Self – applied fluoride
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Fluoridated dentifrices

The first clinical trial of fluoridated dentifrices initiated by Bibby 1942, the active agent was sodium fluoride, and the abrasive was dicalcium phosphate (DCP).

The general functions of these dentifrices are:
1- Physico – mechanical function; that is by the action of the abrasive materials and the toothbrush.
2- Chemical function; that is by the reaction of fluoride with the outer enamel surface and the antimicrobial effect.

Types of fluoridated agents in dentifrices include;
- Sodium fluoride (NaF).
- Stannous fluoride (SnF₂)
- Sodium monofluorophosphate (MPF)
- Amine fluoride
- Combination of NaF and MPF

The range of fluoride concentrations in these agents is 525 – 1450 ppm. The content of fluoride in dentifrices will decrease with the increase in the time of storage i.e six months or more. The type of fluoride agent used must be compatible with the constituents of the tooth paste especially the abrasive systems.

Types of abrasive;
- Ca- pyrophosphate
- Na- metaphosphate
- Silica
- Others

Following brushing there will be retention of fluoride in the oral fluid and dental plaque. Fluoride ions released gradually in the saliva and there by maintains a degree of protections against caries. The increase in the frequency of brushing will increase the benefits of fluoride. Studies recorded caries reduction by using fluoridated dentifrices about 25 – 30%.
Guideline followed in the use of fluoridated dentifrices:

1- Children under five years:
A brush full of 1000-ppm paste may contain (1 mg F ions). Child may swallow pastes accidentally, at this age the child cannot control muscles of swallowing. Thus brushing twice a day with 1000 ppm fluoridated paste the child may swallow 0.5 mg F/day. The child may be at risk to be affected by dental fluorosis, especially in fluoridated area or taking fluoride supplements.
Recommendations:
- Small pea sized amount of tooth paste used.
- Brushing under supervision.
- Use a paste with no or a low concentration of fluoride.

2- Children above 5 – years and adults
For children, in fluoridated and non-fluoridated area a high concentration of fluoride can be used.

**Fluoridated mouth rinses**
It was started in the early 60's of the last century. It can be used in the following conditions:
- Primary preventive programs for children and adults
- In subjects with high risk to dental caries.
- Patients with rampant caries.
- Patients with hyposalivations or xerostomia.
- Patients with sensitive teeth due to tooth wear as (abrasion, attrition, erosion) or because of exposed root.
- Patients with periodontitis and root caries.
- Patients with orthodontic appliance.

Types of agents used:
1- Sodium fluoride, it is the main type used in neutral or acidified forms in a water vehicle.
   Concentrations 0.2% (900 ppm F) applied once a week.
   0.05% (225 ppm) applied daily.
2- Stannous fluoride Concentration 100, 200, 300 ppm.
3- Amine fluoride or ammonium fluoride.

A 10 ml of rinse used by forcefully swishing of liquid around the mouth for one minute then expectorate.
Fluoridated mouth rinse should not be given
1- To children under six years of age, as they cannot control muscles of swallowing.
2- Children living in fluoridated area or receiving fluoride supplements. Studies reported a caries reduction about 30%. Note: Fluoridated mouth rinses should **not** substitute fluoridated dentifrices, rinses is usually supplement toothpaste.

**Fluoridated Gel**

It is used in home programs. Types of agents:
- Sodium fluoride or acidulated phosphate fluoride (concentration 5000 ppm).
- Stannous fluoride (0.4%).

These can be applied using special tray or applied directly to teeth by toothbrush. Applied for 1-5 minutes, then expectorate. Patients advised not to rinse by water or eat or drink for at least 30 minutes. Indications for use:
- Patients with rampant caries.
- Patients with xerostomia.
- Patients with sensitive teeth due to tooth wear as (abrasion, attrition, erosion) or because of exposed root.
- Root caries.

It can be used for four weeks course, when the onset of the disease is stopped the patient can switch back to mouth rinse.

