Professionally applied fluorides

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Fluoride agents have been applied by dental personal since 1940.Most topical fluoride agents have a fluoride ion concentration of between 10,000–20,000 ppm which leads to the formation of calcium fluoride and eventually Fluor hydroxyapatite. It was seen that when fluoride was applied to teeth, it gets deposited in the outer enamel, making it more resistant to dissolution by acids.

Topical fluoride applications are indicated for:

1. Patients with active smooth surface caries and those patients in high caries risk groups.
2. Patients who are at high risk for caries on root surfaces
3. To reduce tooth sensitivity
4. White spots lesion.
5. Active decay
6. Special patient groups, such as:

– Orthodontic patients

– Patients undergoing head and neck irradiation

– Patients with decreased salivary flow

7. Children whose permanent molars should, but cannot be sealed.
8. Additional protection if necessary for children in areas without fluoridated drinking water.

Type of Fluorides Applied by Dentist/ professionally applied include:

A. Aqueous Solutions

Sodium Fluoride [Knutson's Technique]:

Available in both powder and liquid form. ***Neutral pH, 9,200 ppm of available fluoride, 29% effective in caries reduction. The recommended and approved concentration is 2 %.***

Method of preparation:

Dissolving 0.2 gm of powder in 10 ml [20 gm in 1 liter] of distilled water → 2% NaF solution.

Advantages:

1. Taste is acceptable.

2. It is stable if stored in plastic bottle.

3. Non-irritating to gingiva .

4. Does not cause discoloration of tooth structures.

Disadvantage:

1. Patient had to make four visits in relatively short period of time.

2. If stored in glass bottle, the fluoride ion of prepared solution can react with silica of glass forming SiF2 [silicon fluoride], thus reducing the availability of free active fluoride. Hence reducing its anti caries action

Recommended ages: **It is recommended that a series of 4- weekly applications of 2 % NaF be given at ages 3,7,11 and 13, coinciding with the eruption of different groups of primary and permanent teeth.**

Method of application

1. Cleaning and polishing of teeth is done.
2. Teeth are isolated with cotton rolls and dried with compressed air.
3. Teeth can be selected quadrant wise.
4. 2 % aqueous NaF solution is applied with cotton applicator for 4 minutes.
5. Procedure is repeated for remaining quadrants until all of the teeth are treated.
6. Second, third and fourth applications are recommended at intervals of approximately 1 week and they are preceded by cleaning and polishing.
7. Patient is advised to avoid rinsing, drinking and eating for next half hour.

Mechanism of Action of Sodium Fluoride

When sodium fluoride solution is applied on the tooth surface it reacts with hydroxyl apatite crystals rapidly to form calcium fluoride (CaF2). The calcium fluoride forms a layer on the tooth surface blocking further entry of fluoride ions. This sudden stop of the entry of fluoride is termed as "Chocking off effect". Fluoride then slowly leaches from the calcium fluoride. Thus calcium fluoride acts as a reservoir for fluoride release and that is the reason why sodium fluoride is kept untouched on the tooth for 4 minutes.

The calcium fluoride reacts with hydroxyl apatite to form fluoridated hydroxy apatite. This increases the concentration of surface fluoride, making the tooth structure more stable, and surface more resistant to caries attack. It also helps in remineralization of the initial decalcified areas.

The chemical reaction involved is:

$$Ca10\,[PO4]6[OH]2 + 20\,F- \leftrightarrow 10CaF2 + 6PO4-- + 2OH-$$

$$CaF2 + 2Ca5\,[PO4]3\,OH \rightarrow 2Ca5\,[PO4]3F + Ca\,(OH)2$$

2.Stannous Fluoride- [Muhler's Technique]:

Available in powder form either in bulk containers or pre-weighed capsules., ***19,500 ppm of available fluoride and 32% effective in caries reduction. The recommended and approved concentration is 8 %.***

Method of Preparation

The solution has to be **freshly prepared** as they are not stable. It can be prepared by dissolving 0.8 gm of powder in 10 ml of distilled water. The solution is acidic, with a pH of about 2.4– 2.8.

Method of Application

1. Cleaning and polishing of teeth is done.
2. Teeth are isolated with cotton rolls and dried with compressed air.
3. Freshly prepared SnF2 solution is applied using cotton applicator. Care should be taken that all teeth surfaces are treated.
4. Repeated loading of cotton applicator should be done and swabbing is continuously done so as to keep tooth surface moist for 4 minutes.
5. Patient is allowed to expectorate after cotton rolls are removed.

Recommended Schedule

A six monthly interval treatment schedule is advised

Mechanism of Action

Stannous fluoride reacts with hydroxy apatite and in addition to fluoride the Tin of solution also reacts with enamel and forms

Stannous tri-fluorophosphate, which is more resistant to carious

attack.

