PREVENTIVE DENTISTRY

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Professionally applied fluorides

Dental personnel have been applying fluoride agents on teeth since 1940. 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. Although it is now known that frequency and availability of low concentration of fluoride is more important in caries prevention, but studies have shown to support the beneficial effect of infrequent professional application of agents for prevention of dental caries.

Indications for use of professionally applied topical fluorides

• Patients who are at high risk for caries on smooth tooth surfaces

• Patients who are at high risk for caries on root surfaces

• To reduce tooth sensitivity

• White spot lesions

• Caries active individuals

• Special patient groups, such as:

- Orthodontic patients

- Patients undergoing head and neck irradiation

- Patients with decreased salivary flow

• Children whose permanent molars should, but cannot be sealed

• Additional protection if necessary for children in areas without fluoridated drinking water

• Children shortly after periods of tooth eruption

• Patients after periodontal surgery, when roots are exposed

• Individuals with eating disorder

• Mentally and physically challenged individuals.

They may be in the form of sodium fluoride, stannous fluoride or APF.

A. Aqueous Solutions

Sodium Fluoride:

2% NaF is used

• Neutral pH

• 9,200 ppm of available fluoride

• 30% effective in caries reduction

(Knutson's Technique)

Method of preparation: It can be prepared by dissolving 0.2 gm of powder in 10 ml (20 gm in 1 liter) of distilled water. The prepared solution has a basic pH and is stable if stored in plastic bottle. If stored in glass bottle, the fluoride ion of prepared solution can react with silica of glass forming SiF_2 (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 percent NaF be given at ages 3,7,11 and 13, coinciding with the eruption of different groups of primary and permanent teeth.

Mechanism of Action of Sodium Fluoride

When sodium fluoride is applied on the tooth surface there is rapid influx of fluoride leading to the formation of calcium fluoride. 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 a s a reservoir for fluoride release and that is the reason why sodium fluoride is kept untouched on the tooth for 4 minutes.

The chemical reaction involved is:

$Ca_{10}(P0_4)_6(0H)_2 + 20\ F^- \longleftrightarrow 10CaF_2 + 6P0_4^- + 20H^-$

$CaF_2 + 2Ca_5(P0_4)_3\ OH \longrightarrow 2Ca_5(PO_4)_3F + Ca(OH)_2$

Advantages

1. Relatively stable when stored in plastic containers.

2. Taste is acceptable.

3. Non-irritating to gingiva and does not cause discoloration of tooth structures.

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

Stannous Fluoride

• 8% SnF2 is used

• 2.4-2.8 pH

• 19,500 ppm of available fluoride

(Muhler's Technique)

Available in powder form either in bulk containers or pre-weighed capsules. 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 2.8. the left over solution should be discarded after application.

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 form Stannous tri-fluorophosphate, which is more resistant to carious attack.

Chemical reaction *at low concentration* is:

$Ca_5(P0_4)_30H + 2SnF_2 \longrightarrow 2CaF_2 + Sn_2(OH)P0_4 + Ca_3(PO_4)$

At High concentration:

$Ca_5(P0_4)_30H + 16SnF_2 \longrightarrow CaF_2 + 2Sn_3F_3P0_4$

(Tin tri-fluorophosphate)

$+ Sn_2(OH)PO_4$

(Tin hydroxyl phosphate)

$+ 4CaF_2(SnF_3)_2$

(Calcium trifluorostannate)

Tin hydroxy phosphate gets dissolved in oral fluids and is responsible for the metallic taste. Tin tri-fluorophosphate which is the main end product is responsible for making the tooth structure more stable and less susceptible to decay.

Calcium fluoride (CaF_2) so formed further reacts with hydroxyapatite and some fluorhydroxyapatite also gets formed. SnF2 has produced significantly greater caries reduction (59%) than sodium fluoride (30%).

Advantages

1. Rapid penetration of fluoride to the deeper layer of enamel.

2. Highly insoluble tin tri-fluorophosphates complex form on the enamel surface that acts as a protective layer for the enamel decay.

Disadvantages

1. Unstable in aqueous solution and undergoes rapid oxidation so should be prepared fresh for each patient.

2. It is highly acidic in nature (pH 2.1-2.3)

3. It has metallic taste which is unacceptable to most of the children and patient.

4. It may cause gingival irritation particularly to dehydrated and diseased gingival tissues.

5. SnF2 produces discoloration of hypocalcified area of teeth.

6. It produces staining on the margins of the restorations

B. Fluoride Gels

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

Acidulated Phosphate Fluoride

1.23% is used

• 12,300 ppm of available fluoride

• 3.0 pH

• 28% effective in caries reduction

(Brudevolds Solution)

This is available as either as a solution or gel. Both are stable .

