Effect of Fluoride Varnish in Dental Caries: A Review

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Abstract

Dental caries remains amongst the most common oral health problem affecting people in the developing countries. The use of fluoride ions in the form of gels, foams, and varnishes are effective in preventing caries. The varnishes have been routinely used in the western European and Scandinavian countries in the last 30 years because of its ability to provide an increased contact time between enamel surface and fluoride, thus inhibiting demineralization of enamel. The technique of fluoride application, along with its advantages, disadvantages, indications, contraindications, and side effects have been discussed in this review.

Keywords: *Dental caries, Fluoride ions, Fluoride varnishes, Enamel, Oral health.*

Introduction

Oral health is a necessary and integral part of general health. Dental caries is by far the most important oral health problem affecting people of every age group and community.[1,2] The resultant pain and discomfort along with a heavy burden on finances impairs the quality of life of an individual.[3] According to Sturdevant, dental caries is defined as a multifactorial, microbial infectious disease characterized by demineralization of the inorganic and destruction of the organic substance of the tooth. Fluorine, derived from the Latin term fluore meaning to flow, is the most electro negative and reactive element of the halogen family. It combines chemically to exist as fluorides and represents about 0.06% to 0.09% of the earths crust, mostly in the form of minerals such as Fluorspar, Fluorapatite and Cryolite.[4,5]

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Advances in technology and research have enabled dentistry to shift from reparable art to preventive-oriented science. The emergence of fluorides has convincingly demonstrated a decline in caries prevalence.[6]

Mechanism of action of fluorides[7]: Simultaneous working of several mechanisms enable the fluorides to act against caries which have been briefly enumerated: Figure 1.

1. **Increased enamel resistance and reduction in solubility of enamel:** The fluoride acts on enamel and forms fluorapatite crystals which are less soluble and hence prevents dissolution of enamel in the following ways:
   - Reduces bacterial acid production and acidurance
   - Reduces equilibrium solubility of apatite
2. **Increased post-eruptive maturation rate of hypo mineralized areas:** The hypo mineralized areas of newly erupted teeth are prone to caries. Fluoride enhances the rate of post-eruptive maturation of these areas with the deposition of organic material from saliva.
3. **Remineralization of incipient lesions:** The deposition of minerals in a dynamic process over the previously damaged areas of the enamel reduces its solubility. This leads to a growth in the

crystals and becomes more resistant to caries. The remineralization occurs when fluorides combine with calcium and phosphate ions in the saliva. However, when too much fluoride combines with calcium phosphate, the formation of calcium fluoride takes place, which in turn prevents the growth of hydroxyapatite crystals.

4. **Interference with microorganisms:** At higher concentrations fluoride is bactericidal, whereas at lower concentrations fluoride is bacteriostatic. In an acidic environment, fluoride diffuses into the cells as hydrofluoric acid. This continues until the concentration in the external and internal compartment are equal.

5. **Modification in tooth morphology:** Ingestion of fluoride during tooth development results in a more caries resistant tooth with smaller diameters and cusp depths, thus enabling self-cleansing.

Fluoride delivery method

There are two method of delivery-topical and systemic.

1. **Topical fluorides:** These can be placed directly on the teeth with some preparations providing a low concentration of sustained fluoride release while others providing a higher concentration over a shorter span.[8]

The topical fluorides can further be divided into:

- Professionally applied products: These are dispensed by dental professionals in the dental office and uses a concentration between 5000 - 19000 ppm. These are available as gels, foams, and varnishes.
- Self-applied products: These are dispensed by the patient on the recommendation of a dental professional with the concentration range being 200 - 1000 ppm.

