

# PREVENTIVE DENTISTRY

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## Fluoride Toxicity

Toxicity is due to excessive ingestion of fluoride and can be acute or chronic.

### Chronic Toxicity

It is caused due to ingestion of excess amount of fluoride over a prolonged period of time. It can cause dental and skeletal changes referred to as dental and skeletal fluorosis respectively.

### 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

### **Acute Toxicity**

Acute toxicity is due to ingestion of large dose of fluoride in a short period of time while chronic toxicity is due to ingestion of excess fluoride in low doses over a prolonged period of time.

- Certainly Lethal dose of fluoride (CLD) is : A lethal dose is the amount of drug likely to cause death if timely interception by antidote is not initiated.

- In Adult: CLD is 5–10 gm of sodium fluoride taken at 1 time.
- The fluoride ion equivalent is 32–64 mg Fluoride (F) per kg body weight.
- In Children: CLD is approximately 0.5–1.0 gm. It varies with age and weight of the child.
- For children under 6 years of age, however, 500 mg would be lethal
- probably toxic dose : the minimum dose that could cause toxic signs and symptoms, including death, and that should trigger immediate therapeutic intervention and hospitalization ,that dose has generally been accepted to be  $\leq 5$  mg F/kg body weight.

#### **Factors influencing acute toxicity:**

1- Form of administration: Fluoride administered in liquid form is absorbed quickly, hence the symptoms of toxicity is rapidly seen.

2-Age: Younger the age more severe and faster are the symptoms of toxicity.

3-Rate of absorption: Rate of absorption depends on many factors( e.g. food in stomach)

4- Type of fluoride compound e.g. stannous fluoride is slightly more toxic than sodium fluoride because high doses of tin ion adversely affect the kidney and other organs.

#### **Signs and symptoms of acute fluoride toxicity**

- Nausea, vomiting, abdominal pain, increased salivation, nasal discharge
- Generalized weakness, muscle spasm
- Reduced plasma calcium level, increased plasma potassium level
- Weak thready pulse, fall in blood pressure
- Depression of respiratory center
- Cardiac arrhythmia

- Coma and death.

### **Management of acute toxicity**

Immediate management should be aimed at:

- Reducing the fluoride absorption by inducing vomiting through emetics
- Increasing fluoride excretion by increasing the alkalinity of the urine and fluid replacement
- Plasma calcium and potassium level monitoring

### **Management based on the amount of fluoride ions ingested**

- < 5.0 mg/kg Milk + Induce vomiting
- >5.0 mg/kg Induce vomiting  
Milk,+ 5% calcium gluconate,  
Hospitalization
- > 15.0 mg/kg Induce vomiting  
Cardiac monitoring peaking  
of T wave and prolonged QT  
interval in a ECG  
Slow administration of 10 ml  
of 10% calcium gluconate  
Maintain adequate urine output  
Supportive measures for shock

### **Some sources of fluoride poisoning**

#### **Safe dose**

1-Fluoride supplements  
0.25 mg F 1 tab/day (toddler)  
0.5 mg F 1 tab/day (3–6 years)

#### **Probable toxic doses**

Amount contain (PTD)  
200 tablets  
100 tablets

1.0 mg F 1 tab/day >6 years 50 tablets

2-Fluoridated toothpaste

NaF 0.22% Pea-size amount per brushing 50 cc  
(0.5 cc)

MFP 0.76% Pea-size amount per brushing 50 cc  
(0.5 cc)

SnF2 0.4% Pea-size amount per brushing 50 cc  
(0.5 cc)

**Recommendations for parents:**

1. Parental supervision
2. Child-proof containers (for fluoride tablets)
3. Keep products out of reach of young children
4. Supervise children when brushing / rinsing , Small amount of tooth paste to be used
5. Products with low fluoride level to be used
6. Teaching children not to swallow paste or rinse
7. Strict adherence to professional advice

**Possible acute toxicity in dental clinic: APF gel**

1. 1.23% fluoride in phosphoric acid
2. Upper and lower trays of 1.2-6 g/tray
3. Acidic condition (pH 3.5) enhances absorption
4. Because of acidity, a small volume can adversely affect the gastric mucosa and lead to nausea or vomiting in some cases

**Calculations of the percentage of fluoride ion in the total amount of fluoride agent swallowed**

• Multiply the percentage of the fluoride agent with the molecular conversion ratio of that particular fluoride agent to obtain the percentage of fluoride ions present

*Example:* For 2% sodium fluoride, molecular conversion ratio =1/2.2  
 $2 \times 1/2.2 = 0.9\%$  fluoride ions

- To convert the percentage of fluoride ion to fluoride mg/gm, multiply the percentage of fluoride ions with 10

$$0.9 \times 10 = 9 \text{ mg of fluoride ions in one gram of sodium fluoride}$$

- To calculate the amount of fluoride ions swallowed, multiply the fluoride in mg/gm with the total amount of agent swallowed. This gives the total amount of fluoride ions present in the amount swallowed

$$9 \text{ mg/gm} \times \text{total amount of sodium fluoride swallowed} = \text{total amount of fluoride ions swallowed}$$

- From this the toxic dose of fluoride can be calculated for a given child based on the body weight as total amount of fluoride ions swallowed/weight of the child in kg.

#### **An example**

**Child 15 years old, 30 kg weight was admitted to hospital swallowing 10 grams of sodium fluoride powder, the amount of fluoride ions swallowed per body weight:**

$$9 \times 10 = 90 \text{ mg}$$

$$90 \div 30 = 3.0 \text{ mg/kg F}^-$$

$$\text{PTD} = 5 \text{ mg F/kg}$$

$$\text{PTD for 1-2 year old child, } \sim 10 \text{ kg} = 50 \text{ mg F}$$

$$\text{PTD for 5-6 year old child, } \sim 20 \text{ kg} = 100 \text{ mg F}$$

$$\text{PTD for adult, } \sim 60 \text{ kg} = 3000 \text{ mg F (3 g)}$$