

## **I. AGENTS USED IN PROPHYLACTICS AND THERAPY OF CARIES**

Dental caries

- is a pathological process of microbial etiology that results in localized destruction of tooth tissues.
- caused by a biological interaction between bacteria, diet, and tooth surface.

*Streptococci mutans* - the main bacteria implicated in dental caries, which produce lactic acid from dietary carbohydrates.

**Caries prevention** is based on attempts to

- Increase the resistance of the host
- Lower the number of cariogenic microorganisms in contact with the tooth
- Modify the substrate by selecting noncariogenic foodstuffs
- Limit the time available for caries attack

The precise **mode of action of fluoride** is uncertain, but it probably acts via several mechanisms including

- an effect on enamel structure,
- an alteration in tooth morphology,
- and an action on bacterial plaque.

### **Fluoride and enamel structure**

Enamel is mainly composed of crystals of hydroxyapatite.

Fluoride makes apatite crystals less soluble in acid by two mechanisms:

- crystals of fluorapatite have less voids than crystals of hydroxyapatite (reducing solubility)
- fluoride displaces carbon and magnesium ions from apatite crystals (improves the crystalline structure)

Fluoride also has an effect on the remineralization of enamel after acid attack (three possible mechanisms)

1. fluoride reduces the more soluble carbonate of enamel, so reducing its solubility
2. acid attack causes the release of fluoride ions from the enamel surface. The released fluoride, together with fluoride ions contained in plaque and saliva, favors remineralization
3. fluoride accumulates in early carious lesions at concentration that are sufficiently high to reduce enamel solubility

### **Fluoride and tooth morphology**

Fluoride ingested during dental development

- alters the shape of teeth (wider fissures and more rounded cusps)
- alters matrix formation caused by impaired protein synthesis (enamel and dentine are also thinner due to it).

## Fluoride and plaque

Fluoride is an enzyme inhibitor and can have a significant effect on plaque metabolism.

### **Pharmacokinetics of fluoride**

- is passively absorbed from the stomach, stored in skeletal tissue, and the excess is excreted via the kidney, sweat, and faeces.
- the placenta acts as a partial barrier to fluoride, which depends upon the maternal concentration of fluoride.
- the efficacy of therapeutic fluoride given to the pregnant mother to enhance the baby's teeth is uncertain.
- some countries permit, but do not encourage, prenatal fluoride supplementation.

**Fluoride therapy for the prevention of dental caries** is considered under two main headings:

- Systemic fluoride
- Topical fluoride

### I. SYSTEMIC ADMINISTRATION

#### 1. Fluoridation of communal water supplies

In areas with no natural fluoride in the water supply, the addition of fluoride up to 1 part per million (**1 p.p.m.**) causes a significant reduction in the incidence of caries.

**Dental fluorosis** has been directly related to the concentration of fluoride in the drinking water. An optimal level of fluoride in the water supply provides significant protection against caries, yet entails minimal risk of fluorosis. The optimal concentration depends on the annual average maximum daily air temperature in the community (temperature influences the amount of water ingested).

**Opponents water fluoridation** have questioned its safety, yet careful comparison of communities with optimal versus suboptimal concentrations of fluoride in water supplies have found no significant difference in the frequency of birth defects or in mortality statistics (including deaths from heart disease, cancer, and stroke). Optimal fluoridation of drinking water does not pose a detectable cancer risk to humans, as evidenced by extensive human epidemiological data.

#### 2. Fluoridation of school water supplies

Research has shown that adjusting the fluoride content of a school's water supply will produce a reduction in dental caries with no objectionable dental fluorosis.

#### 3. Fluoride supplements

Fluoride **tablets, drops, milk, salt and lozenges** have been unequivocally proved to be effective cariostatic agents, provided they are taken daily and continuously from 6 months to about 14 years of age.

## **Dosage**

The correct **dosage** in prescribing fluoride supplements depends on two factors:

- The age of the child
- The existing fluoride concentration in the water supply

Failure to determine the fluoride concentration in the communal water source can result in overdosage and consequent **dental fluorosis**.

