

Lec.4

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**Systemic fluoride**

**History :**

Early in the twentieth century (1901,1908) Dr.F. McKay began his extensive studies to find the cause of “brown stain,” which later was called mottled enamel and now is known as dental fluorosis. He observed that people in Colorado Springs, Colorado, with mottled enamel had significantly less dental caries. He associated the condition with the drinking water, but tests were inconclusive.

* G .V. Black, USA in 1916 accomplish a histological study on the teeth affected with the brown stain and the histological appearance revealed defect in Enamel and Hypocalcification with No dental caries
* H.V.Churchill a chief chemist of Aluminum company in USA analyses the water of an area with mottled enamel and found the high percentage of fluoride in water about 13.7 ppm
* Dr.H.T.Dean was a dentist who carry out a series of epidemiological investigations on 21-city study and concluded that mottling is rare at fluoride level 1ppm or below . Dean observed an inverse relationship between dental fluorosis and dental caries.

**Excess fluoride intake and dental fluorosis**

* Infants and toddlers are especially at risk for dental fluorosis of the anterior teeth since it is during the first 3 years of life that the permanent front teeth are the most sensitive to the effects of fluoride.
* Fluoride accumulates at the transition/ maturation stage of tooth development so that the entire tooth surface can be affected. Children fed formula made with fluoridated water are at higher risk to develop dental fluorosis

**Clinical Manifestations of Dental Fluorosis**

Clinically, mild cases of dental fluorosis are characterized by a white opaque appearance of the enamel, caused by increased subsurface porosity. The earliest sign is a change in color, showing many thin white horizontal lines running

across the surfaces of the teeth, with white opacities at the newly erupted incisal end. The white lines run along the ‘perikymata’, a term referring to transverse ridges on the surface of the tooth, which correspond to the incremental lines in the

enamel known as Striae of Retzius .

At higher levels of fluoride exposure, the white lines in the enamel become more and more defined and thicker. Some patchy cloudy areas and thick opaque bands also appear on the involved teeth. With increased dental fluorosis, the entire

tooth can be chalky white and lose transparency .With higher fluoride doses or prolonged exposure, deeper layers of enamel are affected; the enamel becomes less mineralized. Damage to the enamel surface occurs in patients with moderate- to- severe degrees of enamel fluorosis.Teeth can erupt with pits, with additional pitting occurring with posteruptive enamel fracture. In the individuals with moderate dental fluorosis,yellow to light brown staining is observed in the areas of enamel damage. In very severe cases, the enamel is porous, poorly mineralized, stains brown, and contains relatively less mineral and more proteins than sound enamel. Severely fluorosed enamel can easily chip posteruptively during normal mechanical use . Although teeth with mild dental fluorosis may be more resistant to dental decay because of the higher levels of fluoride contained in the enamel surface,severely fluorosed teeth are more susceptible to decay, most likely because of the uneven surface or loss of the outer protective layer

**Dental fluorosis severity depends on**:

* Stage of tooth development
* Duration of exposure to fluoride
* Concentration of fluoride in foods and drinks. A direct relationship is present between dental fluorosis and level of F ingested.

The central incisor takes approximately 3 years to go through complete enamel mineralization. Timing of chronic daily fluoride ingestion and the corresponding dental fluorosis pattern that can be expected.

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| **Age** | **Source of excess fluoride** | **Teeth affected** |
| Birth to 3 years | -Fluoridated tap water used for infant formula | Incisors, first molars |
| 3–6 years | -Early toothpaste use | Premolars, canines, second molars |
| 0–6 years | -General anesthetics  -Fluoride supplements  – Fluoridated water  Any combination of the above plus excess swallowing of fluoridated toothpaste.  -Pollution (or drinking water >4 ppm fluoride) | All teeth |

The mechanism of the formation of dental fluorosis:

**Pathogenesis of dental fluorosis**

is related to physiological conditions, including body weight, rate of skeletal growth and remodeling, nutrition, and renal function. Bone is a reservoir of fluoride, as fluoride is incorporated in the forming apatite crystals, and this ion can also be released from these crystals as bone remodels. Therefore, rapid bone growth, as occurs in the growing child, will remove fluoride from the blood stream, possibly reducing the risk of dental fluorosis by lowering serum fluoride levels.

