TOPICAL FLUORIDES

Definition

Topical fluoride therapy refers to the use of systems containing relatively large, concentrations of fluoride that are applied locally, or topically, to erupted tooth surfaces to prevent the formation of dental caries.[8]

Classification

i. Operator administered
   Fluoride solutions
      Sodium fluoride 2%
      Stannous fluoride 8%
   Fluoride gels
      Acidulated phosphate fluoride 1.23%
      Fluoride varnishes
         Duraphat
         Fluorprotector.

ii. Self-administered
   Fluoride dentifrices
   Sodium fluoride
      Fluoride mouth rinses
      Dentifrices containing monofluoro-phosphate.

Sodium Fluoride: 2%

Method of preparation

Sodium fluoride solution can be prepared by dissolving 20 gm of sodium fluoride powder in 1 litre of distilled water in a plastic bottle. If stored in glass containers, the fluoride ion of solution can react with silica of glass forming SiF_2, thus reducing the availability of free active fluoride for anticaries action.

Method of application (Knutson technique)

1. Initially, cleaning and polishing of the teeth is done.
2. An upper and opposing lower quadrant are isolated with cotton rolls.
3. Teeth are dried thoroughly.
4. 2% NaF is applied with cotton applicators and is permitted to dry in the teeth for about 4 minutes.
5. Procedure is repeated for the remaining quadrants.
6. After completion, patient is instructed to avoid eating, drinking or rinsing for 30 minutes.
7. Second, third and fourth applications are done at weekly intervals.

Recommended ages

Full series of four treatments is recommended at ages 3, 7, 11 and 13.

Mechanism of action of sodium fluoride

When sodium fluoride is applied topically, it reacts with hydroxyapatite crystals to form calcium fluoride which is the dominant product of reaction. This is due to high concentration of fluoride (9,000 ppm) in 2% sodium fluoride due to which the solubility product of calcium fluoride get exceeded fast and this initial rapid reaction is followed by drastic reduction in its rate and the phenomenon is called choking off.

Once a thick layer of calcium fluoride gets formed, it interferes with the further diffusion of fluoride from the topical fluoride solution to react with hydroxyapatite. Further calcium fluoride reacts with hydroxyapatite to form

fluoridated hydroxyapatite which increases the concentration of surface fluoride, thus making the tooth structure more stable, less susceptible to dissolution by acids, interferes with plaque metabolism through antienzymatic action and also helps in remineralization of the initial decalcified areas, thus showing its manifold anticaries effect.

Advantages

1. Accepted taste.
2. Stable if stored in plastic containers.

Disadvantage

Four visits relatively at short period of time.

Stannous Fluoride – 8%

Method of preparation (Muhler's solution) Stannous fluoride solution has to be freshly prepared before use each time as it has no shelf life. 0.8 gm of stannous fluoride is dissolved in 10 ml of distilled water in a plastic container and the solution thus prepared is shaken briefly. The solution is then applied immediately to the teeth. The 10 ml of solution should be sufficient to treat the whole mouth of a single patient. If any remains, it should be discarded and not used again.[7]

Method of application

1. Each tooth surface must be cleaned and polished.
2. Teeth are isolated with cotton rolls and dried with compressed air.
3. Either a quadrant or half of the mouth can be treated at one time.
4. Freshly prepared 8% solution of SnF_2 is applied continuously to the teeth with cotton applicators.
5. Teeth are kept moist with solution for 4 minutes.
6. Re-application of solution to tooth is done every 15–30 seconds.

Recommended frequency

The recommended frequency of 8% SnF_2 applications is once per year.

Mechanism of action

When stannous fluoride reacts with hydroxyapatite, in addition to fluoride, the tin of stannous fluoride also reacts with enamel and new crystalline product stannous tin trifluoro-phosphate which is more resistant to decay than enamel is formed. It is due to this reason that always a freshly prepared stannous fluoride solution should be used and the capsule of SnF_2 should be kept in air tight containers, otherwise the stannous form of tin gets oxidised to stannic form, thus making the SnF_2 inactive for anticaries action.

Stannous fluoride with hydroxyapatite shows mainly four end products.