Method of Preparation

Solution: It is prepared by dissolving 20 gm of sodium fluoride in 1 liter of 0.1 M phosphoric acid. To this is added 50 percent hydrofluoric acid to maintain a pH of 3.0 and fluoride ion concentration at 1.23 percent.

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.

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 of APF application is twice a year topically

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,and have long shelf life.

2. No staining of teeth.

3. Gels can self applied.

4. Cheap

5. Viscosity makes it possible to treat an entire arch at the same time, which reduces both the time of application and the risk of excessive ingestion of fluoride.

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.

Procedure for the Application of Solution

a. Oral prophylaxis to done.

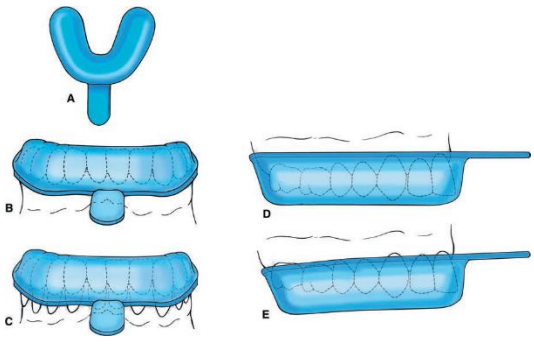
b. Teeth are isolated with cotton rolls and dried with compressed air.

c. Fluoride solution 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 to 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 unnecessary 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 percent of the tray's volume.

e. Fluoride should be applied for 4 minutes.

f. Patient should expectorate for 1-2 minutes after tray removal.

g. Patient should not rinse, eat, or drink for at least 30 minutes after the procedure

For patients with porcelain or resin restorations, neutral sodium fluoride is recommended to prevent etching of restorations.

FluorideVarnishes

Fluoridated varnishes were introduced into the market in the 1960s, and are intended for professional application only. The main advantages of varnishes are the 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. These products are much more concentrated than gels,with typical concentrations of 22,600 ppm fluoride (in NaF varnishes) 7,000 ppm fluoride (in difluorosilane varnishes) .

Duraphat are the most used and studied products. In order to achieve the maximum benefits for caries prevention, varnishes must be applied 2– 4 times/year , depending on caries risk considerations.

Despite having higher fluoride concentrations, varnishes can be regarded as a safer option when compared to gels, due to the small amount used during application

Fluoride concentrations in plasma and urine of children were reported to be lower than toxic levels after the application of a fluoride varnish.

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.

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. APF-silicone dioxide paste and SnF_2 - Zirconium silicate paste are also available.Studies have shown that their use alone cannot be considered as an effective cariostatic method. A thorough polishing may remove a thin, but highly mineralized outer layer of enamel. If prophylaxis is required for periodontal reason , cosmetic reasons then fluoride prophylactic past recommended, as it may help replenish the minerals that abraded during polishing. They may have a modest carious effect.

Restorative Materials Containing Fluoride

Fluorides releasing dental restorative material are also available that provide site specific protection. In general, the rate of fluoride release from such materials is not constant but exhibits a relatively rapid initial rate, which decreases with time .

Advantages:

Greater longevity, a reduced incidence of marginal failure, an elevated concentration of fluoride contingent plaque, together with an antibacterial action when compared with non-fluoride releasing materials.

The purpose of adding fluoride to restorative material is to capture its anticariogenic property. A major reason for failure of restorations is recurrent or secondary caries. Secondary caries has been reported as being the most common reason for replacement of restorations. However, 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. One difficulty with these materials is controlling the rate of fluoride release. Fluoride has also been added to amalgam in an attempt to reduce the risk of recurrent caries at restoration margins.

Fluoride may be released from dental restorative material as part of the setting reaction, or it may be added to formulation with the specific intention of fluoride release. 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 fluoride aluminosilicate glasses (FAG), stannous fluoride (SnF_2). organic amine fluorides (CAFH) and ytterbium fluoride (YbF).

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. Thereafter, a topical system of slow and constant F release were considered.

There are three types of slow-release F devices: 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.



Fluoride Ingestion and Toxicity of Professionally Applied Topical Fluoride :

Fluoride applications must be carefully monitored because the potential for over ingestion and toxicity does exist. Fluoride is rapidly absorbed in the gastrointestinal tract and young children are particularly vulnerable. Patients should not be left unattended during the application of topical fluoride.

The exposure to and retention of fluoride foam by the patient may be significantly less compared with APF gel application. 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.