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The Impact of Using Fluoride in Pediatric Dentistry: A Systematic Review

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ABSTRACT

Background: Dental caries is a global health problem affecting dental health in children due to an imbalance, between time, the interaction between cariogenic bacteria in dental plaque and fermentable carbohydrates. Based on one study, it was stated that globally, 621 million children had untreated dental caries in primary teeth and 2.4 billion people had untreated dental caries in permanent teeth. Therefore a comprehensive approach should be developed and applied in the preventive management of dental caries. Topical fluorides, such as varnish, NaF, SnF_2, and APF are used as preventive reagents because of their remineralization and antimicrobial properties. **Aim:** The purpose of writing this systematic review is to find and explore the impact of fluoride use in the field of pediatric dentistry. **Methods:** Data collection was carried out by searching the literature on article search sites, namely Google Search and Pubmed which were published from 2016 to 2020, searches were carried out in December 2020. Data searches were carried out systematically using the keywords fluoride in dentistry and fluoride in pediatric dentistry. After eliminating duplicated articles, the titles and abstracts of each article were analyzed on 264 articles which resulted in the exclusion of 58 articles. The full-text articles in the remaining 53 articles were re-analyzed and excluded as many as 43 articles and produced 15 articles then entered into the analysis. **Result:**There were 15 articles discussing the impact of fluoride in the field of pediatric dentistry, both positive and negative impacts. **Conclusion:** Fluoride is the gold standard agent in the prevention of dental caries in children, but irrational use of fluoride can cause some negative effects. Therefore it is recommended that you pay attention to several considerations in giving fluoride to children.

Keywords: *Fluoride, Impact, Pediatric dentistry*

INTRODUCTION

Dental caries is a global health problem that affects dental health in children. Caries (tooth decay) can be defined as a disease of the hard tissue of the teeth caused by an imbalance, between time, the interaction between cariogenic bacteria in dental plaque and fermentable carbohydrates.[1,2,3] Caries is one of the most common chronic diseases. in this world. About 2.4 billion people, who make up 35% of the world's population, are affected by untreated caries. Internationally, 60–90% of school children have dental caries. Based on one study, it was stated that globally, 621 million children had untreated dental caries in primary teeth and 2.4 billion people had untreated dental caries in permanent teeth.[3,4,5,6]

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Dental caries is related to the demineralization of the tooth structure by organic acids produced by microorganisms, which can develop from the outer surface of the tooth structure to the vital tissues inside the tooth which can cause pain to swelling. Untreated caries can lead to life affecting conditions for example, toddlers or preschoolers with untreated caries show a poor quality of life which involves pain, difficulty eating and drinking, difficulty sleeping and affecting the child's growth and development while school-age children also experience sleep disturbances, stunted growth, increased school absences and decreased learning abilities. One of the diseases that often attacks children's teeth is Early childhood caries (ECC).[2,4,7]

The American Academy of Pediatric Dentistry (AAPD) defines ECC as the condition of one or more damaged/decayed tooth surfaces missing in the deciduous teeth of children under six years of age. It is considered to be one of the most common childhood diseases, affecting 60-90% of children worldwide. The International Dental Federation (FDI) reports that ECC is one of the main reasons for child absence from school in some countries. This can develop resulting in pain and infection. Therefore a comprehensive approach should be developed and applied in the preventive management of dental caries.[1,2,3] Topical fluorides, such as varnishes, NaF, SnF_2 and APF are used as preventive reagents because of their remineralization and antimicrobial abilities. It can also be found in many dental and oral care products, such as toothpaste, mouthwash, and gels. In addition, fluoride intake through drinking water can also be obtained. It is believed that the anticaries effect of fluoride is due to its ability to protect the hard tissues of the teeth and inhibit bacterial growth and metabolism. The fluoride in saliva can be absorbed onto the surface of the apatite crystals which makes the teeth more resistant to the acidic environment of the oral cavity, thereby preventing the demineralization process, when the pH is low, fluorhydroxyapatite can still tolerate the critical pH of hydroxyapatite, there are 5.5, and can increase the remineralization process. However, irrational use of fluoride can cause several complications such as dental fluorosis, natural fluorosis, neurotoxicity and others. The purpose of writing this systematic review is to seek and explore the impact of fluoride use in the field of pediatric dentistry.[8,9,10,11,12]

