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DENTAL FLUORIDE TREATMENT IN PEDIATRIC PATIENTS

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ABSTRACT
Dental caries remains the most common chronic disease of childhood. Caries is a largely preventable condition, and fluoride has proven effectiveness in the prevention of caries. The goals of this review paper are to clarify the use of available fluoride modalities for caries prevention in the primary care setting and to assist pediatricians in using fluoride to achieve maximum protection against dental caries.

INTRODUCTION

Widespread availability of fluoride is largely acknowledged as the major factor responsible for the declining prevalence of dental caries over the last 30 years. The impact of fluoride on teeth was studied initially in the early 1900s, when researchers noted that residents from communities in which there were naturally high fluoride levels in water seemed more resistant to dental decay.[1]

This observation led to the landmark investigation in the early 1940s of 21 cities that had varying levels of naturally occurring fluoride in the water. Results from this study identified 1 ppm (1 part per million or 1 mg/L) of fluoride in the water supply as the concentration that allowed for maximal caries prevention with minimal risk of fluorosis. Prospective field trials of water fluoridation in four pairs of treatment and control cities in the United States and Canada, begun in 1945, resulted in a 50% to 75% reduction in caries in children in the fluoridated communities during sequential cross-sectional surveys over 15 years.[1]

Since recognition of the association between fluoride and reduced risk of dental caries, the sources of fluoride in the diet have expanded substantially, and understanding of fluoride's effects has evolved. This article reviews current understanding of fluoride's mechanism of treatment in pediatric patients.

Fluoride: Mechanism of Action

The primary and most important action of fluoride is topical, when the fluoride ion is present in the saliva in the appropriate concentration. Hydroxyapatite is the main mineral responsible for building the permanent tooth enamel after the development of the teeth is finished. During tooth growth, the enamel is constantly exposed to numerous demineralization processes, but also important remineralization processes, if the appropriate ions are present in the saliva.[2]

These processes can either weaken or strengthen the enamel. The presence of fluoride in an acidic environment reduces the dissolution of calcium hydroxyapatite. The main action is inhibition of demineralization of enamel, which is carried out through different mechanisms. There are different cariogenic bacteria in the plaque fluid the most important being *S. mutans*. When bacteria metabolize sugars, they produce lactic acid which decreases the pH in saliva. When the pH falls below the critical level of hydroxyapatite (pH 5.5), the process of demineralization of enamel takes place and caries is formed. At the beginning, the process is reversible and it is possible to reduce the formation of new lesions with appropriate preventive measures.[3]

If fluoride is present in plaque fluid, it will reduce the demineralization, as it will adsorb into the crystal surface and protect crystals from dissolution. Because the fluoride ion coating is only partial, the uncoated parts of the crystal will undergo dissolution on certain parts of the tooth, if the pH falls below level 5.5. When the pH rises above the critical level of 5.5, the increased level of fluoride ion leads to remineralization, because it absorbs itself into the enamel and forms fluorhydroxyapatite. After repeated cycles of demineralization and remineralization, the outer parts of enamel may change and become more resistant to the acidic environment due to a lowered critical pH level of newly formed crystals (pH 4.5).[3,4]

The most important effect of fluoride on caries progression is thus on demineralization and remineralization processes. It has also been proposed,

that the fluoride ion can affect the physiology of microbial cells, which can indirectly affect demineralization. Fluoride ions affect bacterial cells through several mechanisms. One of them being a direct inhibition of cellular enzymes – glycolytic enzymes, H+ATPases). It affects cellular membrane permeability and also lowers cytoplasmic pH, resulting in a decrease in acid production from glycolysis.[5]

Current Information Regarding Fluoride Use Incaries Prevention

The following information aims to assist pediatricians in achieving maximum protection against dental caries for their patients while minimizing the likelihood of enamel fluorosis. Sources of ingested fluoride include drinking water, infant formula, fluoride tooth-paste, prescription fluoride supplements, fluoride mouth rinses, professionally applied topical fluoride, and some foods and beverages.[5,6]

Fluoride Toothpaste

Fluoride toothpaste has consistently been proven to provide a caries preventive effect for individuals of all ages. In the India, the fluoride concentration of over-the-counter toothpaste ranges from 1000 to 1100 ppm. In someother countries, toothpastes containing1500 ppm of fluoride are available. A1-inch (1-g) strip of toothpaste translates to 1 or 1.5 mg of fluoride, respectively.[6]

A pea-sized amount of toothpaste is approximately one-quarter of an inch. Therefore, a pea-sized amount of tooth-paste containing 1000/1100 ppm of fluoride would have approximately 0.25mg of fluoride, and the same amount of toothpaste containing 1500 ppm of fluo-ride would have approximately 0.38 mg of fluoride. Most fluoride toothpaste in the United States contains sodiumfluo-ride, sodium monofluorophosphate, or stannousfluoride as the active ingre-dient. Parents should supervise children younger than 8 years to ensure the proper amount of toothpaste and effective brushing technique.[7]