Chemical reaction *at low concentration* is:

$$Ca5[PO4]3OH + 2SnF2 \rightarrow \underline{2CaF2} + Sn2[OH]PO4 + Ca3[PO4]2$$

At High concentration:

$$Ca5[PO4]3OH + 16SnF2 \rightarrow CaF2 + \underline{2Sn3F3PO4} + Sn2[OH]PO4$$

[Tin Trifluorophosphate] [Tin hydroxyl phosphate]

$$+ 4CaF2[SnF3]2$$

[Calcium trifluorostannate]

Tin hydroxy phosphate gets dissolved in oral fluids and is responsible for the metallic taste.

Tin trifluorophosphate which is the main end product is responsible for making the tooth structure more stable and less susceptible to decay.

Advantage

Recommended frequency is 6–12 months interval much less than as in case of sodium fluoride**.**

Disadvantages

1. Solution has to be freshly prepared each time before use.
2. A bitter metallic taste.
3. Can cause gingival irritation.
4. It causes brown pigmentation of teeth particularly in hypocalcified areas and around margins of restorations.
5. It is highly acidic in nature (pH 2.1-2.3).

B. Fluoride Gels

Fluoride gels and foams contain a high concentration of fluoride, typically up to 12.3 mg fluoride.

1. Acidulated Phosphate Fluoride *(Brudevolds Solution)*: This is available as either as a solution or gel. *Both are stable(1.23 percent). 12,300 ppm of available fluoride, 3.0 pH, 28% effective in caries reduction.*

Method of Preparation

1. Solution*:* It is prepared by dissolving 20 gms of sodium fluoride

in 1 liter of 0.1 M phosphoric acid. To this is added 50 % hydrofluoric acid to maintain a pH of 3.0 and fluoride ion concentration at 1.23 %.

2. Gel*:* for preparation of gel [APF], a gelling agent methylcellulose

or hydroxyethyl cellulose is added to the solution and the pH is adjusted 4-5.

3. **Another form of APF Thixotropic gels** is available.

Thixotropic denotes a solution that sets in a gel like state but is not a true gel. Upon the application if pressure, thixotropic gels behave like solutions.

Recommended Frequency

Recommended frequency of APF application is twice a year topically.

Procedure for the Application of Fluoride Solution

a. Oral prophylaxis is done.

b. Teeth are isolated with cotton rolls and dried with compressed air.

c. Fluoride solution is then applied continuously with cotton applicator so as to keep teeth moist with fluoride solution for 4 minutes.

d. After all the teeth are treated patient is asked to expectorate and instructed not to rinse, drink or eat for next half hour.

Procedure for the Application of Fluoride Gel

a. Mouth trays should be tried in the patient's mouth. It may be necessary to adapt or trim trays.

b. Patient should be seated upright and suction should be used during the procedure.

c. Teeth should be air-dried before gel application. For caries prevention, cleaning or prophylaxis is prior to APF.

d. Enough gel, or foam, should be used to completely cover the teeth, but should be no more than 2–2.5 grams per tray or 40 % of the tray's volume.

e. Upper and lower trays should be inserted separately.

f. Fluoride should be applied for 4 minutes, not 1 minute.

g. Patient should expectorate for 1–2 minutes after tray removal.

h. Patient should not rinse, eat, or drink for at least 30 minutes

after the procedure.

Clinical application: The frequency of gel application varies based on the caries risk level of the patient, and is usually provided at least every 6 months.

Mechanism of Action

APF when applied on teeth initially leads to dehydration and shrinkage in the volume of hydroxyapatite crystals. There is further hydrolysis and formation of dicalcium phosphate dehydrate [DCPD], which is highly reactive. The fluoride ions start penetrating into the deeper crystalline structure of enamel and forms fluorapatite which is stronger to acid dissolution.

Advantages

1. It is stable when stored in a plastic container.
2. No staining of teeth.
3. Gels can self applied.

Disadvantages

1. Cannot be stored in glass container because it may remove minerals from the glass [etch].
2. Repeated exposure of porcelain or composite restorations to APF can lead to loss of material leading to surface roughening and cosmetic changes hence not advisable to use acidic topical fluoride agent in patients with these type of restorations.
3. It has an acidic taste.
4. Repeated application necessitates the use of suction, limiting its use in field programs.

Guidelines for the Application of Topical Gels

These are designed to minimize the amount of fluoride that may be swallowed.

1. Limit the amount of gel placed in each commercially available disposable mouth tray to no more than 2 ml or 40 % of the tray capacity.
2. Sit the patient in an upright position with the head inclined forward.
3. Use suction throughout the gel application procedure.
4. Instruct the patient to expectorate, or use a saliva ejector for 30 seconds after the gel application

C. Fluoride Varnishes:

A fluoride varnish is a professionally applied adherent material. They permit the application of high fluoride concentrations in small amounts of material. These products are much more concentrated than gels,with typical concentrations of 22,600 ppm fluoride (in NaF varnishes) .

Advantages:

1. The use of fluoride varnish increases the fluoride concentration in saliva, which remains significantly higher 2 hours after its application than after the use of other fluoride agents.

2. Simple application and requires minimal training.

3. Prolonged contact time between fluoride and the tooth surfaces (increases fluoride uptake by dental hard tissues, as well as the formation of CaF_2 reservoirs), and the possibility of using very small amounts of the product (a thin layer), which minimizes the risk of excessive fluoride ingestion.

