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Best Practices on Fluoride Therapy

Review Council

Council on Clinical Affairs

Latest Revision

~~2014*~~ 2018

~~** The 2014 revision was limited to use of fluoridated toothpaste in young children*~~

Purpose

The American Academy of Pediatric Dentistry (**AAPD**) intends ~~this guideline~~ these recommendations to help practitioners and parents make decisions concerning appropriate use of fluoride as part of the comprehensive oral health care for infants, children, adolescents, and persons with special health care needs.

Methods

This guideline was originally developed by the Council on Clinical Affairs Committee and adopted in 1967. This document is a revision of the previous version, last revised in ~~2013~~2014. To update this guidance, an electronic search from 2012 to 2017 pertaining to ~~A thorough review of~~ the scientific literature ~~in the English language pertaining to~~regarding the use of systemic and topical fluoride was conducted.~~completed to revise and update this guideline.~~ Database searches were conducted using the terms: fluoride caries prevention, fluoridation, fluoride gel, fluoride varnish, fluoride toothpaste, fluoride therapy, and topical fluoride. Because ~~over two million~~ 720 papers were identified through these electronic searches, an alternate strategy ~~strategies~~ of limiting the information gathering to systematic reviews using term "fluoride caries prevention" yielded 95 papers since 2012. Nine well conducted systematic reviews and their references primarily were used for this update [1-9]. ~~such as appraisal of references from recent evidence-based reviews and meta-analyses, as well as hand searches, were performed. This strategy yielded 105 manuscripts, primarily related to randomized clinical trials and evidence-based reviews, that were evaluated further by abstract. Of those, 45 manuscripts each had full examination and analysis in order to revise this guideline.~~ Expert opinions and ~~best current~~ clinical practices also were relied upon for ~~this guideline~~ these recommendations.

Background

~~Widespread use of f~~Fluoride has been a major factor in the decline in prevalence and severity of dental caries in the U.S. and other economically developed countries. ~~When used appropriately, fluoride is both safe and effective in preventing and controlling dental caries. Decisions concerning the administration of fluoride are based on the unique needs of each patient, including the risks and benefits (i.e., risk of mild or moderate fluorosis versus the benefits of decreasing caries increment and, in some cases preventing, devastating dental disease).~~

Fluoride has several caries-protective mechanisms of action. Topically, low levels of fluoride in plaque and saliva inhibit the demineralization of sound enamel and enhance the re-mineralization of demineralized enamel. Fluoride also inhibits dental caries by affecting the metabolic activity of cariogenic bacteria [10]. High levels of fluoride, such as those attained with the use of topical gels or varnishes, produce a temporary layer of calcium fluoride-like material on the enamel surface. The fluoride is released when the pH drops in response to acid production and becomes available to remineralize enamel or affect bacterial metabolism [11]. The original belief was that fluoride's primary action was to inhibit dental caries when incorporated into developing dental enamel (i.e., the systemic route), but the fluoride concentration in sound enamel does not fully explain the marked reduction in dental caries. It is oversimplification to designate fluoride simply as systemic or topical. Fluoride that is swallowed, such as fluoridated water and dietary supplements, may contribute to a topical effect on erupted teeth (before swallowed, as well as a topical effect due to increasing salivary and gingival crevicular fluoride levels). Additionally, elevated plasma fluoride levels can treat the outer surface of fully mineralized, but unerupted, teeth topically. Similarly, topical fluoride that is swallowed may have a systemic effect [12].

Fluoridation of community drinking water is the most equitable and cost-effective method of delivering fluoride to all members of most communities [13]. Water fluoridation at the level of 0.7-1.2 mg fluoride ion/L (ppm F) was introduced in the U.S. in the 1940s. Since fluoride from water supplies is now one of several sources of fluoride, the Department of Health and Human Services ~~recently~~ has ~~proposed~~ recommended ~~to~~ not ~~have~~ having a fluoride range, but rather to ~~limit the recommendation to the lower~~ standardize all water to the l~~imit of~~ 0.7 ppm F level. The rationale is to balance the benefits of preventing dental caries while reducing the chance of fluorosis [1].

