

**Preventive Dentistry**  
**5th Year- Dental Students**  
**Al- Isra'a University**  
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**Lec. 9: Professionally Applied Fluoride (*continue*):**

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**Sodium fluoride (NaF):**

These materials are available in form of powder, solution or gel. The concentration of fluoride is 2 %. When powder is used 0.2 gram dissolved in 10 ml distilled water. When the agent is added to outer enamel surface calcium fluoride is formed. The following reaction take place involves;



The  $\text{CaF}_2$  reacts with hydroxyapatite to form fluoridated hydroxyapatites thus increase the stability of crystals and resistance to acid attack, furthermore it will enhance the re-mineralization of initial caries.



These agents have a basic pH, chemically stable when stored in plastic or polythene containers. It should not be stored in a glass bottle as a fluoride ions will react the silica of the glass forming silicon di oxide reducing the free ionic fluoride necessary for caries reduction. A flavoring and sweetening agents however can be added. These materials are not irritant to the gingival, and do not cause discoloration to teeth.

Method of application: according to (**Knutson's technique**), NaF fluoride agents are added in a series of 4 – weeks at ages of 3, 7, 11 and 13 years. Coinciding the eruption time of permanent teeth and also for protection of primary teeth. The one disadvantage of this agent is that the patient need to visit dentist four time to accomplish this technique.

**Acidulated phosphate fluoride (APF):**

The success of any topical fluoridated agent depends on its capability of depositing fluoride ions in the enamel as fluoroapatite and not only calcium fluoride. Fluoroapatite crystals are stable not like calcium fluoride.



There are two ways of speeding to the reactions that lead to formation of fluoroapatite.

- 1- Increase concentration of fluoride ions in the agent.
- 2- Lowering the pH, that is making the solution more acidic.

Increase the concentration of fluoride ions lead to formation of calcium fluoride and phosphate, while the presence of acid leads to break down of the outer enamel surfaces (hydrolysis of hydroxyapatite and release of calcium and phosphate) thus formation of DCPD (dicalcium phosphate dehydrate)

**Reaction 1:**



**Reaction 2:**



In both reactions phosphate formed. The increase in phosphate concentration causes the shift in the equilibrium of the reaction to right side that is in the direction of formation of fluoroapatite as well as hydroxyapatite crystals. In another word, the increase in the concentration of fluoride ions and lowering the pH in presence of phosphate lead to increase deposition of ions in form of fluoroapatite crystals (ie increase fixation of fluoride ions in the enamel surface).

Acidulated phosphate (APF) is composed of NaF to which acid is added. The concentration of fluoride is 1.23%, the acid is in form of orthophosphoric acid the pH is 3.0.

*(Note: APF solution can be prepared by dissolving 20 gm of NaF in one liter of 0.1 M phosphoric acid this known as Brudevold's solution ).* APF comes in form of solution, gel and foam, to these coloring and flavoring agents added. It is chemically stable when stored in plastic containers, and does not cause discoloration to teeth. However it can - not be stored in glass containers as reducing the free F ions. Other dis advantage of APF, that the repeated exposure of teeth with porcelain and composite restoration to it may cause loss of material and surface roughening with cosmetic change because of its high acidity. The gel is more preferable than solutions as it increase the time of retention of the materials on the tooth surface. The gelling material is in the form of carboxy methyl cellulose or hydroxyethylcellulose. Another type of gelling material added known as

**thixotropic gel**, it is a gel like material (not a true gel) as under pressure it behaves like solution and flow between teeth, at the same time it became viscous by low pressure thus will not flow behind the tray to enter the patient throat.

### **Stannous fluoride (SnF<sub>2</sub>)**

It contains cation (stannous) and anion (fluoride), both react with enamel surface forming calcium fluoride, stannous fluoroapatite and hydrated tin oxide.



These complex agents increase resistance of enamel to acid dissolutions. Caries reduction by SnF<sub>2</sub> was reported to be greater than NaF.

Stannous fluoride used in form of solutions. It is available in powder that is prepared by dissolving appropriate weight in distilled water. For children the recommended concentration of stannous fluoride is **8%** (dissolve 0.8 mg in 10 ml of distilled water) **applied once a year (Muhler's technique)**. For adolescents and adults the recommended concentration is **10 %** (dissolve 1 mg of powder in 10 ml distilled water).

