

Problem

Dental caries is a chronic, progressive, multi-factorial, infectious disease that can begin in early infancy. By adulthood, dental caries will affect over 92 percent of the U.S. population.¹ Dental caries prevalence and severity vary by age group, primary versus permanent dentition, and type of tooth surface, e.g., pits and fissures versus smooth surfaces.² In addition, dental caries is highly related to socio-environmental determinants, with the greatest burden on disadvantaged and socially-marginalized populations.^{3,4} Historically, efforts to prevent and control dental caries have primarily focused on daily brushing, modifying dietary practices, and improving the resistance of tooth enamel to acid attack. However, only fluorides and dental sealants have been shown to be highly effective in preventing or reducing dental caries. Benefiting from fluoridated water and toothpastes, baby boomers will be the first generation to routinely maintain their natural teeth throughout their lives.⁵

Methods

Fluoride modalities are systemic and topical in their effect on the dentition. Systemic fluorides are those that are ingested and include fluoridated water, dietary fluoride supplements and fluoride present in food and beverages. Topical fluorides are applied directly to the teeth and include toothpaste, mouthrinse or professionally applied fluoride gel, foam or varnish. Systemic fluorides also provide topical exposure. The degree of caries protection, lifetime cost, and the appropriateness for use in populations will vary by the fluoride method or combination of fluoride methods selected.^{6,7,8,9,10,11,12} Daily, multiple, low-dose topical exposures to fluorides facilitate the balance between remineralization and demineralization of tooth enamel, thus reducing the incidence (new cases) of dental caries.¹³ Fluorides are most effective when used in combination with other modalities,(e.g., dental sealants) to prevent, control, and reverse the progression of dental caries early in the disease process.^{14,15,16,17} Individuals and populations who use fluoride toothpaste or receive topical fluoride routinely from health care professionals are less likely to benefit from addition of fluoride supplements.^{18,19}

The use of fluoride supplements has been strongly associated with reductions in dental caries in primary and permanent teeth.¹⁹ The 2001 Centers for Disease Control (CDC) Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States ranked the evidence Grade I for well-conducted randomized clinical trials on the effectiveness of fluoride supplements on dental caries among children aged 6-16 years.²⁰

Dietary fluoride supplements are available as tablets and drops to be swallowed, tablets for chewing, and lozenges to be sucked or dissolved in the mouth. Fluoride supplements work topically and systemically in the same manner as other fluorides, by enhancing fluoride concentrations in saliva, plaque, and tooth enamel. By the end of the 1940's, dietary fluoride supplements were used to provide the systemic benefits of fluoride to children living in areas without fluoridated water.²¹ Since the 1980's, laboratory and epidemiologic evidence indicate that the predominant action of all fluorides, including fluoride supplements, is primarily post-eruptive and topical,^{18,22} however, maximum benefit is achieved when both topical and systemic fluorides are used.¹⁹ The pre-eruptive fluoride benefit ends with enamel maturation of the primary teeth by age two and to the permanent anterior teeth around ages six to eight. Fluoride uptake in the enamel of the permanent molars continues until maturation of the wisdom teeth around age 16.^{23,24,25} Supplements are routinely recommended for discontinuation after the age of 16, although research suggests they may continue to be useful as a topical fluoride modality for high-risk individuals.²² Fluoride supplements taken by women prenatally have not been shown to be beneficial in preventing dental decay in their children.²⁶

A 2008 systematic review found a strong and consistent association between the use of fluoride supplements and mild to moderate fluorosis, especially for children younger than age six.²⁷ A 2006 National Research Council (NRC) panel categorized severe dental fluorosis as an adverse health effect rather than a cosmetic effect.²⁸ The 1999-2004 National Health and Nutrition Examination Survey (NHANES) found 23 percent of the U.S. population ages 6-49 had very mild or mild fluorosis and less than three percent had moderate to severe fluorosis; the prevalence of severe dental fluorosis was less than one percent and could not be separately estimated.²⁹ In its milder form, enamel fluorosis is considered a cosmetic effect, not an adverse functional effect.²² Very mild or mild fluorosis is not considered a problem by the general public.³⁰ "The apparent increase in the prevalence of enamel fluorosis in both fluoridated and non-fluoridated communities may stem from an increase in the number of sources of exposure to fluoride, including ingestion of water, toothpastes, dietary fluoride supplements, beverages, foods and professional dental products."³¹