SEARCH METHODS

Data Source

Data collection was carried out by searching the literature on article search sites, namely Google Search and Pubmed which were published from 2016 to 2020, the search was carried out in December 2020. Data searches were carried out systematically using the keywords *fluoride in dentistry, and fluoride in pediatric dentistry.*

Research Criteria

A. Inclusion criteria

1. Articles published from 2016-2020

2. Articles in English

3. Published scientific articles available online

4. Articles examining fluoride in pediatric dentistry as a result of research

B. Articles in English

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1. Articles that cannot be accessed for free
2. Articles that do not address the impact of fluoride use in pediatric dentistry

Data Collection

The data that will be used in this research are secondary data. The data is obtained from articles that are searched for in the article database which will then be reviewed according to the research criteria set by the researcher.

Research procedure

1. Literature search was conducted on the online database google search and PubMed. In addition, a search for the list of references to articles that fall into the inclusion criteria was also carried out to find out whether there were other related studies that were relevant to this research.
2. The determination of keywords was carried out in the literature search, namely *fluoride in dentistry*, and *fluoride in pediatric dentistry*
3. Eliminate duplicated literature
4. Articles are filtered on the basis of title, abstract, and keywords
5. Read complete or partial articles that have not been eliminated to determine whether the article meets the eligibility criteria.
6. Data collection was done manually by creating a research matrix containing: author's name, year, title, and conclusion.
7. Processing the data that has been obtained

The literature search was carried out on the online database, Pubmed, using keywords, namely *fluoride* and *fluoride in pediatric dentistry*of which 264 articles were found.

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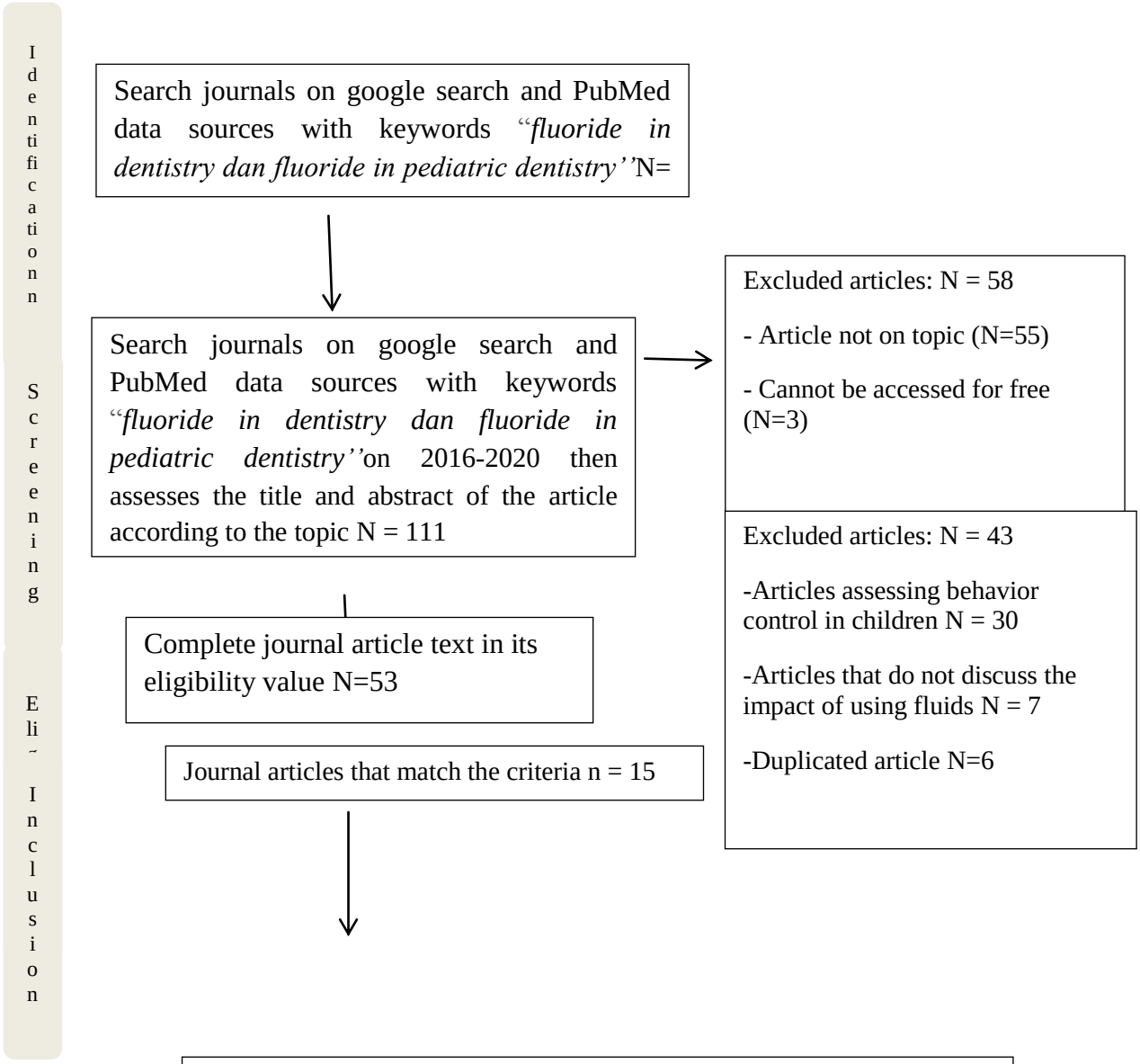

