International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Caries Preventing by Topical Fluoride

Kanishka Awana[1], Dr. Puja Bansal[2], Dr. Deepak Bhargava[3]

[1]Intern, Department of Oral Pathology and Microbiology, School of Dental Sciences, Sharda University, Greater Noida, U. P, India

[2]Professor, Department of Oral Pathology and Microbiology, School of Dental Sciences, Sharda University, Greater Noida, U. P, India

[3]HOD and Professor, Department of Oral Pathology and Microbiology, School of Dental Sciences, Sharda University, Greater Noida, U. P, India

Abstract: ***The use of fluoride has been considered the most important among the non - invasive therapeutic and preventive management of caries, with its mechanism of action primarily topical by incorporating fluorapatite crystals in the tooth enamel, making it more resistant to acid dissolution. This article provides a review of the uses, mechanism of action, formulations along with the recent updates on applied topical fluorides and for prescription - strength home - use topical fluorides for caries prevention.***

Keyword: Fluoride, caries, decay, dental plaque, sodium fluoride

1. Introduction

By 1901, Frederick McKay had developed topical fluorides. He was a recent graduate from dental school. Fluoride - containing medications called topical fluorides are used to treat and prevent dental caries. (1)

The American Dental Association (ADA) Council on Scientific Affairs (CSA) published recommendations for the use of professionally applied topical fluorides for caries prevention in 2006. (2)

The incorporation of fluorapatite crystals into the tooth enamel increases its resistance to acid dissolution, and its use has been regarded as the most significant non - invasive therapeutic and preventive caries management strategy. The cornerstone of dental caries prevention is fluoride, which encourages the remineralization of early carious lesions (therapeutic effect) and inhibits demineralization of dental hard tissues (preventive effect). (3)

Types of fluorides application (4)

Self applied topical fluorides such as:
- Toothpaste
- Mouth rinses
- Gel

Professionally applied topical fluorides **such as:**
- Higher strength rinses
- Gels
- Foams
- Fluoride varnishes

Sodium fluoride, stannous fluoride, and silver diamine fluoride are a few typical active ingredients. These ingredients have various dosing regimens and therapeutic effects because they account for various pharmacokinetic profiles. (5)

Although topical fluoride is useful in preventing dental caries, it should only be used in certain circumstances to prevent unintended side effects. (6)

Self applied topical fluorides:
- *Fluoride Toothpaste*: The most widely used type of self - applied fluoride in the world is found in toothpaste. It's advised to brush your teeth with fluoride toothpaste twice a day, once in the morning and once before bed, for the majority of people (children, adolescents, and adults). (7)
- *Fluoride Mouth rinse or Gels:* Fluoride mouthwash is a concentrated solution that should be rinsed out after use and is recommended for daily or weekly use. Sodium fluoride is the fluoride compound that is most frequently found in mouthwash. Due to the possibility of fluorosis if the rinse is repeatedly swallowed, use in children under the age of 6 is not advised (8)

Professionally applied topical fluorides:
- *Fluoride Mouth rinse, Gels, or Foams*: Professionally applied fluorides are applied by a dental professional during dental visits and come in the form of a gel, foam, or rinse. These fluorides are less frequently required because they are more concentrated than the self - applied fluorides (e. g., 1.23% fluoride ion [12, 300 ppm]. (9)
- *Fluoride - Containing Prophylaxis Paste:* During dental prophylaxis, fluoridated paste is frequently applied. The fluoride concentration in the surface layer of enamel removed by polishing may be restored by the abrasive paste, which contains 4, 000 to 20, 000 ppm fluoride, but it is insufficient to replace fluoride gel or varnish in the treatment of people who are at high risk for dental caries (10)
- *Fluoride Varnish*: Both sodium fluoride (2.26% [22, 600 ppm] fluoride) and difluorsilane (0.1 [1, 000 ppm] fluoride] preparations are used in varnishes. Typically, 0.2 to 0.5 mL are needed for an application, yielding a total fluoride ion application of roughly 5 to 11 mg (11)

Indications of Topical Fluoride
- People who have previously experienced caries or who develop new carious lesions on smooth tooth surfaces. (12)

- Received radiation to the head and neck or taken medication to reduce salivation. (12)
- Kids, particularly those with untreated dental caries, right after the tooth - emerging period. (12)
- After the tooth roots have been exposed, patients who have eating disorders or are undergoing a lifestyle change that may affect eating or oral hygiene routines beneficial to good oral health should undergo periodontal surgery. (12)
- The most important case for the use of topical fluorides in water fluoridated areas is the case of children up to and including the age of sixteen in a region where water fluoridation has been in place for eight years or less. (13)