### ***Advantages of SnF<sub>2</sub>***

- 1- Effective in preventing caries, by rapid penetration of fluoride in deeper layer of enamel thus increase of the resistance of enamel against acid.
- 2- Highly insoluble tin- fluoro- phosphate complex act as a protective layer against acid attack
- 3- Re mineralization of initial carious lesion.
- 4- De sensitization of teeth.
- 5- Antibacterial, includes both specific antibacterial effect against cariogenic bacteria, and non- specific effect against other type of bacteria.
- 6- Has an additive effect by tin ions in addition to fluoride ions.

### ***Disadvantage***

- 1- Not stable in aqueous solution, it under goes rapid hydrolysis and oxidation to form stannous hydroxide and stannic ions. These may reduce the effectiveness of fluoride. Thus, stannous fluoride solution need to be freshly prepared.
- 2- Un pleasant taste with metallic astringent taste and highly acidic (pH 2.1- 2.3).

- 3- Reversible irritation to gingival, as gingival bleaching may occur. It is not recommended to be used in severe gingival inflammation.
- 4- Discoloration of hypo calcified area and staining of margin of restoration.

***Indication of use:***

- 1- Primary preventive programs (once or twice a year).
- 2- High risk group and rampant caries (every 3 or 6 months).
- 3- Initial caries (3 or 6 months)
- 4- Desensitizing agents (once a week then every 3 – 6 months)
- 5- Patients with xerostomia ( 3- 6 months).
- 6- Patients with hypoplasia or calcifications (as amelogenesis imperfecta or dentinogenesis imperfecta).
- 7- Root caries.

**Fluoridated varnishes**

These are slow release or semi-slow release agents. Prolonged exposure time and high fluoride concentrations result in the formation of a large calcium fluoride reservoir. Fluoride release continues for a long time, as for at least 8 hours or even for several weeks according to the type used. Studies showed that the use of fluoridated varnishes resulted in the most significant caries reduction among topical fluoride agents (30-70% caries reduction).

Types:

- 1- Duraphate:

It contains 5% NaF (2.26% F). It is viscous, resinous varnish. In contact with saliva, Duraphate hardens into a yellowish brown coating.

- 2- Fluor protector:

It is a polyurthan-based varnish contains 0.9% silane fluoride (0.1% F). The varnish is acidic and hardens in air into a colorless, transparent film within 2-3 minutes. The silane fluoride, is insoluble in water but reacts on contact with saliva, releasing small amounts of hydrogen fluoride that penetrates enamel more rapidly than other types of fluoride.

- 3- Bifluoride 12:

Is a clear varnish containing 6% NaF and 6% CaF<sub>2</sub>, The varnish base consists of collodion and organic solvents.

***Indication of use:***

- high risk group (to be applied 2-4 times / year).

- Initial caries even for children under 6 years of age as can be applied on the affected surface only.
- Highly indicated for sensitive teeth.
- Root caries.

Varnishes should **not** be applied in presence of sever gingival bleeding to prevent the development contact energy with the components of the varnishes.

### **Fluoride containing prophylactic paste**

Before applications of fluoride agents, it recommends to clean teeth and restoration by polishing with a rubber cup using pumice, in order to remove all exogenous deposit. Different types are available as Zirconium silicate contains stannous fluoride; Silicon dioxide contains acidulated phosphate fluoride. This paste is not a substitute for the topical agents; they are used in order to increase the accessibility for fluoride ions by tooth surface. Thorough prophylaxis will remove a thin layer of enamel (1 – 4  $\mu\text{m}$ ), thus it is always recommend using F pumice.

### **Fluoride and restorative material:**

Different restorative material may contain fluoride to be released slowly to prevent recurrent caries as glass ionomer cement, resin modified glass ionomer cement, resin composite, amalgam. Fluoride may be added also to fissure sealants.

### **Fluoride release devices:**

Devices allow for a slow release of F ions, as glass beads, copolymer membrane type and others. Indicated for patients with high risk group and those wearing orthodontic appliance. Not to be given for a child receiving fluoride supplements.