Figure 1. Figure showing the selection of articles for review

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RESULTS

No.	Authors	Year	Title	Conclusion
1	Duangthip D, Wong MCM, Chu CH, Lo ECM.[13]	2017	Caries arrest by topical fluorides in preschool children: 30-month results	Clinical trials have shown that topical application of fluoride can inhibited dentinal caries in children's teeth.
2	Sherry Shiqian Gao, Shinan Zhang, May Lei Mei, Edward Chin-Man Lo and Chun-Hung Chu[14]	2016	Caries remineralisation and arresting effect in children by professionally applied fluoride treatment – a systematic review	This systematic review of caries prevention from professionally applied fluoride (gel and varnish) shows that professionally applied fluoride is effective in caries prevention.

3	Philippe Grandjean[15]	2019	Developmental fluoride neurotoxicity: an updated review	Fourteen recent cross-sectional studies of endemic areas with naturally high concentrations of fluoride in groundwater support previous findings about cognitive impairment in children with high fluoride exposure. Neurotoxicity appears to be dose dependent, and tentative baseline dose calculations suggest that safe exposure is likely to be below currently accepted or recommended fluoride concentrations in drinking water.

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4	DuangpornDuangthip, Kitty Jieyi Chen, Sherry Shiqian Gao, Edward Chin Man Lo ID and Chun Hung Chu[16]	2017	Managing Early Childhood Caries with Atraumatic Restorative Treatment and Topical Silver and Fluoride Agents	Fluoride varnish is considered a safe and effective agent for the prevention of caries in children. SDF can also be an option to control tooth decay, especially in cavitation in children. SDF can be recommended in pediatric and community dentistry and can be an agent in the prevention of caries in children.

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5	Poulami Mishra, Nusrath Fareed, Hemant Battur, Sanjeev Khanagar, Manohar A. Bhat, Jagan Palaniswamy[17]	2017	Role of fluoride varnish in preventing early childhood caries: A systematic review	Based on this review, assessing the effect of fluoride varnish on ECC significantly the use of fluoride varnish to prevent increased tooth enamel remineralization in children with moderate to high risk of dental caries. The results showed that fluoride varnish was used at concentrations of 1% and 5% in the prevention of ECC.

6	Ying Liao, Bernd W. Brandt, Jiyao Li, WimCrielaard, Cor Van Loveren& Dong Mei Deng[18]	2017	Fluoride resistance in *Streptococcus mutans*: a mini review	Fluoride is widely used as an anti-caries agent. S. mutans and other oral bacterial species are able to develop resistance against the antimicrobial effects of fluoride. Research on several fluoride-resistant strains has shown that this resistance is stable and is acquired through chromosomal mutations. The inhibitory effect of fluoride on intracellular metabolism depends on the entry of hydrogen fluoride (HF), which diffuses into bacterial cells, and dissociates to protons (H^+) and fluoride ions (F^-) in the cytoplasm of bacterial cells.