Uses in Dentistry of Topical Fluorides

- Topical fluoride formulations are effective measures for preventing and arresting the progression of dental caries, especially early childhood caries (ECC). (14)
- Existing teeth in the mouth are strengthened by topical fluorides, making them more resistant to decay. (15)
- Decreasing plaque bacterial growth also helps to remineralize enamel. (15)

Mechanism of action

Fluoride works primarily via topical mechanisms which include: (1) Inhibition of demineralization at the crystal surfaces inside the tooth, (2) Enhancement of remineralization at the crystal surfaces (the resulting remineralized layer is very resistant to acid attack) (3) Inhibition of bacterial enzymes. (16)

a) *Inhibition of demineralization at the crystal surfaces inside the tooth: -*

Due to fluoride's high affinity for metals, it has a significant propensity to react with the calcium hydroxyapatite Ca10 (PO4) 6 (OH) 2 in tooth enamel. The calcium fluorapatite Ca5 (PO4) 3) F is then precipitated when the hydroxide group in hydroxyapatite is replaced. For the purpose of remineralization, these fluorapatite precipitations remove extra phosphate and calcium from the saliva. (17)

b) *Enhancement of remineralization at the crystal surfaces (the resulting remineralized layer is very resistant to acid attack)*

Topical fluoride also acts as an antibacterial to lessen demineralization by preventing the development of bacteria that cause tooth eruption in dental plaque. Hydrogen fluoride is easily made when fluoride ions mix with hydrogen cations. The ensuing acidification of the bacterial cytoplasm by hydrogen fluoride renders crucial enzymes for bacterial metabolism, such as enolase and proton - releasing adenosine triphosphatase, inactive. (18)

Topical fluoride reduces pH levels, which means that bacteria must expend more energy to maintain a neutral environment. This leaves less energy for reproduction and more polysaccharide and acid synthesis. (18)

While these acids are important for the formation of bacterial enzymes such immunoglobulin a protease, these polysaccharides are required for adhesion to enamel. (18). By preventing microbial metabolism in the dental plaque, these procedures help to lower the risk of dental caries. (18)

c) *Inhibition of bacterial enzymes: -*

The resistance of enamel to acid can be increased by topical fluoride. Enamel bacteria, such as Streptococcus mutans, produce acids to keep the pH level low during fermentation. Once the acidity drops below the critical pH, these acids eventually cause the hydroxyapatite in teeth to dissociate (pH 5.5). Topical fluorides create fluorapatite, which has a lower critical pH (pH 4.5) than normal enamel. As a result, it is more acid resistant and unlikely to degrade even in an acidic environment. (19). This mechanism slows down the demineralization rate of teeth. (19)

Formulation of topical fluoride

Common active ingredients include sodium fluoride, Stannous fluoride, silver diamine fluoride.

1) *Sodium fluoride:* Sodium fluoride varnish is used to prevent caries development, arrest early enamel and even soft dentine caries through promotion of remineralization of carious tooth substance. It is also used to treat tooth hypersensitivity. (20)
2) *Stannous fluoride:* Stannous fluoride used at home for the remineralization of white spot and hypomineralization lesions of enamel (e. g. molar or incisor hypo mineralization). (21)
3) *Silver diamine fluoride:* Silver diamine fluoride use in the treatment of tooth sensitivity, which is the same type of clearance as fluoride varnish, and must be professionally applied. (22)
   a) 2.26% topical fluoride in fluoride varnish, 1.23% topical fluoride in fluoride (acidulated phosphate fluoride) gel, or a prescription - strength. (23)
   b) Homemade medication Topical fluoride in mouthwash, toothpaste, or gel at a concentration of 0.5% or 0.09%. (23)

2. Recommendations of Topical Fluorides

The following professionally applied or prescription - strength, home - use topical fluorides for caries prevention in patients at elevated risk:

1) For patients 6 years of age and older, 2.26% fluoride varnish, 1.23% fluoride (acidulated phosphate fluoride) gel, 0.5% fluoride gel or paste, or 0.09% fluoride mouthwash. (23)
2) . The maximum fluoride content that was advised for use on children under the age of 6 was 2.26%. (23)
   a) Children who are at a high risk of tooth decay and whose primary drinking water has a low fluoride concentration can be prescribed fluoride supplements. (23)
   b) The use of topical fluorides prescribed by a doctor for patients at high risk of developing caries, whether they are professionally applied or used at home. (24)
   c) In order to prevent caries, one should practise good oral hygiene, receive oral health education, receive dietary counselling, avoid prolonged milk or sweet liquid feedings, especially while sleeping, and use fluoride. (25)