Fluoridated gel is not recommended for children under 6-years of age.

**Professionally applied fluoride.**

Medicaments typically dispensed by dental professional in the dental office to prevent or arrest dental caries. Materials applied are in forms of solutions, gel, foam, varnishes or pumices. Different agents are available as:
- Sodium fluoride
- Stannous fluoride
- Potassium fluoride
- Zirconium fluoride
- Titanium fluoride
- Others.

The concentration range of fluoride in these agents is 9000 – 22000 ppm. Method of application:

Techniques followed for application of fluoride in the dental office are:
- **Paint on technique**, by which fluoride material applied to teeth by cotton applicator of brush.
- **Tray technique**: a small amount of fluoride is added to a tray then inserted in the patient mouth. Trays come in different shapes and types as foam lined or paper, custom vinyl etc.

For both techniques:
- Teeth are cleaned first (scaling and polishing) to remove dental plaque, calculus, stain and debris. These may interfere with the uptake of fluoride ions and reduce its effectiveness.
- Teeth are isolated using cotton roll and saliva ejector. The head of the patient tilted forward to avoid accidental swallowing of the materials.
- The fluoridated agent applied following dryness of teeth for 1 – 4 minutes. The amount of agent used must not exceed 4 ml to prevent acute toxicity.
- Use un waxed dental floss to push the material between teeth.
- Following treatment ask the patient to expectorate several times.
- Instruct the patient not eat or drink for at least 30 minutes.

**Indications**
In general materials indicated to be use in;
- Prevention of dental caries
- Rampant caries.
- Sensitive teeth and root caries

**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.
These agents have a basic pH, chemically stable when stored in plastic or polythene containers, a flavoring and sweetening agents can be added.
These materials are not irritant to the gingival, and do not cause discoloration to teeth.

**Acidulated phosphate fluoride**
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.

\[
\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2 + 2 \text{F} \rightarrow \text{Ca}_{10}(\text{PO}_4)_6\text{F}_2 + 2 \text{OH}
\]
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)

Reaction 1:

\[
\text{Ca}_{10} \text{(PO}_4\text{)}_6 \text{(OH)}_2 + 20 \text{F} \rightarrow 10\text{CaF}_2 + 6\text{(PO}_4\text{)}^{-3} + 2\text{(OH)}.
\]

Reaction 2:

\[
\text{Ca}_{10} \text{(PO}_4\text{)}_6 \text{(OH)}_2 \text{Acid} \rightarrow \text{CaHPO}_4 + 4\text{Ca}^{+2} + 2\text{H}_2\text{O}
\]

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 3.2.

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.

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. Another type of gelling material added known as thixotropic gel, it is a gel like material under pressure 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\textsubscript{2})**

It contains cation (stannous) and anion (fluoride), both react with enamel surface forming calcium fluoride, stannous fluoroapatite and hydrated tin oxide.
Ca_{10}(PO_4)_6(OH)_2 + 19 SnF_2 \rightarrow 10 CaF_2 + 6Sn_3F_3PO_4 + SnO.H_2O

These complex agents increase resistance of enamel to acid dissolutions. 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). For adolescents and adults the recommended concentration is 10 % (dissolve 1 mg of powder in 10 ml distilled water).

Advantages of SnF_2

1- Effective in preventing dental caries, by the increase of the resistance of enamel against acid.
2- Re mineralization of initial carious lesion.
3- De sensitization of teeth.
4- Antibacterial, includes both specific antibacterial effect against cariogenic bacteria, and non specific effect against other type of bacteria.
5- 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, it has metallic astringent taste.
3- Reversible irritation to gingival, as gingival bleaching may occur. It is not recommended to be used in sever gingival inflammation.

Indication of use

1- Primary preventive programs (once or twice a year).
2- High risk group and rampantcaries (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 dentionogenesis imperfecta).
7- Root caries.