Nutrition is also important for controlling the serum level of fluoride, as ions such as calcium, magnesium and aluminum can reduce the bioavailability of fluoride. A deficiency in these ions in food can also affect (enhance) fluoride uptake. The mechanisms by which fluoride alters enamel maturation are multi- factorial.

**Classification of dental fluorosis:**

Fluorosis index of H.T. Dean (1942)

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| **Score** | **Criteria** |
| Normal (0) | The enamel represents the usual translucent semivitriform type of structure. The surface is smooth, glossy, and usually of a pale creamy white color |
| Questionable  (0.5) | The enamel discloses slight aberrations from the translucency of normal enamel, ranging from a few white flecks to occasional white spots. This classification is utilized in those instances where a definite diagnosis of the mildest form of fluorosis is not warranted and a classification of ‘normal’ is not justified. |
| Very mild (1) | Small opaque, paper white areas scattered irregularly over the tooth but not involving as much as 25% of the tooth surface. Frequently included in this classification are teeth showing no more than about 1–2 mm of white opacity at the tip of the summit of the cusps of the bicuspids or second molars. |
| Mild (2) | The white opaque areas in the enamel of the teeth are more extensive but do not involve as much as 50% of the tooth. |
| Moderate (3) | All enamel surfaces of the teeth are affected, and the surfaces subject to attrition show wear. Brown stain is frequently a disfiguring feature. |
| Severe (4) | Includes teeth formerly classified as ‘moderately severe and severe. All enamel surfaces are affected and hypoplasia is so marked that the general form of the tooth may be affected. The major diagnostic sign of this classification is discrete or confluent pitting. Brown stains are widespread and teeth often present a corroded- like appearance. |

**Treatment of Dental Fluorosis**.

The treatments for fluorotic teeth are limited. For the mildest forms of fluorosis (FI 1, 2) bleaching,to make the color of the tooth surface uniform ,can be recommended. Treatments for moderate dental fluorosis include microabrasion, where the outer affected layer of enamel is abraded from the tooth surface in an acidic environment. Composite restorations combined with microabrasion or application of aesthetic veneers can be used for the patients with moderate fluorosis, while for the cases with severe fluorosis, prosthetic crowns may be necessary .

**Dental fluorosis and bone fluorosis:**

* Generalized dental fluorosis of all the permanent teeth indicates that the bone is potentially a major source of the excess fluoride that causes dental fluorosis in children.
* People ingesting fluoridated water for many years have higher levels of fluoride in their entire skeletal systems.
* Several ecological studies have been published suggesting that there is an increased risk in hip fractures when dental fluorosis is endemic
* Fluoridated water at 1 ppm or less is not associated with significant

bone fractures

* a lifetime of excess chronic intake of fluoride because even very low daily

fluoride intake associated with mild fluorosis has been seen to be associated with changes in bone density.

* Symptoms of skeletal fluorosis appear later than dental fluorosis. Structural changes take place in the bones, which make them weak. Ligaments may also calcify and harden and bony spurs may appear in skeletal fluorosis.

Symptoms of skeletal fluorosis include:

* Pain in small joints
* Pain and stiffness in the back
* Deformity of the hips , knees and other joints. Knock knees may be present.
* Deformity of the spine. Spinal deformity can cause compression on the spinal cord and the exiting nerves, resulting in pain muscle weakness, tingling and numbness and other symptoms along the distribution of the nerves
* Other symptoms like digestive tract symptoms like pain in abdomen, diarrhea, constipation, neurological symptoms like tingling and numbness, increased tendency to urinate and increased thirst, and muscle pain, stiffness and weakness may also be present. These symptoms may appear before the onset of skeletal fluorosis and therefore may be useful in early diagnosis
* Diagnosis Fluorosis can be diagnosed based on: Measurement of urinary and serum fluoride levels, as people with fluorosis tend to have increased levels of fluoride
* Bone biopsy with bone fluoride estimation to detect skeletal fluorosis
* CT scan detect changes in bone associated with fluorosis
* MRI scan detect changes associated with compression of tissues and nerves