2. **Systemic fluorides:** These are allowed to circulate in the bloodstream and are given at a low concentration over a longer time span.[9]

Fluoride Varnishes: Fluoride is usually more effective when applied topically by professionals in the form of gels, foams, and varnishes. While using gels and foams, a high amount of fluoride is leached away in the first 24 hours and almost two-thirds are lost within days.[10-12] Thus, an increase in the contact time between enamel surface and topical fluoride agents became necessary to increase its efficacy.[13,14] This led to the incorporation of fluorides into a varnish-like coating by Schmidt in 1964. Varnishes were found to be a safe vehicle for exposing the enamel to fluoride for longer periods with deeper penetration into the enamel surface. Arends and Schutof using microradiography and micro-hardness tests have shown that a 24-hour exposure of enamel to fluoride varnishes can inhibit demineralization completely.[15] The prolonged retention of fluoride in the form of varnishes is because of a coating of pellicle proteins and secondary phosphates. During caries attack, a low pH results in the loss of pellicle coating, releasing calcium fluoride. The fluoride ions are absorbed onto the enamel surface to increase the rate of remineralization.[16-19] The various types of fluoride varnishes available today includes the following[20]:

i. **Duraphat:** Duraphat is a yellowish viscous material consisting of 22600 ppm sodium fluoride in a neutral colophonium base. The amount of caries reduction was found to be between 7% - 44% in deciduous and between 30 - 40% in the permanent dentition.

ii. **Fluorprotector:** Fluorprotector is a clear polyurethane-based product containing 7000 ppm fluoride in the organic compound Difluorosilane. It is dispensed in the form of 1 ml ampules, each containing 6.21 mg of fluoride. Its clinical efficiency has been established between 1% - 17%.

iii. **Carex:** The fluoride content of Carex is 1.8% with an efficacy similar to that of Duraphat as a caries-preventing agent.

The mean fluoride release from various fluoride varnishes have been demonstrated in **Figure 2**.

Technique of varnish application: When the varnish is freshly squeezed out of the tube, occasionally dark streaks may appear representing a separation of the ingredients inside and containing only a fraction of the required fluoride content. Thus, the freshly squeezed out varnish should be discarded. Alternatively, a rotary tube shaker can be used to obtain a uniform mix of the varnish.[12] While applying the varnish, teeth are dried post prophylaxis. Around 0.3- 0.5 ml of varnish is dispensed amounting to 6.9-11.5 mg of fluoride for full coverage of the dentition. The varnish is applied starting with the proximal surfaces, sequentially on the lower arch followed by the upper arch using a single tufted small brush. The patient is then asked to wait for 4 minutes with his mouth open before spitting to allow

the fluoride to set over the teeth. Finally, the patient is instructed not to rinse or drink anything till the first hour and not to eat anything solid till the next morning to prolong the interaction time between the fluoride and enamel.[21] **Figure 3.**

Some of the brands of fluoride varnish in regular use includes:

i. Colgate PreviDent varnish

ii. Embrace varnish

iii. Enamel Pro varnish

iv. Varnish 3M

Advantages, disadvantages, indications and contraindications and side-effects of fluoride varnishes[22-25]

Advantages:

- Easy to apply
- Have different flavours
- It has a sticky consistency which helps to stay in contact with tooth for several hours
- Dry rapidly
- Reduce the number of cariogenic bacteria s. mutans by over ten-fold
- It has a higher concentration than the foam and gel

Disadvantages:

i. They may cause a temporary change in the surface of teeth due to the color and adherence

ii. Varnish may damage by eating and brushing so the yellowish color fades

iii. Cost is more than gel

iv. Some patients can cause nausea due to the taste of varnish especially when consuming food within 24 hours post-treatment

Indications:

i. Fluoridated cavity varnish

ii. For high caries

iii. Remineralization of lesion in root dentin

iv. For orthodontic bands and brackets

v. On advanced enamel carious lesion

Contra-indications:

i. May cause discoloration in the area

ii. For open cavities area

iii. Low-risk caries

Side effects: The use of too much fluoride can cause fluorosis which gives white patches on teeth.