1. Tin hydroxyphosphate
2. Tin trifluorophosphate

3. Calcium trifluorostannate
4. Calcium fluoride

Calcium fluoride so formed, further reacts with hydroxyapatite and small fractions of flour—hydroxyapatite also gets formed. The other end product, tin hydroxyphosphate gets dissolved in oral fluids and is responsible for the metallic taste after topical application of stannous fluoride.

The main end product tin trifluorophos-phate is responsible for making the tooth structure more stable and less susceptible to decay.

Advantage

Application required only once per year.

Disadvantages

1. Has to be prepared freshly each time before use.
2. Metallic taste.

Acidulated Phosphate Fluoride—1.23%

Method of preparation (Brudevolds solution)

It is prepared by dissolving 20 gm of sodium fluoride in 1 litre of 0.1 M phosphoric acid. To this added is 50 percent hydrofluoride acid to adjust the pH at 3.0 and fluoride-concentration at 1.23 percent.[4]

APF gel (Fig. 21.9)

For the preparation of APF gel, a gelling agent methyl cellulose or hydroxyethyl cellulose is to be added to the solution and the pH is to be adjusted between 4 and 5.

Another form of APF for topical applications, namely thixotropic gels, is also available. The term thixotropic denotes a solution that sets in a gel-like state but is not a true gel. With application of pressure, thixotropic gels behave like solutions; it has been suggested that these preparations are more easily forced into the interproximal spaces than conventional APF gels.

A foam form of APF is also available. Laborartory studies indicate that the amount of fluoride uptake in enamel after applications using the foam is comparable to that observed with conventional APF gels and solutions.[7]

Method of application

1. Oral prophylaxis.
2. Teeth are isolated with cotton rolls on both lingual and buccal sides.
3. Teeth are dried.
4. APF solution is continuously and repeatedly applied with cotton applicators.
5. Teeth are kept moist for four minutes.

Recommended frequency

The recommended frequency of APF topical application is twice a year.