Community water fluoridation has been associated with the decline in caries prevalence in adolescents from 90 percent in at least one permanent tooth in U.S. 12-17 years-olds in the 1960s, to 60 percent in a

1999-2004 survey [14]. When used appropriately, fluoride is both safe and effective in preventing and controlling dental caries. Although adverse health effects, such as decreased cognitive ability, endocrine disruption and cancer, have been ascribed to the use of fluoride over the years, the preponderance of evidence from large cohort studies and systematic reviews does not support an association of such health issues and consumption of fluoridated water [1]. Regarding cognitive ability, a recent study of mothers' urinary fluoride levels and their child's IQ levels suggested an association with exposure levels greater than those recommended in the U.S. for water fluoridation [15]. However, a prospective study in New Zealand did not support an association between fluoridated water and IQ measurements [16], and a national sample in Sweden found no relationship between fluoride levels in water supplies and cognitive ability, non-cognitive ability, and education [17]. Consumption of fluoride during the mineralization of teeth, however, can cause fluorosis (children 1-3 years of age being most susceptible for fluorosis of the permanent incisors). The NHANES 1999-2004 study found 23 percent of the U.S. population had very mild or mild fluorosis [18]. Decisions concerning the administration of fluoride are based on the unique needs of each patient, including the risks and benefits (e.g., risk of mild or moderate fluorosis versus the benefits of decreasing caries increment and, in some cases preventing, devastating dental disease).

Fluoride supplements also are effective in reducing prevalence of dental caries and should be considered for children at high caries risk who drink fluoride-deficient (less than 0.6 ppm F) water [19] (see Table). Determination of dietary fluoride before prescribing supplements can help reduce intake of excess fluoride. Sources of dietary fluoride may include drinking water from home, day care, and school; beverages such as soda [20], juice [21], and infant formula [22]; prepared food [23], and toothpaste. Concentrated ~~I~~infant formulas requiring reconstitution with water have raised concerns regarding ~~especially powdered formulas that have been reconstituted with fluoridated water, have been associated with~~ an increased risk of fluorosis [24]. Infants may be particularly susceptible because of the large consumption of such liquid in the first year of life, while the body weight is relatively low [12]. ~~However, a recent~~ An evidence-based review found that consumption of ~~suggests that reducing fluoride intake from~~ reconstituted infant formula can be associated with an increased risk of mild fluorosis, but recommended the continued use of fluoridated water [25]. One study has shown that dental fluorosis levels do not vary in fluoridated areas regardless of premixed versus reconstituted formula [26]. Standardization of the optimal fluoride levels in drinking water to 0.7 ppm F, however, makes this issue mute. ~~alone will not eliminate the risk of fluorosis development. Fluorosis is associated with cumulative fluoride intake during enamel development, with the severity dependent on the dose, duration, and timing of intake. Findings from a national survey report that eight percent of 12-15 year-olds have mild fluorosis and five percent have moderate fluorosis.~~

Table. DIETARY FLUORIDE SUPPLEMENTATION SCHEDULE

Age	<0.3 ppm F	0.3 to 0.6 ppm F	>0.6 ppm F
Birth to 6 months	0	0	0
6 mo to 3 years	0.25 mg	0	0
3 to 6 years	0.50 mg	0.25 mg	0
6 to at least 16 years	1.00 mg	0.50 mg	0

Professionally-applied topical fluoride treatments are efficacious in reducing prevalence of dental caries. The most commonly used agents for professionally-applied fluoride treatments are ~~five~~ 5 percent sodium fluoride varnish (**NaFV;** 2.26%F, 22,600 ppm F) and ~~1.23 percent~~ acidulated phosphate fluoride (**APF**; 1.23%F 12,300 ppm F). ~~The efficacy of~~ Meta-analyses of 23 clinical trials, most with twice yearly application, favors the use of fluoride varnish in primary and permanent teeth [2]. Unit doses of fluoride varnish are the only professional topical fluoride agent that are recommended for children younger than age six [2]. ~~when used at least twice a year has been reported in at least four randomized controlled trials. The efficacy of fluoride varnish in permanent teeth, applied at three or six month intervals, also has been reported in at least four randomized controlled trials.~~ Meta-analyses of ~~14~~ placebo-controlled trials show that fluoride gels, applied at three month to one year intervals, also are efficacious in reducing caries in permanent teeth [27]. Some topical fluoride gel and foam products are marketed with recommended treatment times of less than four minutes, but there are no clinical trials showing efficacy of shorter than four-minute application times [28]. There also is limited evidence that topical fluoride foams are efficacious in children [2]. Children at ~~increased~~ risk for caries ~~risk~~ should receive a professional fluoride treatment at least every six months [28]. ~~As the risk categories may change over time, the type and frequency of preventive interventions should be adjusted.~~