Duraphat [NaF]:

It was first fluoride varnish to be tested. It contains 2.26 % NaF or 22.6 mgF/ml. It is a viscous, resinous which should be applied to dry, clean tooth. Duraphat hardens into a yellowish brown coating in the presence of saliva. The efficacy of Duraphat between 30 to 45 %.

Mechanism of Action

When varnish is painted on the tooth surface, it acts as a fluoride depot from which fluoride ions are continuously released. These ions react with hydroxyapatite over a longer period of time as varnish is not quickly washed away by saliva. This leads to deeper penetration and significant anticaries effect.

Method of Varnish Application

1. Oral prophylaxis is done.

2. Teeth are dried and but not isolated with cotton rolls as varnish sticks to cotton.

3. First lower arch is taken up for application and then upper arch as saliva collects rapidly on the lower arch.

4. Dispense a small amount of varnish (0.3 ml to 0.5 ml, or 2 drops, for the entire primary dentition) to the applicator dish or pad.

5. Application is done with single tufted brush starting with proximal surfaces (Dental floss can be used to ensure thatthe varnish reaches interproximal areas). 6. Since varnish sets rapidly when they come in contact with

saliva, no drying is necessary.

7. After application, patient is made to sit with mouth open for 4 minutes.

Recommended Dosage

- ✓ Fluoride varnish has a high fluoride concentration, but its safety is acceptable. Varnish is fast setting, fluoride is slowly released, and a small amount is needed for the complete dentition. Measurements of fluoride after topical treatments with varnish. show levels far below those considered toxic.
- ✓ Consequently, varnishes may be a better alternative to fluoride gels, especially for young children.
- ✓ The only disadvantage of sodium fluoride varnishes is that they cause a temporary change in tooth color, which dental professionals need to inform their patients of.

Indications:

Fluoride varnishes are used for:

- **Disabled children**
- **Incipient caries lesion**
- **After restorative treatment is complete under general anesthesia**
- **Very young children who cannot expectorate the gel. Fluoride varnishes are safe because the amount of varnish usually used is 0.3-0.5 ml which delivers only 3-6 mg of fluoride.**

Note: Patient is advised not to eat or brush for at least 4 hrs. after varnish application.

D.Fluoride Prophylactic Paste

The major functions of prophylactic paste are:

1. To clean the tooth surface through the removal of all exogenous deposits.

2. Polish the dental hard tissues, including restorations.

Prophylactic paste contains abrasive particles which abrade the deposits and debris from tooth surface.

E. Restorative Materials Containing Fluoride

The purpose of adding fluoride to restorative material is to capture its anticariogenic property. A major reason for the failure

of restorations is recurrent or secondary caries, incorporation of fluoride

into restorations may be beneficial because of the observed cariostatic action of fluoride.

The fluoride ions are slowly released from the materials. Fluoride has also been added to amalgam in an attempt to reduce the risk of recurrent caries at restoration margins.

Fluoride containing restorative materials includes glass ionomer

cements, resin modified glass ionomer cements, polyacid modified resin composites (compomers), resin composites, fissure sealants and dental amalgam.

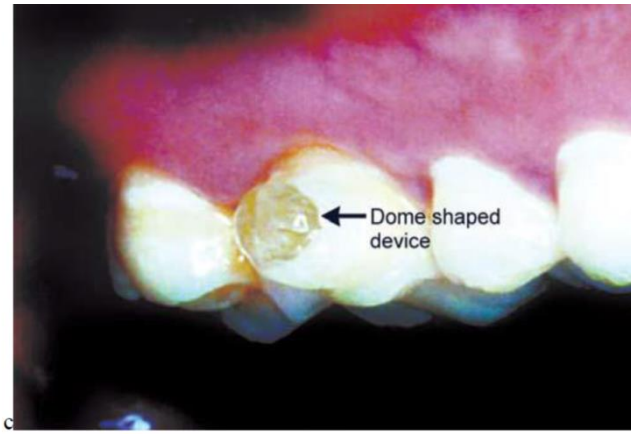
Fluoride releasing components have included fluoroaluminosilicate glasses (FAG), stannous fluoride (SnF2), organic amine fluorides (CAFH) and ytterbium fluoride (YbF).

F. Fluoride Containing Devices (Slow Release):

As the current scientific consensus regards a constant supply of low levels of fluoride, especially at the biofilm/ saliva/dental interface, as being of the most benefit in preventing dental caries, it is reasonable to expect a positive effect on caries prevalence of a treatment able to raise intraoral F concentrations at constant rates, without relying on patient compliance.

Considering that intraoral levels of F play a key role in the dynamics of dental caries, it has been suggested that the use of controlled and sustained delivery systems can be considered as a mean of controlling dental caries incidence in high-risk individuals.

There are three types of slow-release F devices:



Glass Device fluoride **Slow Release**(dome shape)

the copolymer membrane type, developed in the United States,

and the glass bead, developed in the United Kingdom.

More recently, a third type, which consists in a mixture of sodium fluoride (NaF) and hydroxyapatite.


Thank You !