Fig. 21.7: Commercially available fluoride gel

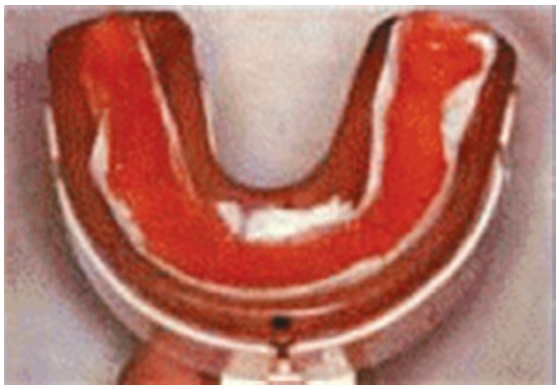

Fig. 21.8: Gel loaded on the tray for application

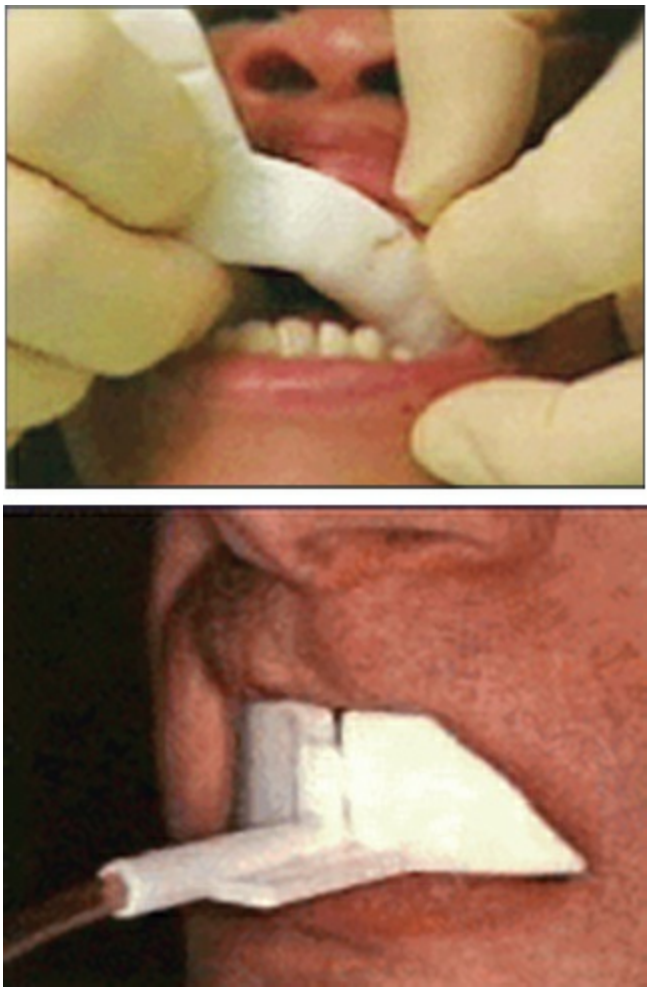

Fig. 21.9: Placement of gels

Mechanism of action

When APF is applied on the teeth, it initially leads to dehydration and shrinkage in the volume of hydroxyapatite crystals which further on hydrolysis forms an intermediate product called dicalcium phosphate dihydrate (DCPD).

This DCPD is highly reactive with fluoride and starts forming immediately when APF is applied and fluoride penetrate into the crystals more deeply through the openings produced by shrinkage and leads to formation of fluorapatite.

Advantages

1. No staining of tooth structure.

2. Stable when kept in polyethylene bottle.
3. In case of gel, self-application is possible.

Disadvantages

1. Sour and bitter in taste.
2. Repeated applications necessitates the use of suction, thereby minimising its use in the field.

Fluoride Varnish (Figs 21.10 and 21.11)

The two most commonly used varnishes are:

- Duraphat (NaF varnish)
- Fluorprotector (silane fluoride)

Composition

Fluorprotector is a colourless, polyurethane lacquer. The fluoride compound is a difluorosilane-ethyl-difluorohydroxy, silane. The active fluoride available is 7000 ppm. Duraphat is a sodium fluoride in varnish form containing 22.6 mg F/ml suspended in an alcoholic solution of natural organic varnishes. It is available in bottles of 30 ml suspension containing 50 mg NaF/ml. The active fluoride available is 22,600 ppm[3].

Fig. 21.10: Commercially available fluoride varnish

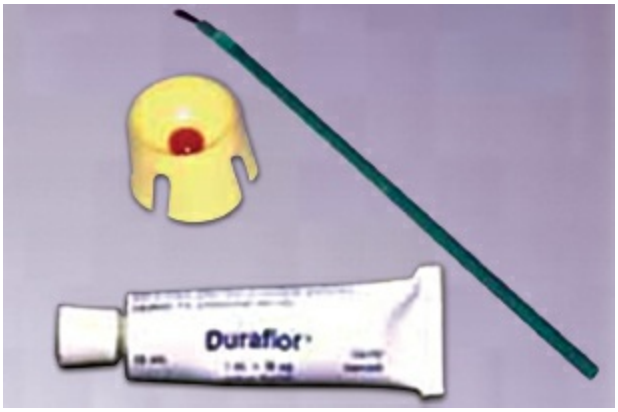

Fig. 21.11: Dispensing of varnish solution

Method of varnish application *(Figs 21.12 to 21.17)*

1. Oral prophylaxis.
2. Teeth are dried.
3. Teeth are not isolated with cotton rolls as varnish being sticky has a tendency to stick to cotton.
4. The application is done first on lower arch as saliva collects more rapidly around it, and then on the upper arch.
5. Application of varnish is done with single tufted small brush.
6. After application, patient is made to sit with mouth open for four minutes.
7. Patient is instructed not to rinse or drink anything at all for one hour and not to eat anything solids but take liquids and semisolids only till next morning.
8. Contact between varnish and tooth surfaces are needed to be maintained for 18 hours for prolonged interaction between fluoride and enamel.

