

The Importance of Tooth Decay Prevention in Children Under Three

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National attention to children's oral health is relatively new. For example, surveys of children's health and development before the late 1980s did not focus on baby (deciduous or primary) teeth. This reflected the prevailing societal and professional view that baby teeth were relatively unimportant because they would be replaced with permanent teeth. Tooth decay and tooth pain were common and largely accepted. A national survey of 12- to 17-year olds, conducted in 1966–1970, found only 10% were cavity-free in their permanent teeth (Milgrom & Reisine, 2000). At that time, many young people lost one permanent tooth or more by adulthood. The oral health status of children has improved since then. National surveys conducted in 1988–1991 found that the proportion of 12- to 17-year-olds with no cavities was over 30%. Recent data, from 2004, indicate that 44% of 15-year-old children have no cavities (Centers for Disease Control and Prevention [CDC], 2009b). The oral health of very young children in the United States was thought to be good. Surveys conducted in 1988–1994, the first years in which there were systematic surveys of children under 5 years of age, found that 82% of children ages 2 to 4 had no cavities in their baby teeth (CDC, 2009a). Unfortunately, celebration was premature and tooth decay appears now to be increasing. Data from a 1999–2004 national study showed that only 73% of 2- to 5-year-olds were cavity-free in their baby teeth. Among third graders in the United States, the rate of cavity-free children ranged from a low of 28% to a high of just under 60% (Tomar & Reeves, 2009).

Public Health Intervention

PUBLIC HEALTH INTERVENTIONS of the past century have led major improvements in oral health for most people. The introduction of optimal levels of fluoride in public water systems and fluoridated toothpaste in the 1950s was and continues to be a major public health achievement. Water fluoridation came about because scientists

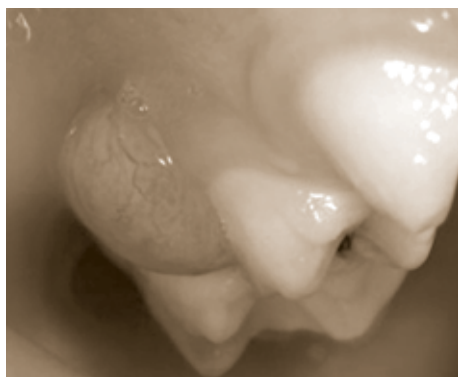
observed that children who grew up in areas where the water had greater amounts of fluoride naturally had fewer cavities than children who grew up in communities where fluoride levels were low or the element was absent. The availability of fluoridated toothpaste came about after years of scientific research and more than six dozen large clinical studies. The use of fluoride to protect the teeth is

neither “mass medicine” nor artificial. This approach, advocated by public health officials, optimizes what nature has shown us to work.

Fluoride was thought to affect the developing teeth before tooth eruption but it is known now that fluoride benefits the teeth both before and after tooth eruption. Today we think the benefits can be derived by ingesting small amounts of fluoride (e.g., as tablets, as drops, or in fluoride-enhanced salt) and by bathing the teeth in fluids that contain fluoride such as water, toothpaste

Abstract

Tooth decay and tooth loss was once the norm but public health interventions have led to major improvements for most people. Nevertheless, not all children have benefited. Dental disease in young children is unacceptably high. Tooth decay is preventable. Early childhood educators are often the first to notice the problem. Professional organizations recommend a child see a dentist at 1 year of age. Children who are at high risk benefit from optimal exposure to fluoride. Even if they drink fluoridated water, children should use fluoridated toothpaste and receive fluoride varnish treatments. Children may also benefit from treatments of topical iodine and xylitol products.



Swelling in gums (also called a gum boil) emanating from a badly decayed tooth in a child.

mixed with saliva, and various forms of topical fluoride applied by dentists. Before tooth eruption, fully formed teeth present in the jaw benefit from fluoride carried through blood plasma. When young children are exposed to safe levels of fluoride, their teeth erupt with a fluoride-rich zone in the tooth surface. Fluoride from water or supplements enriches the saliva and the tooth plaque (the biofilm on the teeth) that provide added protection.

Optimal Exposure to Fluoride

SOME PARENTS AND child care professionals worry about children receiving too much fluoride and possible changes to the teeth—a condition called *fluorosis*. In communities where fluoride is added to the public water supply, the level of fluoride is regulated to prevent overexposure. Teeth that have been exposed to fluoride appear to some parents as brighter and whiter than teeth not exposed to fluoride, and of course, teeth without cavities look a lot better than teeth with cavities. Overexposure and unsightly cosmetic changes can occur if parents are not careful with supplements and toothpaste. Both need to be used according to instructions. The topical treatments provided by dental and medical professionals do not cause fluorosis.