7	RizwanUllah, Muhammad Sohail Zafar, Nazish Shahani[18]	2017	Potential fluoride toxicity from oral medicaments: A review	Dental caries is not caused by fluoride deficiency and fluoride supplementation because the safety level of fluoride is low, products containing high levels of fluoride must be stored and used as recommended and must be monitored by professional dentists some of the effects are dental and bone fluorosis, gastrointestinal hypersensitivity, affecting mental development, and reduce intelligence in children.

8	.Johannsen, C.-G. Emilson, G. Johannsen, K. Konradsson, P. Lingstr€om, P. Ramberg[19]	2019	Effects of stabilized stannous fluoride dentifrice on dental calculus, dental plaque, gingivitis, halitosis and stain: A systematic review	This systematic review shows an increased plaque-reducing effect of toothpaste containing SnF_2 compared to other toothpastes. This review found that SnF stabilized in toothpaste had a positive effect on reducing calculus formation, gingivitis, stains and halitosis.

9	Declan Timothy Waugh[20]	2019	The Contribution of Fluoride to the Pathogenesis of Eye Diseases: Molecular Mechanisms and Implications for Public Health	This study provides mixed evidence suggesting that excessive F exposure may contribute to degenerative eye disease by stimulating or inhibiting biological pathways associated with the pathogenesis of cataracts, AMD and glaucoma.

10	Luca Fiorillo, Gabriele Cervino, Alan Scott Herford, Luigi Laino and Marco Cicciù[21]	2020	Stannous Fluoride Efects on Enamel: A Systematic Review	Stannous fluoride also has the potential to provide benefits related to the antibacterial properties of the substance, the fluoride present in oral fluids (ie, biofilm and saliva) greatly enhances the crystallization of fluorapatite into the tooth structure. Stannous fluoride found on the surface of the tooth enamel will form a protective layer that can protect the enamel from the effects of the acidic environment in the oral cavity.
11	Peter Milgrom, Jeremy A. Horst, Sharity Ludwig, Marilynn Rothen, Benjamin W. Chaffee, Svetlana Lyalina, Katherine S. Pollard, Joseph L. DeRisi, Lloyd Mancl[22]	2017	Topical Silver Diamine Fluoride for Dental Caries Arrest in Preschool Children: A Randomized Controlled Trial and Microbiological Analysis of Caries Associated Microbes and Resistance Gene Expression	According to literature, topical SDF 38% prevents tooth decay and is effective for the short-term treatment of dental caries in preschool children, with periodic application.

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12	Charles R. Parkinsona, Anderson T. Harab, Marc Nehmea, Frank Lippertb, Domenick T. Zerob[23]	2017	A randomised clinical evaluation of a fluoride mouthrinse and dentifrice in an in situ caries model	This study showed 220 ppm fluoride mouthwash as a clinically potential anti-caries.
13	Samira Helena Jo˜ao-Souza, S´avioJos´e C. Bezerra, Patr´ıciaMoreira de Freitas, Nelson B. de Lima, Ana Cec´ılia CorrˆeaAranha, Anderson T. Hara, Ta´ıs Scaramucci[24]	2017	In situ evaluation of fluoride-, stannous- and polyphosphate-containing solutions against enamel erosion	These studies have shown positive results with sodium fluoride in the prevention of enamel erosion, with fluoride concentrations ranging from 500 to 950 ppm F.
14	Priscila Maria ArandaSalomão, LíviaPicchiComar, MaríliaAfonsoRabeloBuzalaf and Ana Carolina Magalhães[25]	2016	In situ remineralisation response of different artificial caries-like enamel lesions to home-care and professional fluoride	The results of this study indicated that the most responsive lesions to fluoride were Buffer and PA gel in minimally demineralized lesions. For high demineralized lesions, fluoride was not effective enough to increase the remineralization process.

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			treatments	
15	ZeynepAslJGüçlü, AlevAlaçam, and Nichola Jayne Coleman[26]	2016	A 12-Week Assessment of the Treatment of White Spot Lesions with CPP-ACP Paste and/or Fluoride Varnish	Findings from this 12-week clinical study indicate that topical application of 10% CPP-ACP paste twice daily in addition to a standard oral hygiene program, which includes fluoridated toothpaste, antimicrobial mouthwash and xylitol gum, significantly increases remineralization of white spot lesions.

