal areas — all classical signs of fluorosis. This case would most likely be classified as having a fluorosis score of 2 on the Dean scale (Dean 1942) and about 3 on the Thylstrup scale (Thylstrup and Fejerskov 1978).

The water supply in Cambridge, Ontario, the patient's place of residence, has a natural fluoride concentration of 0.42 ppm. This child was not breast fed, hence her total fluid intake was the naturally fluoridated water. In addition, she was started on daily fluoride dosage of 0.5 mg from a fluoride-vitamin preparation shortly after birth and continued this therapy until the age of two years. At the age of two the fluoride-vitamin preparation was discontinued and she was placed on 1.0 mg F/day which she continued to take until the time of presentation to her dentist. Also at this age, she started to use fluoride-containing toothpastes (1.0 mg/g). She started to see a dentist regularly at about three years of age and was given a topical fluoride application approximately every six months.

During the first two years of life, the child's daily supplement of 0.5 mg F in an area where the water supply contained 0.42 ppm was more than the recommended level. The recommended fluoride dose for this

age group is 0.25 mg/day, but since the water contained 0.42 ppm, no supplementation was necessary. As shown by Aasenden and Peebles (1974), this amount of fluoride supplement can cause dental fluorosis even in a fluoride-deficient area. In an area with a suboptimal amount of fluoride in the water, the potential for fluorosis would be even greater.

After the age of two years and with the use of toothpaste, her daily fluoride intake would increase, because children ingest approximately 30% of the dentifrice they use.² Ekstrand and Ehrnebo (1980) have shown that most of the fluoride in dentifrice is rapidly and effectively absorbed from the gastrointestinal tract. Only about 37% of the ingested fluoride is excreted in urine.

Case 2

The seven and one-half-year-old daughter of an oral surgeon was born in a nonfluoridated area with fluoride concentration of 0.1 ppm. The patient's medical history was normal. She was totally breast fed and therefore was not on infant formula. Upon eruption of the permanent incisors, the parents noticed that the enamel was white, chalky, and opalescent. The child was taken to a pediatric dentist who observed that the teeth had a generalized chalky appearance and exaggerated perikymata. The history revealed that, from shortly after birth until three years of age, the patient received 1.0 mg F/day dissolved in a glass of water. Thereafter, up to the age of seven years, the child ingested 1.0 mg F/day in tablet form.

The clinical picture of fluorosis (Fig 2) in this child is consistent with the history of excessive fluoride supplement intake. The use of fluoride dentifrice starting at about the age of three years would result in an increase in the fluoride intake, although the amount in the supplement alone was sufficient to cause the fluorosis. Before the age of two years, the dose of the fluoride supplement was four times the recommended dose and was only appropriate from the age of three years.

The father, being aware of the importance of fluoride and the general recommendation of 1 ppm F as the accepted concentration in drinking water, erroneously extrapolated this dosage for his child.

Discussion

Practitioners, especially those who treat children, should be aware of the appropriate dose of fluoride supplement, indications, and contraindications. Some studies that have reported the patterns of prescribing fluoride supplements show that some practitioners are unaware of the proper dosage guidelines and the actual fluoride concentration in the area's water supply.³ The studies also show that some practitioners have no

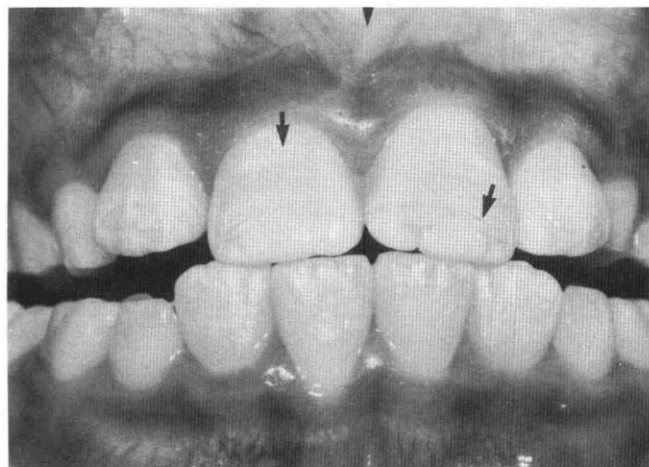


FIG 2. Intraoral photograph of case 2. Note the generalized opaque white areas characteristic of mild fluorosis. Arrows show the prominent appearance of the perikymata on the surfaces of the permanent anterior teeth.

knowledge that dietary fluoride is contraindicated, especially in areas where the water supply has a fluoride concentration greater than 0.7 ppm. In areas where the fluoride level is greater than 0.3 ppm it is not prescribed for infants up to two years of age. In one of these studies, a nationwide survey of physicians who treat children, 11% of pediatricians and 22% of family practitioners in areas without fluoride in the drinking water did not prescribe fluoride supplements, whereas 79% of pediatricians and 49% of family practitioners in small towns with fluoridated water prescribed supplements (Margolis et al. 1980).