Silver diamine fluoride (**SDF**; 5%F 44,800 ppm F) recently has been approved by the U.S. Food and Drug Administration and currently is used most frequently to arrest dentinal caries. SDF arrests caries by the antibacterial effect of silver and by remineralization of enamel and dentin [9]. Some clinical trials show a caries arrest rate greater than 80 percent [7], but such studies have a high risk of bias and a wide variation of results, leading to conditional recommendations at this time [29]. Although the product is highly

concentrated, less than a drop is needed to treat several caries lesions. The only reported side effect of the SDF is that caries lesions stain black after treatment, and will temporarily stain skin with contact.

~~Other topical fluoride products, such as 0.2 percent sodium fluoride (**NaF**) mouthrinse (900 ppm F)*(Torell; Horowitz; Heifetz)* and brush-on gels/pastes (e.g., 1.1 percent NaF; 5,000 ppm F) also have been shown to be effective in reducing dental caries in permanent teeth.~~ Home use of fluoride products for children should focus on regimens that maximize topical contact, in lower-dose higher-frequency approaches [30]. Meta-analyses of more than 70 randomized or quasi-randomized controlled clinical trials show that fluoride toothpaste is efficacious in reducing prevalence of dental caries in permanent teeth, with the effect increased in children with higher baseline level of caries ~~and by~~with higher concentration of fluoride in the toothpaste, greater frequency of use, and supervision of brushing [31,32]. A meta-analysis of eight clinical trials on caries increment in preschool children also shows that tooth brushing with fluoridated toothpaste significantly reduces dental caries prevalence in the primary dentition [6]. Using no more than a smear or rice-size amount of fluoridated toothpaste for children less than three years of age may decrease risk of fluorosis. Using no more than a pea-size amount of fluoridated toothpaste is appropriate for children aged three to six [8] (see Figure). To maximize the beneficial effect of fluoride in the toothpaste, ~~teeth~~ supervised toothbrushing should be ~~brushed~~done twice a day,~~-~~and rinsing after brushing should be kept to a minimum or eliminated altogether [4]. Other topical fluoride products (e.g., prescription strength, home-use 0.5 percent fluoride gels and pastes; prescription-strength, home-use 0.09 percent fluoride mouthrinse have benefit in reducing dental caries in children six years or older [2].

Recommendations

1. There is confirmation from evidence-based reviews that fluoride use for the prevention and control of caries is both safe and highly effective in reducing dental caries prevalence.
2. There is ~~evidence~~ support from ~~randomized clinical trials and~~ evidence-based reviews that fluoride dietary supplements are effective in reducing dental caries and should be considered for children at caries risk who drink fluoride-deficient (less than 0.6 ppm) water.
3. There is ~~evidence~~ support from ~~randomized controlled trials and meta-analyses~~ evidence-based reviews that professionally applied topical fluoride treatments as ~~five~~2.26 percent NaFV or 1.23 percent F gel preparations are efficacious in reducing caries in children at caries risk.
4. There is ~~evidence~~ support ~~from meta-analyses~~ evidence-based reviews that fluoridated toothpaste is effective in reducing dental caries in children with the effect increased in children with higher

baseline level of caries, higher concentration of fluoride in the toothpaste, greater frequency in use, and supervision. Using no more than a smear or rice-size amount of fluoridated toothpaste for children less than three years of age may decrease risk of fluorosis. Using no more than a pea-size amount of fluoridated toothpaste is appropriate for children aged three to six.

5. There is ~~evidence~~ support from ~~randomized clinical trials~~evidence-based reviews that prescription strength, home-use 0.5 percent fluoride gels and pastes and prescription-strength, home-use 0.09 percent fluoride mouthrinse ~~0.2 percent NaF mouthrinse and 1.1 percent NaF brush-on gels/pastes~~ also are effective in reducing dental caries ~~in children~~.
6. There is support from evidence-based reviews to recommend the use of 38% silver diamine fluoride for the arrest of cavitated caries lesions in primary teeth as part of a comprehensive caries management program.

Figure. Comparison of a smear (left) with a pea-sized (right) amount of toothpaste.

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