Children younger than 6 years are more likely to ingest some or all of the toothpaste used. Ingestion of excessive amounts of fluoride can increase the risk of fluorosis. This excess can be minimized by limiting the amount of toothpaste used and by storing toothpaste where young children cannot access it without pa-rental help. Use of fluoride toothpaste should begin with the eruption of the first tooth. When fluoride toothpaste is used for children younger than 3 years, it is recommended that the amount be limited to a smear or grain of rice size (about one-half of a pea). Once the child has turned 3 years of age, a pea sized amount of toothpaste should be used. Young children should not be given water to rinse after brushing because their instinct is to swallow.[5]

Expec-torating without rinsing will both reduce the amount of fluoride swal-lowed and leave some fluoride in the saliva, where it is available for uptake by the dental plaque. Parents should be strongly advised to supervise their child's use of fluoride toothpaste to avoid overuse or ingestion. High-concentration toothpaste (5000ppm) is available by prescription only. The active ingredient in this toothpaste is sodiumfluoride. This agent can be recommended for children 6 years and older and adolescents who are at high risk of caries and who are able to expectorate after brushing. Dentists may also prescribe this agent for adolescents who are undergoing or-thodontic treatment, as they are at increased risk of caries during this time.[6,7]

Fluoride Varnish

Fluoride varnish is a concentrated topical fluoride that is applied to the teeth by using a small brush and sets on contact with saliva. Advantages of this modality are that it is well tolerated by infants and young children, has a prolonged therapeutic effect, and can be applied by both dental and non-dental health professionals in a variety of settings. The concentration of fluoride varnish is 22 600 ppm (2.26%), and the active ingredient is sodium fluoride. The unit dose packaging from most manufacturers provides a specific measured amount (0.25 mg, providing 5 mg of fluoride ion). The application of fluoride varnish during an oral screening is of benefit to children, especially those who may have limited access to dental care.[8]

Current American Academy of Pediatric Dentistry recommendations for children at high risk of caries is that fluoride varnish be applied to their teeth every 3 to 6 months.[3]

The 2013 ADA guideline recommends application of fluoride varnish at least every 6 months to both primary and permanent teeth in those subjects at elevated caries risk.[9]

Because state regulations vary regarding whether fluoride varnish must be applied within the context of a preventive care code, this information should be determined before billing.

Instructions for Use

Indications for Use in the primary care setting, fluoride varnish should be applied to the teeth of all infants and children at least once every 6 months and preferably every 3months, starting when the first tooth rupts and until establishment of a dental home.

Fluoride varnish must be applied by a dentist, dental auxiliary professional, physician, nurse, or other health care professional, depending on the practice regulations in each state. It shouldnot be dispensed to families to apply at home.[10]

Application of fluoride varnish is most commonly performed at the time of a well-child visit. Teeth are dried with a 2-inch gauze square, and the varnish is then painted onto all surfaces of the teeth with a brush

provided with the varnish. Children are instructed to eats oft foods and not to brush their teeth on the evening after the varnish application to maximize the contact time of the varnish to the tooth. The following day, they should resume brushing twice daily with fluoridated toothpaste.[11-13]

Over-the-Counter Fluoride Rinse

Over-the-counter fluoride rinse provides a lower concentration of sodium fluoride than toothpaste or varnish. The concentration is most commonly230 ppm (0.05% sodiumfluoride).[14]

Ex-pert panels on this topic have concluded that over-the-counter fluoride rinses should not be recommended for children younger than 6 years becauseof their limited ability to rinse and spit and the risk of swallowing higher-than-recommended levels of fluoride.[14-16]

A teaspoon (5 mL) of over-the-counter fluoride rinse contains approximately1mgoffluoride. For children younger than 6 years, this type of rinse provides an additional, low-dose topical fluoride application that may assist in the prevention of enamel demineralization.[17-20]

However, the evidence for an anticaries effect is limited. The daily use of a0.05% sodiumfluoride rinse may be of benefit for children older than 6 years who are at high risk of dental caries; however, there is no additional benefit beyond daily use of fluoridated toothpaste or children at low risk of caries.[21]

CONCLUSION

Fluoride occurs naturally in our environment and is always present in our lives. Exposure can occur through dietary intake, respiration and fluoride supplements. Fluoride can be toxic in extremely high concentrations. Its everyday use in concentrations present in beverages for dental hygiene is safe. Preventive topical use of fluoride supplements because of their cariostatic effect.

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