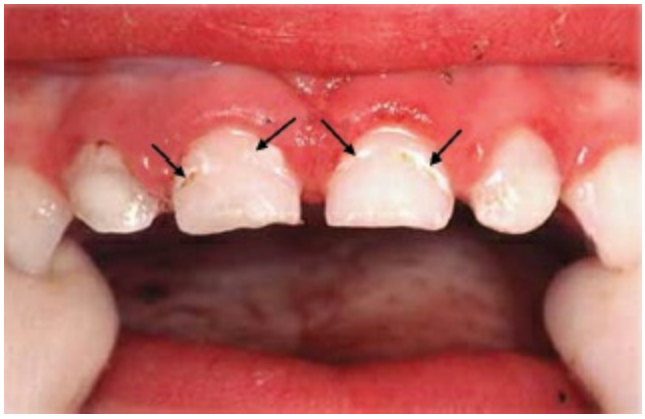

Fig. 21.12: Incipient caries lesion indicated for varnish application

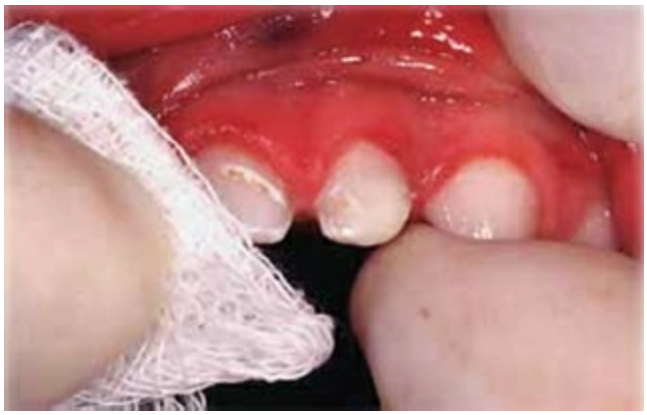

Fig. 21.13: Drying the tooth surface with gauze

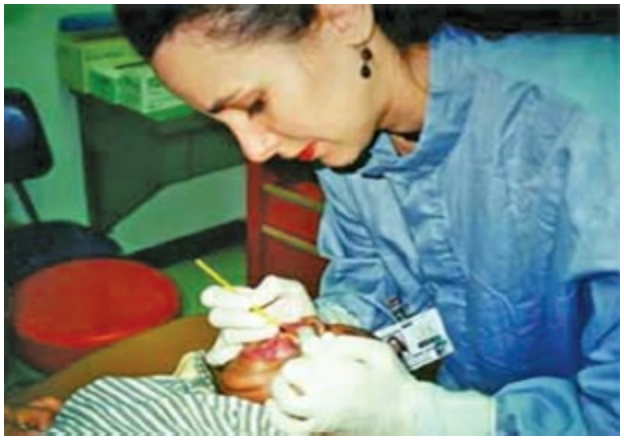

Fig. 21.14: Varnish application

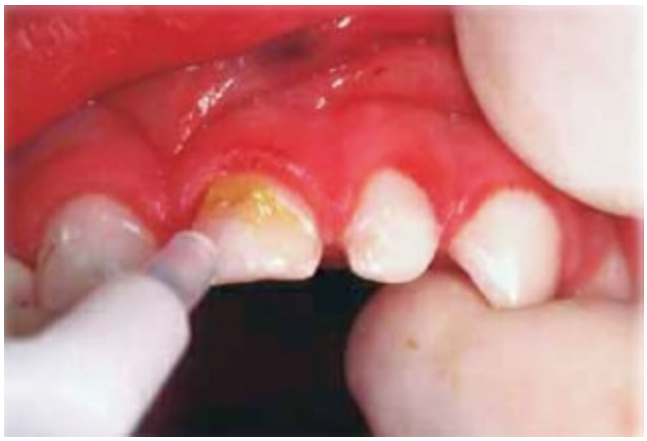

Fig. 21.15: Varnish application using unitufted brush

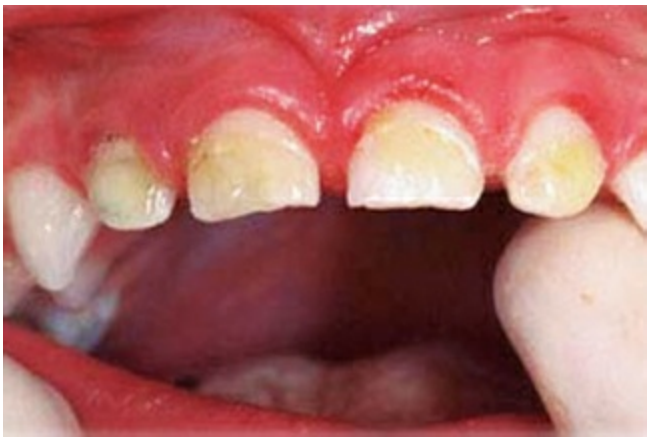

Fig. 21.16: Allow to dry after application

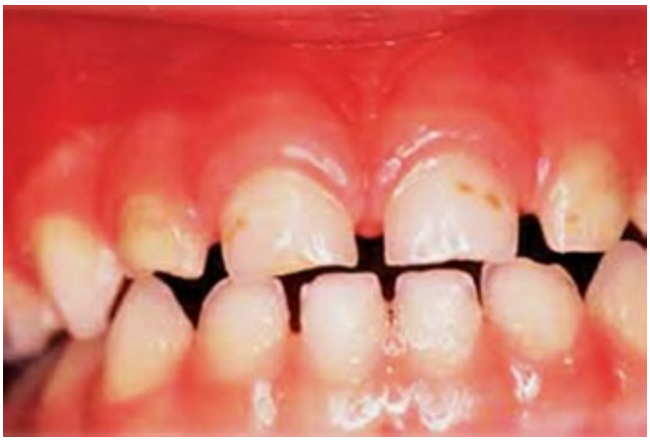

Fig. 21.17: Three months after application

Mechanism of action

When varnish is applied topically under controlled conditions, a reservoir of fluoride ions gets build up around the enamel of teeth. Fluoride keeps on slowly releasing and continuously reacting with the hydroxyapatite crystals of enamel over a long period of time leading to deeper penetration of fluoride and formation of fluorapatite.

Recommended dose

The recommended dose of 0.5 ml of duraphat for single application contains 11.3 mg F, and 0.5 ml of fluorprotector contains 3.1 mg F.

MI Varnish

MI varnish is a 5% sodium fluoride varnish that has a desensitizing action when applied to tooth surfaces. MI varnish also contains RECALDENT™ (CPP-ACP): Casein phosphopeptide-amorphous calcium phosphate. The application leaves a film of varnish on tooth surfaces (Fig. 21.18).

Fig. 21.18: MI varnish

Fluoride Dentifrices

The term dentifrice is derived from a latin word (dens – tooth, fricare – to rub). The most commonly used fluoride dentifrices are sodium mono fluorophosphates and sodium fluoride.

Mono fluorophosphates dentifrices are considered to be more advantageous than NaF and SnF_2 because it has

1. Neutral pH.
2. Greater stability to oxidation and hydrolysis.
3. Greater shelf life.
4. Increased availability of fluoride.
5. No staining of teeth.

Indications

1. *Dental caries prevention*: Recommended for each patient as part of the complete prevention program.