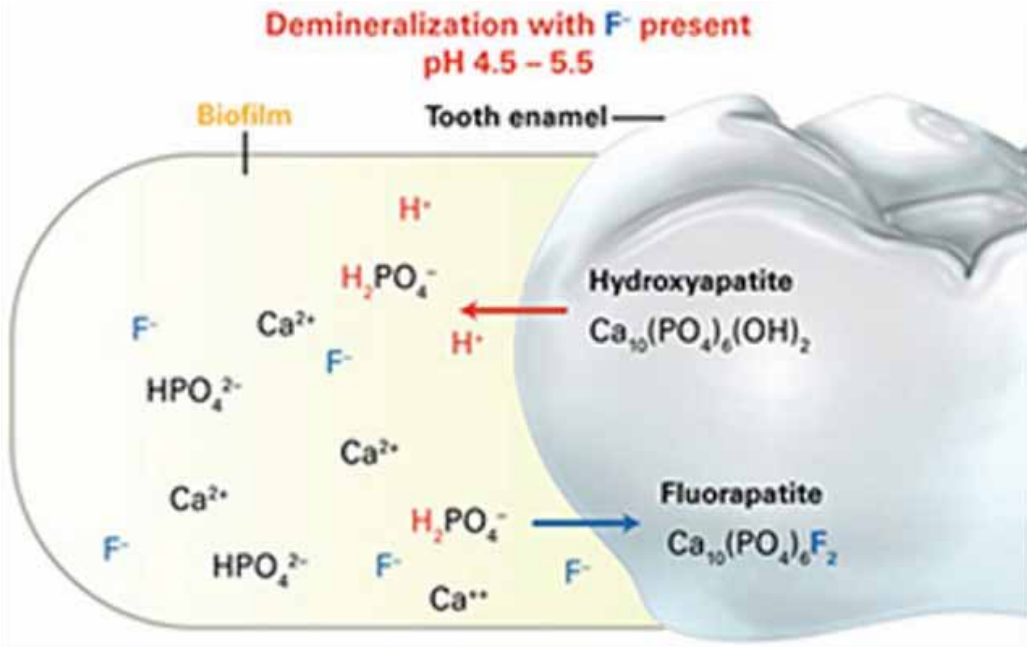

Figure 1: Mechanism of action of fluorides

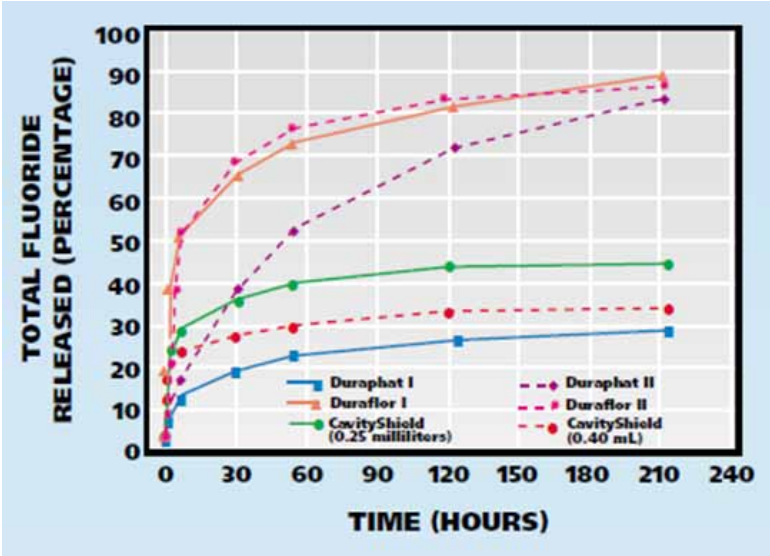

Figure 2: Graph showing mean fluoride release from various types of varnishes

Figure 3: Application of fluoride varnish helps remineralization and prevents caries

Conclusion

The fluoride varnishes have been routinely used as a standardized form of fluoride for professional applications in the Western European and Scandinavian countries for the last 30 years because of their well-documented effectiveness and safety. The shorter chairside time, easier application, better taste with increased acceptability, and cost-effectiveness make it more appropriate for using it in public health settings among children with high caries risk.

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Conflict of Interests: None

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