In all U.S. states, local water suppliers, whether governmental or private, monitor the level of fluoride in the water supply. An inquiry to the local water utility should supply you with valuable information about your water. Children drinking fluoridated water should not be given supplements.

A second concern pertains to receipt of too little fluoride. With immigration to the United States, there are increasing numbers of parents who come from countries where it is not safe to drink tap water. As a result of their previous experience, and the advertising of “boutique” water, some parents may prefer to give their children bottled water. Water

manufacturers are not required to list the fluoride content on the bottle. Most often, this bottled water does not contain optimal levels of fluoride. Water that is distilled or has undergone reverse osmosis, as indicated on the label, will be fluoride-free.

Fluoride levels in breast milk and in liquid formula are low. When concentrated liquid or powdered formula is mixed with water and is the *primary* source of nutrition, the formula should be made up with water low in fluoride to avoid overdosing the child (Tinanoff, 2009).

Disparities in Oral Health and Dental Care

RACIAL, ETHNIC, AND economic disparities in children’s oral health are dramatic. The 1999–2004 national study mentioned earlier found that fewer than 50% of Mexican American preschool children were free of tooth decay. The rates for African American preschool children were high also. The problem is compounded by socioeconomic disadvantage; children in families living below the federal poverty level experience the worst tooth decay. Native Americans and Alaska Natives also experience extremely high rates of disease. Moreover, most of the tooth decay in these disadvantaged groups is untreated. Children living in poverty have twice as many decayed teeth as children who live above the poverty level (National Institute of Dental Craniofacial Research [NIDCR], 2009).

Tooth Decay Is Largely Preventable

VISIBLE CAVITIES ARE the outcome of “dental caries,” a bacterial infection. The infection can be acquired early in life, even before teeth appear. Genetic analyses of the oral bacteria of children and their family members indicate that the bacterial infection is most often passed from mother to child. Transmission is likely carried through saliva shared in everyday activities such as sharing spoons, touching hands to mouths, or licking the infant’s pacifier. Mothers in poor dental health are highly infected with cariogenic bacteria, including *Streptococcus mutans*, that can infect the child easily. Healthy mothers with lower levels of the bacteria are less likely to pass the bacteria to their children with the frequency and at the amounts that will lead to tooth damage. However, others in close contact with the infant, including an infected sibling, playmate, or even a child care worker, can pass the bacteria to the infant. The early infection is without symptoms.

A diet rich in refined carbohydrates—sugars from many sources—helps create an environment in the mouth for the infection to flourish. Normally, these pathogenic bacteria are only a small part of the natural biofilm

(i.e., tooth plaque) on the teeth but they can predominate in children with severe tooth decay. Children with a great deal of visible plaque on the teeth are most vulnerable. The process leading to a visible cavity is slow. The bacteria take in sugars in the diet to produce energy required for them to survive and multiply. In producing energy, they excrete a combination of water and acid. The acid damages (demineralizes) the layer of the tooth just below the white enamel. When the damage is great enough, the enamel breaks, leaving a hole. The bacteria that lead to tooth decay thrive in an acid environment and grow even faster once the process is started. A way to think about the process of tooth decay is to liken it to the working of a power plant. Power plants use fossil fuels to produce energy. The by-products of the energy production, much talked about today, are carbon dioxide and water. Carbon dioxide is a weak acid and sometimes comes down as acid rain—damaging buildings and killing trees. Basically, the damage to teeth occurs by the same process. It is not that children should have no carbohydrates or sugars; however, the more frequent the sugar exposure to the teeth, the greater the chance of tooth decay.

Some of the consequences of untreated tooth decay include sensitivity while eating, pain, gum abscesses (see photo), and, in rare cases, systemic infections that lead to death if left untreated. Tooth pain caused by dental caries is thought to be a major cause of school absences, which is detrimental on the societal level, especially for children from lower socioeconomic backgrounds (Gift, Reisine, & Larach 1992).

Tooth decay is not inevitable. The old wives’ tale that a mother lost a tooth for every baby probably resulted from active tooth decay in the mother that went untreated. Today, we know that dental care during pregnancy is safe and that women who have healthy mouths have children who are less likely to be infected and much less likely to have cavities. The basic prescription for pregnant women is to have cavities filled, remove hopeless teeth damaged beyond repair, and practice good oral hygiene at home. Women may also obtain an antiseptic mouth rinse containing chlorhexidine gluconate from either their dentist or their obstetric provider. Use of chlorhexidine rinses twice per day reduces the possibility of infecting the child. Finally, a naturally occurring sugar called xylitol has also been shown to improve oral health and prevent infecting infants (Nakai et al., 2010; Söderling, Isokangas, Pienihäkkinen, & Tenovu, 2000). Xylitol is available in a syrup, chewing gum, and mints, and it can also be purchased for use on cereal and other foods (see box for how to obtain and how much to use).