2. ***Caries – risk patients*:** Patients with moderate to rampant dental caries should be advised to brush several times each day with fluoride – containing dentifrice.
3. ***Desensitization*:** Certain dentifrices containing fluoride have desensitizing properties.

Mechanism of action

There are two possible modes of action regarding caries inhibitory mechanism of mono fluorophosphates. According to Erricsson, 1963, mono fluorophosphates is deposited in the crystalline lattice and in subsequent intracrystalline transposition, fluoride is released and replaces the hydroxyl group to form fluorapatite.

The second mode of action attributes the anticariogenic activity due to mono fluorophosphates as such and it may exchange with the phosphate groups in the apatite crystals and this reaction is not competitive of fluoride.

Preparations

Fluoride dentifrices are available as gels or pastes. Sodium fluoride and sodium mono-fluorophosphates dentifrices are approved currently.

Recommended procedures

1. Select an approved fluoride containing dentifrice.
2. Place a small amount of dentifrice on the toothbrush tips.
   Use only a small amount, the size of a pea.
3. Spread dentifrice over the teeth with a light touch of the brush.
4. Proceed with correct brushing for sulcular removal of bacterial plaque.
5. Keep dentifrice container out of reach of children.

Safety

Fluoride toothpaste generally contains around 800 to 1000 ppm of fluoride and the free available fluoride is approximately 500 to 600 ppm, i.e. about 30 mg fluoride in a tube of 50 gm.

Recommendations for use of fluoride

1. *For children below 4 years*: Fluoride toothpaste is not recommended.
2. ***For children 4–6 years*:** Brushing once daily with fluoride toothpaste and other two times without a paste.
3. ***For children 6–10 years*:** Brushing twice daily with fluoride toothpaste and once without paste.
4. ***For children above 10 years*:** Brushing three times with fluoride toothpaste.