Tabel1. Characteristics of each artilcle included in systematic review

After eliminating duplicated articles, the titles and abstracts of each article were analyzed on 264 articles resulting in 58 articles being excluded. The full-text articles in the remaining 53 articles were re-analyzed and excluded as many as 43 articles and produced 15 articles then entered into the analysis.

DISCUSSION

The results of this systematic review show that fluoride is the gold standard agent in caries prevention. Dental caries is one of the most common chronic childhood diseases. This creates an economic burden and a person's quality of life. Permanent first molars are the teeth most susceptible to caries in school children and adolescents 8-10 years. [1,2,3,5,6]

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The level of tooth decay varies, children in lower socioeconomic groups (measured by income, education and work) tend to experience more tooth decay. Untreated tooth decay can lead to progressive deterioration of the tooth surface and is often accompanied by pain. Preventing tooth decay in children and adolescents is considered a priority in dental and oral health services. Therefore, it is important to identify approaches in the management of dental caries that are minimally invasive, such as water fluoridation, fluoridated toothpaste, topical fluoride varnishes.[7,8,9,10]

This systematic review found that the progression of dental caries can be stopped with topical application of fluoride without operative treatment. The results of a Cochrane study on caries prevention from professional use of fluoride (gel and varnish) showed that professionally applied fluoride was effective in caries prevention. This review is based on evidence from four clinical trials assessing the role of 38% SDF in the control of caries in primary teeth. Apart from naturally occurring, fluoride can be added to water supplies in some areas, and is mostly used in toothpaste and other readily available products.[11,12,13,1415]As a preventive measure, fluoride can be applied directly to the tooth surface in the form of a liquid, gel or varnish dosage. Mouthwash containing fluoride can be used under the supervision of a school-based program to prevent tooth decay in children. Fluoride mouthwash is recommended to gargle one to two minutes per day with a less concentrated solution containing fluoride, once a week or two weeks with a more concentrated solution, because of the risk of ingesting too much fluoride, it is not recommended for children under six years of age, however, there is no Food and Drug Administration (FDA) approved drug to treat dental caries. Fluoride toothpaste has been approved by the FDA as an OTC drug to prevent dental caries (Figure 2). Toothpaste containing SnF_2 has been shown to have a preventive and therapeutic effect on dental calculus, dental plaque, gingivitis, halitosis and stains.[16,17,18,19,20,27]

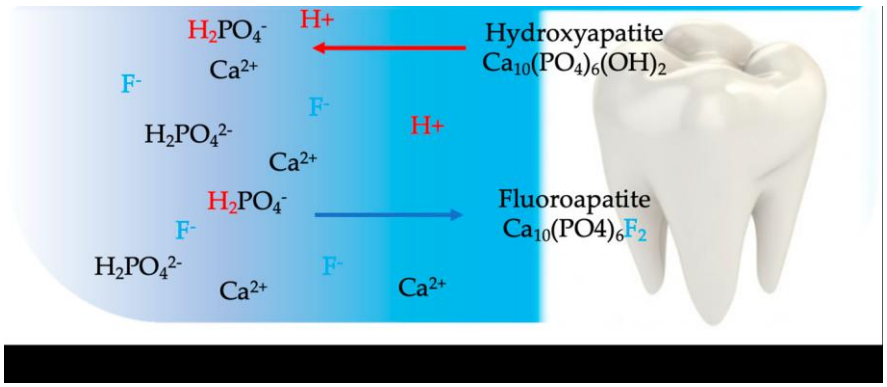

Figure 2. The mechanism of enamel demineralization and remineralization processes.
Source: (Fiorillo L, et al. Stannous Fluoride E_ects on Enamel: A Systematic Review. Biomimetics. 2020; 5(41):3)[24]

Decrease in calculus in teeth resulted in a significant reduction in calculus formation that occurred after 6 months of testing a toothpaste containing SnF_2 and calcium phosphate mineralization inhibitor compared to other toothpastes, because the hardness and calculus deposits could only be removed by mechanical action. This review found that SnF_2 stabilized toothpaste had a positive effect on reducing dental plaque buildup, gingivitis, stains and halitosis. Regular brushing with fluoride toothpaste is the main non-professional intervention in preventing caries, but the caries prevention effect varies according to the different fluoride concentrations in toothpaste (Figure 3).[21,22,24,25,27]

