FOCUS ON FLUORIDES: UPDATE ON THE USE OF FLUORIDE FOR THE PREVENTION OF DENTAL CARIES

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SORT SCORE

A	B	C	NA

SORT, Strength of Recommendation Taxonomy

LEVEL OF EVIDENCE

1	2	3

See page A8 for complete details regarding SORT and LEVEL OF EVIDENCE grading system

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J Evid Base Dent Pract 2014;14S: [95-102]

1532-3382/$36.00

http://dx.doi.org/10.1016/j.jebdp.2014.02.004

ABSTRACT

Improving the efficacy of fluoride therapies reduces dental caries and lowers fluoride exposure.

Background

Fluoride is delivered to the teeth systemically or topically to aid in the prevention of dental caries. Systemic fluoride from ingested sources is in blood serum and can be deposited only in teeth that are forming in children. Topical fluoride is from sources such as community water, processed foods, beverages, toothpastes, mouthrinses, gels, foams, and varnishes. The United States Centers for Disease Control and Prevention (CDC) and the American Dental Association (ADA) have proposed changes in their long standing recommendations for the amount of fluoride in community drinking water in response to concerns about an increasing incidence of dental fluorosis in children. Current research is focused on the development of strategies to improve fluoride efficacy. The purpose of this update is to inform the reader about new research and policies related to the use of fluoride for the prevention of dental caries.

Methods

Reviews of the current research and recent evidence based systematic reviews on the topics of fluoride are presented. Topics discussed include: updates on community water fluoridation research and policies; available fluoride in dentifrices; fluoride varnish compositions, use, and recommendations; and other fluoride containing dental products. This update provides insights into current research and discusses proposed policy changes for the use of fluoride for the prevention of dental caries.

Conclusions

The dental profession is adjusting their recommendations for fluoride use based on current observations of the halo effect and subsequent outcomes. The research community is focused on improving the efficacy of fluoride therapies thus reducing dental caries and lowering the amount of fluoride required for efficacy.

Key words: Fluoride, fluorosis, decay prevention, fluoride delivery systems

INTRODUCTION

There is no question about the importance of fluoride for the prevention of dental caries as it is the first line of defense, along with education, for preventing the onset of caries. Fluoride is the only compound recognized by US Food and Drug Administration (FDA) for the prevention of dental caries; however, not all fluoride containing products are recognized by the FDA for caries protection. At this time fluoride for caries prevention comes primarily from fluoridated community water, toothpastes, and mouthrinses. The intake of water and processed beverages in the United States provides approximately 75% of a person's fluoride intake.[1]

In the last couple of years there has been a significant reevaluation and proposed adjustment of public policies related to community water fluoridation. The proposed changes are based on current research into fluoride availability in the environment as well as the increasing incidence of very mild and mild fluorosis. There is also new research into the mechanisms of fluoride for anticaries efficacy which may lead to better prevention strategies. New and/or improved fluoride products are entering the marketplace at an increased rate; these products include: toothpastes, fluoride varnishes, fluoride containing whitening agents, and other fluoride containing cleaning products. For some, if not most of these new products, there is very little research to support their efficacy. This update presents new evidence, implications, and strategies related to fluoride use in community water fluoridation and for some fluoride based products for the prevention of dental caries.

Community Water Fluoridation

Community water fluoridation began 70 years ago and now approximately 72% of the population of the United States has fluoridated water in their homes. In early 2011, after years of review and evaluation, the CDC, EPA, and the ADA proposed a modification to their recommendations for the amount of fluoride in drinking water to be 0.7 μg/mL (ppm) everywhere in the United States. The previous recommendations ranged from 0.7 ppm to 1.2 ppm fluoride and were climate dependent. Although the announcements of the proposed changes in the recommendations were released for public comment, a large number of municipalities immediately lowered the fluoride content of their water supply to 0.7 ppm. This means that although the proposed recommendations have not been officially adopted by the CDC or ADA, the populations of those communities are already receiving less fluoride than they did in the past. The municipal water providers are possibly putting their communities at risk for increased incidence of dental caries. It may take several years for any change in caries incidence to be noticed.

The new proposed and previous water fluoridation recommendations are based on calculations of total fluoride intake by children under the age of 8 because this is the population most vulnerable to develop fluorosis from systemic fluoride. In the 1950's the only source of fluoride for children was in the drinking water so the calculations about fluoride intake estimated the amount of water that children drank and set the recommendations accordingly. In the warmer southern regions the children drank more water; while in the colder northern regions children drank less water. Thus, until 2011 the CDC and the ADA recommended that the amount of fluoride in drinking water should range from 0.7 ppm in warmer climates to 1.2 ppm in cooler climates. Reviews about the drinking habits of children have shown that due to air conditioning and other factors, children in all regions of the United States drink similar amounts of water and fluoridated beverages.

Studies have also shown that the fluoride intake of most children is supplemented from environmental sources. This fluoride from the environment, called the halo effect, includes sources such as processed foods and beverages, toothpaste, and to a small extent pesticides (**Figure 1**). The total fluoride intake for the youngest members of the population can often be higher than optimal which may lead to an increased incidence of very mild and mild fluorosis. Fluoride use in drinking water, dentifrice, and professional therapies has reduced caries incidence; however, indiscriminant use of fluoride has led to an increase of fluoride in the environment. The fluoride halo is thought to be the cause for the rapid increase in the rates of very mild and mild fluorosis (the lowest categories) over the last decade.[2]

Fluorosis occurs as a result of elevated amounts of fluoride during enamel formation before the tooth is erupted. The elevated fluoride may lead to defects in the enamel ranging from white specks or white striations to rough and pitted surfaces. **Figure 2** shows examples of fluorosis from none, to very mild, and severe. Very mild fluorosis is often misdiagnosed and thus may be over reported because there are other conditions that appear similar. For instance, the use of antibiotics such as amoxicillin (in the β-lactam family of antibiotics which includes penicillins, amoxicillins and cephalosporins) during childhood causes white spots on the tooth that could easily be mistaken for, but are not due to fluoride.[3] It is interesting to note that other antibiotics such as tetracycline also cause tooth discoloration which results in a dark colored stained striations that are easily distinguished from fluorosis. Since anterior permanent teeth develop in children under the age of 8, higher than optimal fluoride concentration exposure on a consistent basis can result in fluorosis. Fluorosis is due to fluoride deposited in the tooth as it is maturing, therefore the effects cannot be seen until the tooth erupts. Sources of fluoride during these early years can occur from ingestion of infant formula, drinking water that has higher than optimum levels of fluoride, fluoride toothpaste ingestion, or from inappropriately supervised fluoride supplements.

Powdered infant formula and infant formula concentrate are particularly important contributing sources for higher amounts of fluoride. Studies have shown that some brands contain sufficient amounts of fluoride that when mixed with optimally fluoridated water result in greater than optimal amounts of fluoride in the formula.[4] The CDC and ADA have varied their recommendations about this in recent years. In 2006 the CDC and ADA recommended that low-fluoride water be used to reconstitute infant formula to guard against exposing the infant to excess amounts of fluoride. Recent evidence reviewed by the CDC "suggests that mixing powdered or liquid infant formula concentrate with fluoridated water on a