Amine Fluoride Dentifrices (Fig. 21.19)

A special category of topical fluorides are organic fluorides in the form of amine fluorides (AmF).

- Amine fluoride 297 (OLAFLUR) contains 1000 ppmF.
- Amine fluoride 242 (HETAFLUR) contains 250 ppmF.

Fig. 21.19: Amine fluoride dentifrice

Fluoride Mouth Rinses (Table 21.1)

Mouth rinsing is a practical and effective means for self-application of fluoride. The only persons excluded from the practice of this method are children under 6 years of age and those of any age who cannot rinse because of oral-facial musculature problems or other handicap.[3]

Table 21.1: Composition and frequency of approved fluoride rinses[7]

Source of fluoride	*Fluoride content*		*Recommended frequency*
	Percent	*ppm*	
Sodium fluoride	0.20	900	Weekly
Sodium fluoride	0.02	100	Twice daily
Sodium fluoride	0.05	225	Daily
APF	0.02	200	Daily
Stannous fluoride	0.10	243	Daily

Method of preparation

The procedure of making a rinse everyday in home is by dissolving 200 mg NaF tablet (10 mg NaF and rest the filler as lactose) in 5 teaspoons of fresh clean water (25 ml approx.) which is sufficient for daily mouth rinse of a family of about four members.

Method of use

1. Rinse daily with 1 teaspoonful (5 ml) after brushing before bed.
2. Swish between teeth with lips tightly closed for 60 seconds; expectorate.

Fluoride rinses can be used as daily mouth rinse by community and fortnightly in schools.

Advantage

30–40% average reduction in dental caries incidence.

Disadvantage

Requires community participation.

Multiple Fluoride Therapy

Multiple fluoride therapy describes fluoride combination programs.This program included the application of fluoride in the dental office in the form of both fluoride containing prophylactic paste and a topically applied fluoride solution, in addition to self-care using an approved fluoride dentifrice. In addition, some form of systemic fluoride, preferably community water fluoridation was included.[7]

Recent Advances in Fluoride Release

Controlled Release Fluoride

Observations have suggested that the sustained release of fluoride from an intraoral device could be an approach for the control of dental caries in special groups. Such a device has now been developed which consists of a central depot of sodium fluoride intimately mixed with a plastic copolymer and surrounded by a rate-controlling membrane. Fluoride diffuses out at a rate that is controlled by the thickness of the membrane and the exposed surface area of the device. Device can release fluoride at a rate of from 0.02 to 1 mg/day for up to six months.[2]

All the available evidence shows slow release techniques could play a major role in the prevention of dental caries. The devices could be incorporated into space maintainers, orthodontic appliances, partial dentures, crown and bridge work and of course directly on to the tooth surfaces. Patients most likely to benefit from the use of these devices include those who have salivary gland malfunction as a result of disease on radiation therapy. The handicapped who are unable to carry out normal oral hygiene procedures are also likely to be beneficiaries.

Types of Intraoral Fluoride-Releasing Devices (Fig. 21.20)[10]

The various types of intraoral fluoridereleasing devices are:

- Copolymer membrane device
- Glass device containing fluoride.
- Hydroxyapatite-Eudragit ₹ 100 diffusion controlled fluoride system
- Slow-fluoride release tablets for intrabuccal use.

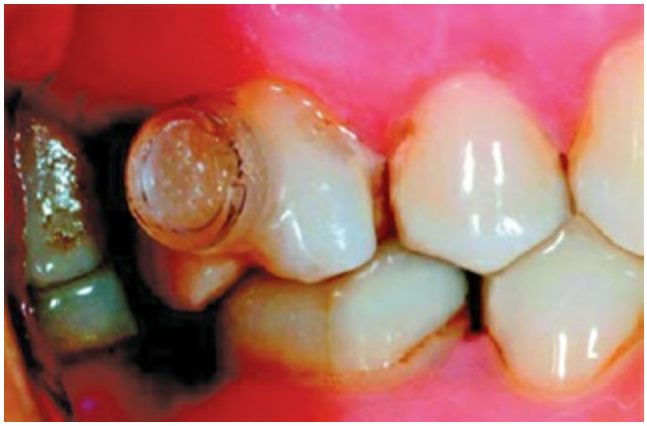

Fig. 21.20: Glass device and bracket attached to upper first permanent molar teeth