USING XYLITOL AS A SUGAR SUBSTITUTE EVERY DAY OR IN BAKING

Xylitol is a great sugar substitute. It looks and tastes similar to table sugar but has fewer calories. It works fine in cakes, cookies, coffee, tea, oatmeal, cereal, pancakes or brownies. You can substitute xylitol for sugar in the same amounts you normally use. In substituting for brown sugar, for every cup of sugar use $\frac{3}{4}$ xylitol and $\frac{1}{4}$ cup molasses. In some recipes you may need to increase the amount of liquid because xylitol absorbs moisture. Add xylitol before adding liquid ingredients. Xylitol does not work well in yeast breads that need to rise. It is easy to find xylitol-containing recipes on the Web. Powdered xylitol is widely available in health food stores and many supermarkets. Store it in an airtight container or it may get hard.

The Role of Early Childhood Professionals

THE EARLIEST CAVITIES appear as brown or bright white spots near the gumline (see photo). Bottle-fed children—when the bottle contains sugary liquids or fruit drinks—may have cavities on the tongue side of the upper front teeth. Usually the cavities appear first on the upper front teeth but may also be present in the back teeth. Parents, early childhood educators, and child care and medical professionals should lift the child's lip and look at the teeth. With a little practice it is easy to spot a developing cavity. If caught early, the brown and white discolorations can be reversed with dental treatment.

Toothpaste

Fluoridated toothpaste—see “Choosing a Toothpaste for Children”—is critically important for slowing or reversing the caries process and preventing cavities (Milgrom, Huebner, & Ly, 2009). Children at high risk for tooth decay should start having their teeth brushed when the first tooth begins to appear, because the period when teeth are just coming in is when they are the most vulnerable to decay. Children who are at elevated risk for tooth decay include children in poverty, children with developmental disabilities or other special needs that interfere with thorough brushing, and children who take medications that can affect gum growth or salivary production.

The directions and warnings on labels of fluoridated toothpaste vary depending on what other additives are in the paste. Typically, a toothpaste with few additives



PHOTO COURTESY OF DONALD CHIT

The earliest cavities appear as brown or bright white spots near the gumline.

will state that use with children under 2 years of age should be directed by a dentist or physician. It is likely that this dissuades parents from using it at all. In response, a government-sponsored expert committee was asked to develop a decision support matrix to guide topical fluoride use with children. The panel's report (Altarum Institute, 2009) includes the recommendation that, “All children at high risk use fluoride toothpaste.” The panel recommended that children under 2 years use a “smear” of toothpaste and children aged 2–6 years use a slightly larger “pea-sized” amount of toothpaste. The recommendation differed by age because children under 2 years old are not able to spit out excess toothpaste and more likely to inadvertently swallow toothpaste. The panel also emphasized the role of adults and parents because tooth brushing is more effective when young children are supervised or assisted by an adult.

For children at lower risk for dental decay, parents and other caregivers should begin brushing the child's teeth with fluoridated toothpaste when the child is 2 years of age. Toddlers and young preschoolers should have their teeth brushed by an adult twice per day. The toothbrush should be small enough to put in the child's mouth and have soft bristles. Parents may also apply toothpaste with a finger or finger brushes. It is not necessary to rinse the mouth after brushing a child's teeth. Baby gels and other nonfluoridated cleaners are not effective in preventing tooth decay, and their use is not recommended. Parents may encounter dentists whose information about toothpaste use is not yet up to date.

Fluoride Varnish

Dental professionals—and, increasingly, family doctors, pediatricians, and nurses—should be asked to apply fluoride varnishes to

a child's teeth as soon as they erupt. Fluoride varnish also helps reverse brown and white spots—early signs of decay. This is valuable for all children, regardless of their risk status, and has no drawbacks. The varnish is different and more effective than the gels in styrofoam trays that most parents remember from their childhoods. It is safe for babies and can be applied in a few seconds. It does not sting and does not taste bad.

The typical varnishes have a brownish color, but the color does not stain and the teeth will be normal looking a day later. Some dentists use a white varnish. It contains the same amount of fluoride but should be avoided if the child is known to have an allergy to peanuts. Fluoride varnish should

CHOOSING A TOOTHPASTE FOR CHILDREN

Toothpaste for children should contain fluoride. The form of fluoride (e.g., sodium fluoride) varies, but all toothpastes with fluoride sold in the United States meet the Food and Drug Administration requirements for effectiveness and safety. There is no need to try to sort out the labeling of concentrations such as percent fluoride or weight by volume percent, which may vary depending on the brand. Bleaching or whitening toothpaste is not recommended for children, nor are toothpastes advertised for mouth freshening or sensitive teeth. Abrasive toothpaste, like those sold to smokers, can damage children's teeth. Children prefer sweeter toothpastes than adults do, so it is best to avoid mint flavors. All of the major manufacturers have fluoride toothpaste for children.