Some of the confusion about the dose may be due to the various schedules previously suggested.⁴ The ADA Council on Dental Therapeutics (1984) and the American Academy of Pediatrics Committee on Nutrition (1986) have harmonized their schedules. The only difference between the ADA and AAP schedules is that the latter recommended that fluoride supplementation be started at two weeks of age and continued until age 16, whereas the former recommended supplementation from birth to age 13. The dosage regimen (Table) more closely parallels changes in body weight during infancy and childhood. This is an advantage in view of the recognition that fluoride requirements are related to body weight.

Pharmaceutical companies have reformulated the doses of fluoride supplements to facilitate supplementation since the mode of delivery was a limiting factor to prescribing fluoride by some practitioners. The supplements are available in liquid and tablet forms with or without vitamins. The ADA Council on Dental Thera-

³Margolis et al. 1980; Siegel and Gutgesell 1982; Rigilano et al. 1985.

⁴ADA Council on Dental Therapeutics 1969/70; AAP Committee on Nutrition 1972; Ripa 1974; Nikiforuk 1975; Wei et al. 1977; Parkins 1977; Driscoll and Horowitz 1978.

²Ericsson and Forsman 1969; Hargreaves et al 1972; Dowell 1981.

peutics (1984) has not accepted combinations of dietary supplements with vitamins because of the problem of dividing doses. Since fluoride-vitamin preparations now are formulated to provide 0.25 and 0.50 mg F/day (Nelson 1986), it is no longer difficult to adjust the amount of fluoride prescribed in areas where the drinking water contains substantial but inadequate levels of fluoride. However, when fluoride-vitamin combinations are used, parents must be motivated to continue to give fluoride supplements to their children after they stop giving them vitamin supplements as the need for fluoride goes on for much longer than the usual time that vitamins are given.

There is controversy over supplementation for totally breast-fed infants and children who consume formulas.

The fluoride levels in human breast milk have been found to vary between 0.02 and 0.08 mg/liter (Ekstrand et al. 1981). Therefore, it has been suggested that totally breast-fed infants, regardless of the fluoridation status of the area, may be given fluoride supplements (ADA Council on Dental Therapeutics 1984). However, it may not be necessary to give fluoride supplements to totally breast-fed children who are residing in optimally fluoridated areas because most babies ingest water between meals and when mixed with juices, cereals, and other food products.

The manufacturers of infant formulas in the United States have significantly lowered the fluoride content of the water used to make their products so that their fluoride content is less than 0.40 ppm (Johnson and Bawden 1987). This simplifies the calculation of an infant's total fluoride intake needs in fluoride-deficient areas. In fluoridated areas no supplementation is necessary for infants who consume formulas or any diet supplemented by additional food and water.

The case histories presented in conjunction with other reports in the literature permit the recommendation of the prophylaxis of dental caries to be initiated between two weeks and six months of age for maximum benefits. In addition, a sample of the patient's drinking water should be analyzed before considering prescribing fluoride supplements. The dosage should be carefully calculated to match the child's age or weight according to recommended regimens. Parents should be counseled on their children's proper use of fluoride-containing dentifrices so as to minimize ingestion.

Conclusion

Two cases were described of fluorosis of the permanent teeth in children who received more fluoride supplement than recommended dosage schedules. The first case received 0.5 mg F/day from infancy and 1.0 mg F/day from the age of two to six years in an area that has a natural water fluoride concentration of 0.42 ppm. The

second case received 1.0 mg F/day from birth to seven years of age in an area with a natural water fluoride concentration of 0.1 ppm.

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Protect yourself

Dentists and other health care employers will be responsible for providing "appropriate safeguards for health care workers who may be exposed" to blood-borne diseases such as AIDS and hepatitis B, under recommendations released in November by the U.S. Occupational Safety and Health Administration. Dentists must conform to the national "Right to Know" laws and train and supply their employees with the means to protect themselves against infectious diseases and potentially hazardous chemicals. Effective immediately, dentists must provide dental hygienists and assistants with protective gloves, masks and eyewear and follow infection control guidelines recommended by the American Dental Association (ADA) and the Centers for Disease Control. They also must conduct in-office educational programs for their staff on procedures and barrier techniques.

Dentists who fail to follow the new guidelines and educate their office staffs could face fines of up to \$10,000 per incident. Complaints made by either employees or patients will be followed up with an inspection and possible citation and fine if the employing dentist is found to be in violation.

In May, 1988, additional provisions of the requirements will become effective. At that time it will be necessary for all dentists to maintain material safety data sheets, labels, and other forms of warnings on all potentially hazardous chemicals found within the dental office. In addition, employing dentists must have a written training program and must provide this information and training to all employees. The ADA, through its Council on Dental Materials, is attempting to identify all of the specific chemicals found in the dental office. To date they have found more than 600.