Approximately two-thirds of mild-to-moderate enamel fluorosis cases in non-fluoridated areas and 13 percent of fluorosis in fluoridated communities could be explained by the use of fluoride supplements under the pre-1994 supplementation protocol. The other one-third of cases in non-fluoridated communities and two-thirds in fluoridated communities is attributable to children's early use and ingestion of fluoride toothpaste when toothbrushing.³² The average number of decayed, missing, and filled surfaces (DMFS) of permanent molars is consistently lower in children with enamel fluorosis as compared with children without enamel fluorosis.^{33,34} The balance between the benefit of fluoride supplements and the avoidance of the rare occurrence of moderate or severe enamel fluorosis depends

upon analysis of caries risk along with fluoride content of the primary source of drinking water; availability of other sources of fluoridated water (e.g., home, child care settings, school, or bottled water) and other sources of topical fluoride (e.g., toothpaste, mouthrinse or professionally applied fluoride gel, foam, or varnish).³⁵

Dental and other healthcare professionals should assess the current level of fluoride in the primary source of drinking water and evaluate other dietary sources of fluoride before prescribing supplements. Children need to be monitored and their caregivers supported for needed changes in dosage and ongoing use. One ten-year study found that less than 24 percent of children using supplements used them as directed, raising doubt about the effectiveness of fluoride supplements as a public health measure.³⁶ In addition, multiple studies of physicians and dentists have documented their lack of knowledge of fluoride supplements and inappropriate prescribing practices.³⁷

In 2010, because of known increases in exposures to fluoride from multiple sources and the increased prevalence of mild enamel fluorosis, the American Dental Association (ADA) recommended that prescription of fluoride supplements be limited to children at high risk for developing caries.¹⁹ Several assessment tools are available to measure risk for dental caries, including the American Dental Association (ADA) [Caries Risk Assessment Form \(Age<6\)](#) and [Caries Risk Assessment Form \(Age>6\)](#),³⁸ the American Academy of Pediatrics [Oral Health Risk Assessment Tool](#),³⁹ and the American Academy of Pediatric Dentistry [Caries Risk-Assessment Tool \(CAT\)](#).⁴⁰ Programs promoting the use of fluoride supplements need to incorporate a risk assessment strategy in their caries prevention programs.

Eighty-eight percent of children older than age five attend public schools, with the others attending private schools or home-schooled, making these sites an opportune setting for implementing publicly-funded caries prevention programs that include fluoride.^{41,42} However, initiating fluoride supplements in children older than age five in school programs may not add substantial benefits for them over the topical action of other fluorides.⁴³ Consideration of multiple risk factors and protective factors is recommended when prescribing fluoride supplements for at-risk populations. Even in selected high-risk populations, there needs to be a balance between individual risk for dental caries and the potential for dental fluorosis.¹⁹

Fluoride supplements should be prescribed based on caries risk assessment, fluoride concentration level in the primary source of drinking water and other dietary sources of fluoride and the child’s age. Dietary fluoride supplements are recommended for children at-risk for dental caries as a single daily ingested dose following the dosage schedule jointly established by the CDC, AAPD, and ADA, as shown in this table.¹⁹

Fluoride Supplement Dosage Schedule – 2010			
Approved by the American Dental Association Council on Scientific Affairs			
Age	Fluoride Ion Level in Drinking Water (ppm)*		
	<0.3	0.3-0.6	>0.6
Birth–6 months	None	None	None
6 months–3 years	0.25 mg/day**	None	None
3–6 years	0.50 mg/day	0.25 mg/day	None
6–16 years	1.0 mg/day	0.50 mg/day	None
<p>*1.0 part per million (ppm) = 1 milligram per liter (mg/l) ** 2.2 mg sodium fluoride contains 1 mg fluoride ion.</p>			
Important Considerations When Using Dosage Schedule:			
<ul style="list-style-type: none"> • If fluoride level is unknown, drinking water should be tested for fluoride content before supplements are prescribed. For testing of fluoride content, contact the local or state health department. • All sources of fluoride should be evaluated with a thorough fluoride history. • Patient exposure to multiple water sources can make proper prescribing complex. • Ingestion of higher than recommended levels of fluoride by children has been associated with an increase in mild dental fluorosis in developing, unerupted teeth. • Fluoride supplements require long-term compliance on a daily basis. 			

Fluoride supplements are effective in reducing dental caries in children when fluoride in community water supplies is suboptimal and ingested sources of fluoride are low. Ongoing monitoring, support and compliance with the dosage schedule by parents and healthcare professionals are necessary to avoid the possibility of very mild and mild fluorosis.

Policy Statement

ASTDD supports the use of fluoride supplements for children who are at high-risk for dental caries, whose primary source of drinking water has suboptimal levels of fluoride and whose other ingested sources of fluoride are low. Fluoride supplements should be prescribed based on caries risk assessment and fluoride history. Healthcare professionals should monitor parents’ compliance with the current supplement dosage schedule on an ongoing basis.

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