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Toothpaste with a higher fluoride concentration increases the risk of fluorosis in primary dentition. Marihno et al. suggested that an increase of 500 ppm F (in the range 1100-2500 ppm F) would strengthen the caries prevention potential by 6%. Fluoridated toothpaste with a content <1450 ppm F has been reported to be less effective in high-risk children. Mouthwashes with higher fluoride concentrations (2800 and 5000 ppm) are only available by prescription. Most of the clinical studies evaluating toothpaste on caries prevention.[23,26,28,29,30]Numerous studies have shown the effectiveness of fluoride in the prevention of caries and it is known that fluoride is the most effective agent in the prevention of caries. Fluoride increases the surface remineralization of enamel, and reduces its susceptibility to demineralization because it increases the resistance of apatite structures to acidic environments and has antibacterial properties. SnF_2 can incorporate into the enamel by demineralization and deposition on the tooth surface can cause acid-resistant deposition surface deposition. Studies have shown that solutions containing 500 ppm F and 800 ppm Sn are able to reduce the solubility of enamel and dentin in the range of 45-67% and 47-68%, respectively. The American Dental Association (ADA) recommends that children at moderate risk should receive fluoride varnishes or gel applications at intervals of 6 months and at higher risk patients at intervals of three to 6 months.[31,32,33,34,35,36,37]

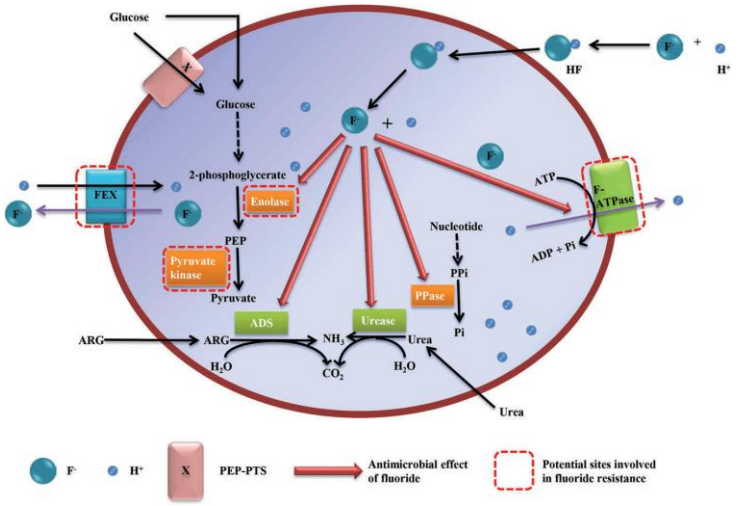

Figure 3. Mechanism of the antimicrobial effect of fluoride and fluoride resistance to *Streptococcus mutans*)

Source: (Liao Y, et al. Fluoride resistance in *Streptococcus mutans*: a mini review. Journal of oral mycrobiology. 2017; 9 (1) :4)[16]

Topical fluoride has long been the gold standard agent in the prevention of dental caries, as sodium fluoride (NaF) can trigger enamel remineralization. NaF-containing dental varnishes are recommended for topical fluoride application for the prevention of dental caries and the treatment of lesions in children under 6 years of age according to the guidelines of the American Dental Association. In children under 6 years of age at high risk of dental caries, the recommendation is application of NaF varnish every 3 months. Fluoride varnishes have been shown to be safe for children.[32,36,38,39,40,41]

Fluoride is one of the most reactive elements found in nature and is present in small amounts in all mineral tissues of the body such as enamel, dentin and bone. Fluoride is involved in a number of enzymatic reactions. In mineralized tissues and biomaterials, fluoride ions increase the stability of tissues and mineralized materials by decreasing the solubility of the hydroxyapatite mineral

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phases present in biomaterials and mineralized tissues such as enamel, due to less tooth decay in people consuming naturally fluoridated water compared to non-fluoridated areas.[41,42,43,44,45]