For young infants- drops

Older children - fluoride tablets or lozenges (in 0.25, 0.5, and 1 mg strengths).

At 1994 American Dental Association and also American Academy of Pediatric Dentistry recommended that the fluoride supplement dosage schedule be lowered because of the increased prevalence of enamel fluorosis.

The new dosage schedule approved by the Council on Scientific Affairs includes the following changes:

- Fluoride supplementation starts at 6 months instead of birth
- The 0.25 mg dose of fluoride is extended to 3 years of age (instead of 2 years)
- The 0.5 mg dose of fluoride is used from 3 to 6 years of age (instead of 2 to 3 years)
- The 1.0 mg dose of fluoride is not started until age 6 years (until the upper anterior teeth are already formed)
- Supplements are not prescribed if the domestic water contains more than 0.6 ppm fluoride (previously it was 0.7 ppm)

In addition, it was recommended that fluoride drops used in the youngest age group be prepared in a more dilute form, such as 0.25mg fluoride in 0.25 ml (instead of a single drop), to minimize overdispensing errors at home.

**The dose of fluoride tablets or drops will need to be modified according to the concentration of fluoride in the drinking water.** If the water concentration is the greater than 0.7 ppm, then no additional fluoride supplements should be given to the child since this will increase the risk of fluorosis.

#### 4. Fluoridated milk

The amount of fluoride added to milk, in the form of sodium fluoride, is the equivalent of receiving 1 mg per day.

In warm climates, fluoridated fruit juices may be a practical alternative to fluoridated milk.

#### 5. Fluoridated table salt

Salt is another excellent vehicle for dispensing fluoride. It is effective, but not as good as fluoride in the water supply.

## II. TOPICAL ADMINISTRATION

### 1. Professional topical application of fluorides

#### **Fluoride solution**

- an aqueous solution of sodium or stannous fluoride;
- the acidulated phosphate fluoride system.

#### **Fluoride varnishes**

- allows a longer contact between the enamel surface and fluoride ions.
- Duraphat - contains 2.26% fluoride (as sodium fluoride) in an alcoholic suspension of rosin, Fluor Protector - contains 0.7% fluoride (as difluorosilane) in a polyurethane varnish (generally, the polyurethane varnish has been less active).

### 2. Self-applied topical fluoride in the home

- the daily self-application of 1.1% sodium fluoride gel in custom-fitted trays for 5 minutes daily.
- brushing with a fluoride gel
- fluoride in the toothpaste

## FLUORIDE TOXICOLOGY

### Acute toxicity

When ingested in amounts of 1-3 mg/day, as would be the case in optimally fluoridated communities, it is perfectly safe. However, 5 to 10 g of sodium fluoride is a certain fatal dosage for adult, and lesser amounts are lethal to children. Incidents of acute fluoride poisoning have been recorded, resulting from industrial accidents, inhalation of fumigants, ingestion of household insecticides containing fluoride etc.

Patients with severe fluoride poisoning characteristically exhibit

- nausea, vomiting and diarrhea
- progressive hypotension
- pronounced hypocalcemia and hypomagnesaemia
- acidosis
- cardiac irregularities

### Chronic toxicity

- Dental fluorosis is hypomineralization of enamel produced by chronic ingestion of excessive amounts of fluoride during tooth development
- Fluorosis may range in severity from a few white flecks to excessive brown staining and pitting. Pits are secondarily produced defects of post-eruptive origin rather than true hypoplasias.
- The prevalence and severity of fluorosis depend on the amount of fluoride ingested, the duration of exposure, the state of tooth development, and individual variation in susceptibility.
- If the natural water supply contains in excess of 2 ppm fluoride, the prevalence of fluorosis can be reduced by changing the source of water supply or by the defluoridation using activated alumina or bone char for adsorption.
- Some fluorosis can also be prevented by stopping the use of fluoride supplements in communities that already have optimal fluoridation of the water supply.