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achieved in the absence of fluoride varnish or regular use of fluoride toothpaste. Oral xylitol syrup is available by prescription in the United States under the brand name Xylarex (Arbor Pharmaceuticals, Raleigh, NC). There are also xylitol/fluoride toothpastes, although the efficacy of the pastes has not been established.

Children With Special Health Care Needs

Early childhood professionals should help educate parents and caregivers about the unique issues facing children with special needs who may have a higher prevalence of oral disease because of oral/facial conditions or because of secondary effects of medically necessary diets or medications. For example, children with congenital heart disease, clefts, esophageal defects, hypotonia, muscular dysfunction, or mental retardation can have feeding problems. Sucking or chewing problems can lead to meals lasting an hour or longer. Their diets may be heavy in liquid nutrition or soft, often cavity-causing, sweet foods. Foods retained in the mouth a long time before being swallowed add fuel to the caries process. It is also common to give sweet foods such as dried fruits, soda, or juice to cure constipation or diarrhea. In extreme, to maintain hydration and prevent kidney failure, parents often resort to high-sugar drinks. Long-term use of sweetened medications can be another source of risk for caries, as can chronic use of antihistamines that reduce salivation. Children with oral sensitivities, cognitive limitations, or behavioral conditions that interfere with regular and thorough tooth brushing are also at increased risk for tooth decay.

Encourage the Establishment of a Dental Home

The “dental home” concept is based on the medical home model, in which children have a regular, consistent source of medical care. The ideal dental home provides care that is accessible, family-centered, continuous, comprehensive, coordinated, compassionate, and culturally competent (Nowak & Casamassimo, 2002). Previous work has suggested that low-income children are more likely to use dental care when their mothers have a regular source of dental care (Grembowski, Spiekerman, & Milgrom, 2008). A dental home is a place where caregivers can learn about the oral disease prevention process through anticipatory guidance and children can receive personalized caries risk assessment and preventive treatments such as fluoride varnish.

The American Academy of Pediatric Dentistry recommends that a child see a dentist at age 1 or soon after the eruption of the first tooth. Not all dentists are

Fluoride varnish may be helpful in preventing cavities in children.

be applied at least twice per year, and three to four applications per year may be helpful to prevent cavities in children at higher risk. Fluoride treatments are benefits included in the federal Medicaid EPSDT (Early Periodic Screening, Diagnostic and Treatment)

package for children. Day care centers and preschools can arrange to have dental exams and fluoride varnish provided at the center’s site. No special equipment is required. This cannot wait until a child is old enough to be eligible for Head Start.

Additional Preventive Therapies

Children at high risk will have much reduced tooth decay if they consume fluoridated water, have their teeth brushed twice per day with fluoridated toothpaste, and receive topical fluoride varnish treatments. However, those at highest risk may still get cavities. Studies show that many preschool children who are hospitalized for extensive dental treatment develop new tooth decay within 6 months after treatment. Parents often misunderstand that surgical treatments do not address the underlying problem of a chronic oral infection. Research has suggested that applying topical povidone iodine (PVP iodine; Betadine) to the teeth along with fluoride can reduce risk of recurrent tooth decay. Additionally, this combination approach can help prevent first decay in healthy children.

Xylitol, recommended earlier for use by pregnant women and new mothers to reduce their bacteria levels, could also benefit children directly. There is substantial evidence of the benefits of adding xylitol to the diet of preschoolers who are at high risk for decay. A recent study showed that 10 ml of xylitol syrup given two or three times per day to children 15 to 30 months of age reduced tooth decay by as much as 70% (Milgrom, Ly, et al., 2009). The protective effect was

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NATIONAL MATERNAL AND CHILD ORAL HEALTH RESOURCE CENTER

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The Center provides states and communities with resources to address current and emerging public oral health issues.

THE NORTHWEST CENTER TO REDUCE ORAL HEALTH DISPARITIES

<http://depts.washington.edu/macroh>

The Northwest Center to Reduce Oral Health Disparities conducts community-based research on solutions to dental and oral health disparities among vulnerable, rural, or underserved groups, particularly low-income families with children.

comfortable with young children, and some may not be very familiar with the research about early childhood interventions. Experienced general dentists can provide the preventive treatments recommended for young children; it is not necessary to seek a pediatric dentist. In some states, including Washington, there are county-level programs to help parents locate local dentists willing to treat young children, low-income children, and children with special needs. State laws vary with regard to services that can be provided by other dental professionals, including dental hygienists. For example, some states have increased the scope of practice for licensed hygienists to include performing fluoride treatments as a preventive measure. Early childhood professionals and parents should work together to identify dental resources specific to their local community. §

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