References

[1] Crystal YO, Niederman R. Evidence based Dentistry Update on Silven Fluoride. Dental Clinics of North America.2019 jan, 63 (1): 45 - 68.
[2] American Dental Association Council on Scientific Affairs. Professionally applied topical fluoride: evidence - based clinical recommendations, J Am Dent Assoc.2006 Aug, 137 (8): 1151 - 9.
[3] Shwartz M, Gröndahl HG, Pliskin JS, Boffa J. A longitudinal analysis from bite - wing radiographs of the rate of progression of approximal carious lesions through human dental enamel.1984, 29 (7): 529 - 36.
[4] Department of Scientific Information. Evidence Synthesis & Translation Research, ADA Science & Research Institute, LLC. July 15, 2021.
[5] Nóbrega DF, Fernández CE, Del Bel Cury AA, Tenuta LM, Cury JA. Frequency of Fluoride Dentifrice Use and Caries Lesions Inhibition and Repai.50, March 2016, (2): 133 - 140.
[6] Johnston NR, Strobel SA. Principles of fluoride toxicity and the cellular response: a review. Archives of Toxicology.94, 2020 - 04 - 01, (4): 1051 - 1069.
[7] Centers for Disease and Prevention. Other Fluoride Products. U. S. Department of Health and Human Services.4, july 15, 2021., (130): 318 - 31.
[8] Recommendations for using fluoride to prevent and control dental caries in the United States. Centers for Disease Control and Prevention.2001 Aug 17, (50): 1 - 42.
[9] Centers for Disease and Prevention. Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States. August 17 2001, (50): 1 - 42.
[10] Recommendations for using fluoride to prevent and control dental caries in the United States. Centers for Disease Control and Prevention.2001 Aug 17, (50) 1 - 42.
[11] SM., Adair. Evidence - based use of fluoride in contemporary pediatric dental practice. Pediatr Dent.2006 mar - apr 28, (2): 133 - 42.
[12] MUTHU MS, SIVAKUMAR N. PEDIATRIC DENTISTRY - PRINCIPLES AND PRACTICE. january 2011.
[13] AH, Winters. Indications for the use of topical sodium fluoride in areas with water fluoridation.1960 Oct, 64 (1): 4 - 6, 20 - 1.
[14] Duangthip D, Chen KJ, Gao SS, Lo ECM, Chu CH. Managing Early Childhood Caries with Atraumatic Restorative Treatment and Topical Silver and Fluoride Agent.14, 2017 Oct 10, (10): 1204.
[15] WH, Atkinson. American Dental Association (ADA). http: //www.ada. org/. [Online] August 3, 1859. http: //www.ada. org/.
[16] JD, Featherstone. Prevention and reversal of dental caries: role of low level fluoride. Community Dent Oral Epidemiol.1999 Feb, 27 (1): 31 - 40.
[17] Farooq I, Bugshan A. The role of salivary contents and modern technologies in the remineralization of dental enamel: a narrative review.2020 Mar 9, (9) 171.
[18] Aoun A, Darwiche F, Al Hayek S, Doumit J. The Fluoride Debate: The Pros and Cons of Fluoridation. Preventive nutrition and food science.2018 Sep, (23) 171 - 180.
[19] Johnston NR, Strobel SA. Principles of fluoride toxicity and the cellular response: a review. Archives of Toxicology.2020, 94 (4) 1051–1069.
[20] Chu CH, Lo E. Uses of sodium fluoride varnish in dental practice. Annals of the Royal Australasian College of Dental Surgeons.2008 Jun, (19): 58 - 61.
[21] Blinkhorn A, Mekertichian K. Fluoride and dental health. Pediatric Dentistry.2013, 14th.
[22] Mei ML, Lo EC, Chu CH. Clinical Use of Silver Diamine Fluoride in Dental Treatment. Compendium of continuing education in dentistry.2016 Feb, 37 (2): 93 - 8.
[23] Department of Scientific Information. Evidence Synthesis & Translation Research, ADA Science & Research Institute, LLC. July 15, 2021.
[24] Weyant RJ, Tracy SL, Anselmo TT, Beltrán - Aguilar ED, Donly KJ, Frese WA, Hujoel PP, Iafolla T, Kohn W, Kumar J, Levy SM, Tinanoff N, Wright JT, Zero D, Aravamudhan K, Frantsve - Hawley J, Meyer DM. Topical fluoride for caries prevention: executive summary of the updated clinical recommendations and supporting systematic review. Journal of the American Dental Association (1939). dec 2013, (144), 1279 - 91.
[25] Manchanda S, Sardana D, Liu P, Lee GH, Li KY, Lo EC, Yiu CK. Topical fluoride to prevent early childhood caries: Systematic review with network meta - analysis.2022 Jan, 116.