Other sources of fluoride include: fluoridated water, milk and tea. Fluoride occurs naturally in water or added (water fluoridation). The optimal level of fluoride recommended in drinking water is 0.7 mg/l, however the concentration of fluoride in water varies by geographic area. Therefore, clear data is needed to demonstrate a careful selection of fluoride products to avoid the toxic effects of fluorides. Fluoride toothpaste is available in the form of low fluoride (500 ppm), standard fluoride (1100-1500 ppm) and high fluoride toothpaste (>1500 ppm). Fluoride is added in various forms of toothpaste and mouthwash such as sodium fluoride (NaF), mono-fluorophosphate (MFP), or stannous fluoride (SnF).[43,46,47,48,50]

Mouthwash has an advantage over toothpaste due to its low viscosity which results in better absorption into the most difficult to reach areas of the tooth such as the interproximal areas. The beneficial role of fluoride for the maintenance of good oral health has been recognized for decades and has been strongly substantiated by scientific research. However, it should be emphasized that tooth decay (dental caries) is not caused by fluoride deficiency and fluoride supplementation due to the low safety level of fluoride, products containing high levels of fluoride should be stored and used as directed and should be monitored by a professional dentist. [41,42,43,47]

In areas with high levels of fluoride in drinking water, materials for alternative treatments/prevention with low levels of fluoride should be prescribed and monitored. There is clinical evidence that varrnish fluoride is considered a safe and effective agent for the prevention of caries in children. Fluoride varnish is used at concentrations of 1% and 5% for the prevention of ECC, the anticaries effect of fluoride is due to its ability to protect hard tooth tissue and inhibit bacterial growth and metabolism. A complaint that is also frequently encountered is dentin hypersensitivity (DH), which occurs when exposed to exposed dentinal tubules due to gingival recession and/or loss of enamel (for example, through erosion or abrasion). The short, sharp characteristic of DH pain resulting from an external stimulus, such as temperature or osmotic pressure, causes fluid movement within the exposed dentinal tubules, which stimulates neural processes in the complex dentinpulp area (Figure 4). Some evidence shows that agents that can provide faster DH reduction, namely toothpaste containing SnF_2, can reduce DH. SnF_2 is known to relieve DH by closing the dentinal tubules through chemical deposition of oxides and hydroxides on the surface of the dentin. This precipitate has been shown to be relatively resistant to dissolution by acids in vitro. Stannous ions in neutral solutions tend to be oxidized to a stannic state and form hydroxide deposits. [40,43,44,45]

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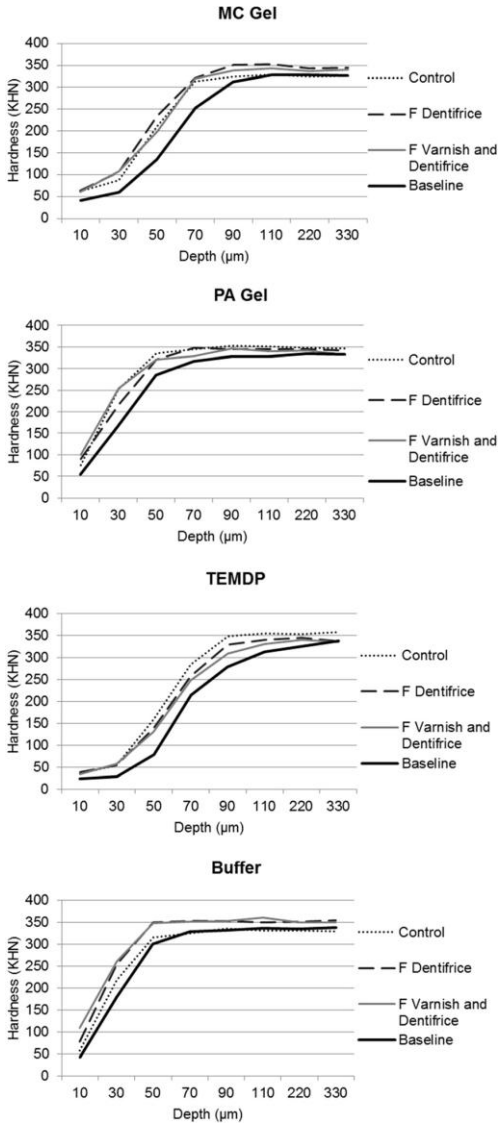

