Fluoridation Mechanism and Effects

Fluorine is an electronegative, naturally occurring element. It is the most reactive of all chemical elements.The reduced form of fluorine (or its ionic form) is called as fluoride.Fluorine cannot occur in nature in its elemental form, but only as a fluoride ion which continues to play a vital role in prevention of dental caries, it was introduced into dentistry over 70 years ago, The decrease in prevalence and severity of dental caries over the second half of the 20th century in many industrialized countries is attributed to use of fluorides. However, excessive fluoride intake during the period of tooth development can cause dental fluorosis.

Sources of Fluoride

1- Ground waters: Rain water, Sea water &river water

2- Atmosphere: fluoride- containing soils and gas, underground coal fires and volcanic activities

3- Food: present to some extent in nearly all foods. Certain foods contain more F than others, e.g. tea & some seafoods.

4- Drugs & fluoride-containing dental products.

5- Pollution: in vicinity of industries involved in production of aluminum from cryolit & phosphate fertilizers.

Community water fluoridation:

Water fluoridation considered as one of the "ten greatest public health achievements of the 20th century."It is the controlled addition of fluoride to a public water supply for optimal dental health which effectively prevents caries. It is the best method of delivering fluoride on a population basis.

History:

- The history of community water fluoridation traced back to 1901 Dr. Frederick McKay, a dentist noticed that some of his patients in Colorado springs have permanent stain on their teeth. He named these stains as "mottled enamel" which were intrinsic, or incorporated into the enamel structure, and they were limited to a subgroup of patients who had either been born in Colorado Springs or moved there at a very young age.

-1916 Dr. McKay & Dr. Black conducted studies on individual in 26 communities in USA & concluded that an "unidentified factor" present in the water was responsible for mottling of enamel. Dr. McKay found that these mottled enamel cases are singularly free from caries."

-McKay had identified the etiologic agent which is the high level of fluoride in drinking water.

- Dean and co-workers conducted a survey on 21 cities to establish the relationship between mottled enamel which replaced by the term dental fluorosis and the level of fluoride in the water supply.

The three types of fluoride that are used to fluoridate water are:

- Sodium fluoride,

-Sodium fluorosilicate

-Fluorosilicic acid.

The optimum level of fluoride in the communal water supply varies depending on the temperature and geographic location, its range from 0.7-1.0 ppm. This concentration allows minimum dental fluorosis with maximum caries reduction.

Community water fluoridation is safe and cost-effective and should be introduced and maintained wherever it is socially acceptable and feasible.

Types of fluoride:

A- <u>Systemic fluorid</u>: Its benefit in pre-and post eruptive phase

1-Communal water fluoridation 2-

Alternative methods for C.W. F.:

- ❑ School water fluoridation.
- ❑ Home water fluoridation.
- ❑ Fluoridated tablets.
- ❑ Fluoridated salts.
- ❑ Fluoridated milk.

B- <u>Topical fluoride</u>: Its benefit in post eruptive phase

1. **Self applied:**
   - ❑ Dentifrices.
   - ❑ Fluoridated mouth rinse.
   - ❑ Fluoridated gel.
2. **Professional fl. application:** In the form of solutions, gel, foam, varnishes, prophylactic paste or pumice. Many types of fluoridated agent used, mainly:
   - ❑ Sodium fluoride (NaF).
   - ❑ Stannous fluoride (SnF2).
   - ❑ Acidulated phosphate fluoride.
   - ❑ Zirconium fluoride.
   - ❑ Titanium fluoride.
   - ❑ Amine fluoride.

Choice of fluoride type and dose depends on:

- current levels of fluoride intake.
-caries status.
-age of subjects in the area.

Mechanism of action:

Fluoride reduces the decay of tooth enamel by its incorporation into the dental enamel and formation of fluorapatite . The fluoride ions reduce the rate of tooth enamel demineralization and increase the rate of remineralization at the early stages of cavities. The remineralization cycle as a preventive method is occurring when fluoride is present in the oral cavity. The concentration of fluoride in saliva varies among individuals, and depends on various factors such as salivary secretion rate and the type & conc.of fluoride exposure.

In general, fluoride has many effects in relation to caries reduction(anti-caries effect)these include:

1-Decrease solubility of enamel in acid by converting hydroxyapatite into less soluble fluorhydroxyapatite/fluorapatite.

2- Enhance remineralization of enamel in areas that have been demineralized by acids.

3- Antibacterial action: Bactericidal in high conc. & bacteriostatic in low conc. Fluoride affects oral bacteria and dental plaque ecology. It inhibits bacterial adsorption & decreases acid production of *plaque bacteria* (inhibiting glycolysis in microorganisms).

4- Improve tooth morphology making them more self-cleansings**.**

Metabolism of fluoride

When F is ingested, the absorption occurs mainly in the stomach. F concentration in the blood reaches a peak after about 30 minutes, and returns to the usual level after 11- 15 h. about 99% of F is associated with calcified tissue (bone & teeth). F also can be absorped following inhalation and through the skin. The main route of F excretion is via the kidney.

Side effects of fluoride:

Fluoride is a hazardous substance when large doses are taken acutely or when lower doses are taken chronically, it could cause:

- Dental fluorosis.
- Reversible gastric disturbances.
- Skeletal fluorosis.
- Death.

Dental Fluorosis

Hypomineralization of enamel results from prolonged ingestion of fluoride during the period of tooth development.

Clinically: Opaque white patches in the enamel which may become striated, mottled, pitted or stained yellow to dark brown.

There are many indices for assessment of dental fluorosis, one of these is Dean's Dental Fluorosis Index which was developed by Dean in1942.

Scores used in Dean's Index are as follows:

Normal (0): The enamel is smooth, glossy and translucent, usually a pale creamy- white color.

Questionable (0.5): There are slight aberrations from the translucency of normal enamel. Lesions may range from a few white flecks to occasional spots.

Very mild (1): Opaque paper-white areas are visible, involving less than 25% of the facial or buccal tooth surface.

Mild (2): White opacity of the enamel is more apparent than for code 1, but still covers less than 50% of the surface.

Moderate (3): Marked wear and brown stain, frequently disfiguring, is visible.

Severe (4): Hypoplasia is so marked that the general form of the tooth may be altered. Pitted or worn areas and brown stain are widespread. Teeth often have a corroded appearance.

Prevention of dental fluorosis

Alternative water supply with optimal or suboptimal F levels is the only effective preventive measure in area with high level of F in drinking water. If this not possible, the available drinking water can be defluridated.

Defluoridation of water: Is the downward adjustment of F ion concentration in public water supply to be maintained at 1 ppm by weight.