Figure 4. Hardness profile (lesion and final) for each type of lesion and remineralising protocol. Footnote: *Two-way repeated measures ANOVA followed by Bonferroni test ($p < 0.0001$ for lesion, $p < 0.0001$ for treatment, $p < 0.05$ for interaction between factors at 10, 90, 110, and 330 μm and $p > 0.05$ at 30, 50, 70, and 220 μm)
Source: (Salomão P M A, Comar L P, Buzalaf M A, Magalhães A C. In situ remineralisation response of different artificial caries-like enamel lesions to home-care and professional fluoride Treatments. BMC Oral Health. 2016; 16 (2): 6)[42]

The fluoride in saliva can absorb to the surface of the apatite crystals in the enamel in an acidic environment, which can inhibit the demineralization process. Fluoride is toxic to bacterial cells so that it can function as an antimicrobial. Fluoride application at 250-12,300 ppm has been shown to reduce the number of Streptococcus mutans in dental plaque significantly. The results of this systematic review also show that fluoride can reduce the risk of white spots on the surface of teeth. Noncavitated white spot lesions (WSLs) are an early sign of a dynamic physicochemical process and trigger a continuing demineralization process. The combination of good oral hygiene, diet control, and fluoride therapy is a widely recommended strategy for early caries prevention and recovery. The substitution of fluoride ion in hydroxyapatite strengthens the bonds and reduces

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the solubility of the enamel. Fluoride therapy for the treatment of WSL is the potential for hypermineralization of the surface layer in the presence of high concentrations of fluoride ions which prevent the penetration of calcium and phosphate ions into the lesion. Fluoride can increase the remineralization process when the oral environment is acidic, hydroxyapatite without a fluorine coating means that hydroxyapatite has a critical pH of 5.5, so if the pH of the oral cavity is below a critical pH it will trigger the demineralization process. The condition of the enamel acid environment will trigger the demineralization process, causing the hydroxiapatite component to dissolve, with the presence of fluoride in the oral fluid (saliva & biofilm), hydroxiapatite will react with fluorine to form fluorhydroxyapatite which has a critical pH of 4.5, thereby reducing demineralization of enamel. [31,42,45,47]

At low concentrations in drinking water, fluoride has a favorable effect on tooth development, but excessive exposure (greater than the WHO guideline value of 1.5 mg/l) can have a number of side effects. Health effects that can occur include mild dental fluorosis to bone fluorosis as the level and period of exposure increases. Dental fluorosis is a disorder of tooth enamel development, caused by the successive exposure to high levels of fluoride during tooth development. Although, WHO has set a guideline limit for fluoride of 1.5 mg/l in drinking water, more than 260 million people worldwide drink water from sources with high fluoride concentrations. Ingesting excessive amounts of fluoride can cause damage to various systems or organs of the body. The main clinical manifestations that often occur are dental fluorosis, bone fluorosis and other symptoms caused by excessive fluoride accumulation. [21,32,34,37]

Caries prevention evaluated the fluoride standard of the Environmental Protection Agency (EPA) and concluded that fluoride can negatively affect the brain both directly and indirectly. High concentrations of fluoride in drinking water are one of the factors of neurotoxic effects. Following the NRC review, evidence has accumulated that the developing human brain is inherently much more susceptible to injury from neurotoxic agents, such as fluoride, than the adult brain.[49,50,51,52]In studies using murine BV-2 microglial cells, it was shown that the toxic effect of fluoride on the nervous system could be partly attributed to microglial activation, which leads to increased synthesis of ROS and RNS (reactive nitrogen species) and results in oxidative stress. This was confirmed in a study by Saralakumari et al. demonstrated an association between chronic fluoride exposure and increased oxidative stress in humans. Chronic fluoride exposure mechanisms can also contribute to the pathogenesis of degenerative eye diseases including cataracts, AMD and glaucoma. Fluoride increases susceptibility to degenerative eye diseases through various biological pathways and interactions. F acts to inhibit the activity of enolase, crystallin, Hsp40, Na +, K + -ATPase, Nrf2, -GCS, HO-1 Bcl-2, FoxO1, SOD, PON-1 and GSH, and upregulates NF-_B, IL- 6, AGEs, HsP27 and Hsp70 expression. In addition, exposure to F leads to increased oxidative stress and impaired antioxidant activity.[53,54,55]

CONCLUSION

Fluoride is the gold standard agent in the prevention of dental caries in children, but irrational use of fluoride can cause some negative effects. Therefore it is recommended that you pay attention to several considerations in giving fluoride to children.

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