PIT AND FISSURE SEALANTS

Introduction

- Oral diseases are progressive, cumulative, and become more intricate to treat with advancement.

- Untreated oral disease can affect a person's ability to masticate and communicate efficiently. Aesthetically, untreated dental disease can impact on one's self-esteem and attribute to poor self image.

- Dental caries remains the single most common childhood disease that is neither self-limiting nor corrective with antibiotics.

- Dental caries is a localized post eruptive , pathological process of external origin involving softening of the hard tooth tissue and proceeding to the formation of cavity.

  - WHO

Classification of Caries

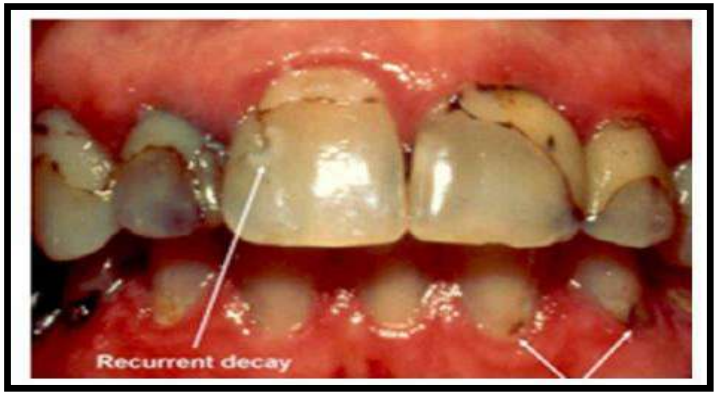
- **Based upon Location:**

Pit & Fissure Caries

Smooth Surface Caries

Root Caries

- **Based upon Rate of Progression:**
  1. Acute caries.
  2. Chronic caries.
  3. Recurrent caries.
  4. Incipient caries.
  5. Arrested caries.



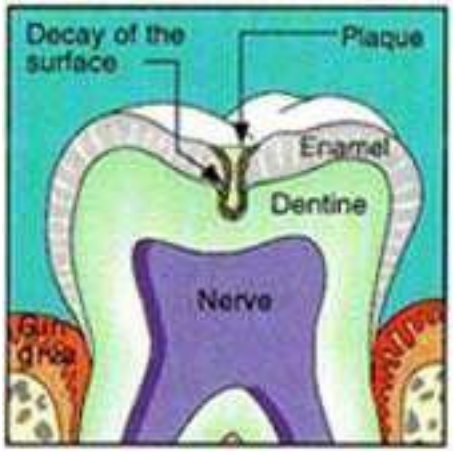
Recurrent Caries

- **Based upon Etiology:**

Early Childhood Caries (ECC)

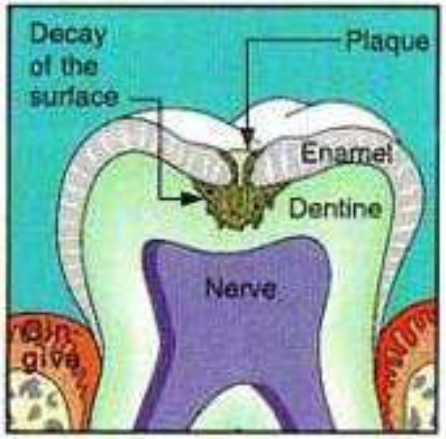
Rampant caries

- **Based upon the Affected Hard Tissue:**



Enamel Caries

Cementum Caries



Dentinal Caries

- The occlusal surfaces of teeth comprise 12% of the total number of tooth surfaces, which means the pit and fissures of the occlusal surfaces of teeth are eight times more susceptible to decay as the smooth surfaces of the teeth.

- The teeth at highest risk for carious lesions are the first and second molars, and 90% of all dental caries in school children occurs in pits and fissures of the occlusal surface of the molars.

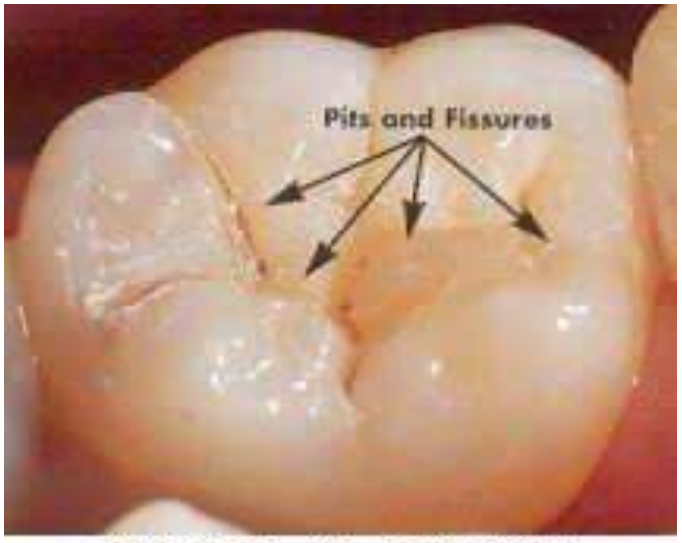
- In dentistry the agents or methods of primary prevention of dental caries includes fluorides, pit and fissure sealants, plaque control, and dietary analysis to control the consumption of fermentable carbohydrates.

- Dental sealant programs are just one way to help increase primary prevention in the oral health disparities of children.

Definitions

- Pit : is defined as small pin point depression located at the junction of developmental grooves or at terminals of those grooves.
- Fissure : is defined as deep clefts between adjoining cusps.

Provide areas
for retention of caries
producing agents.



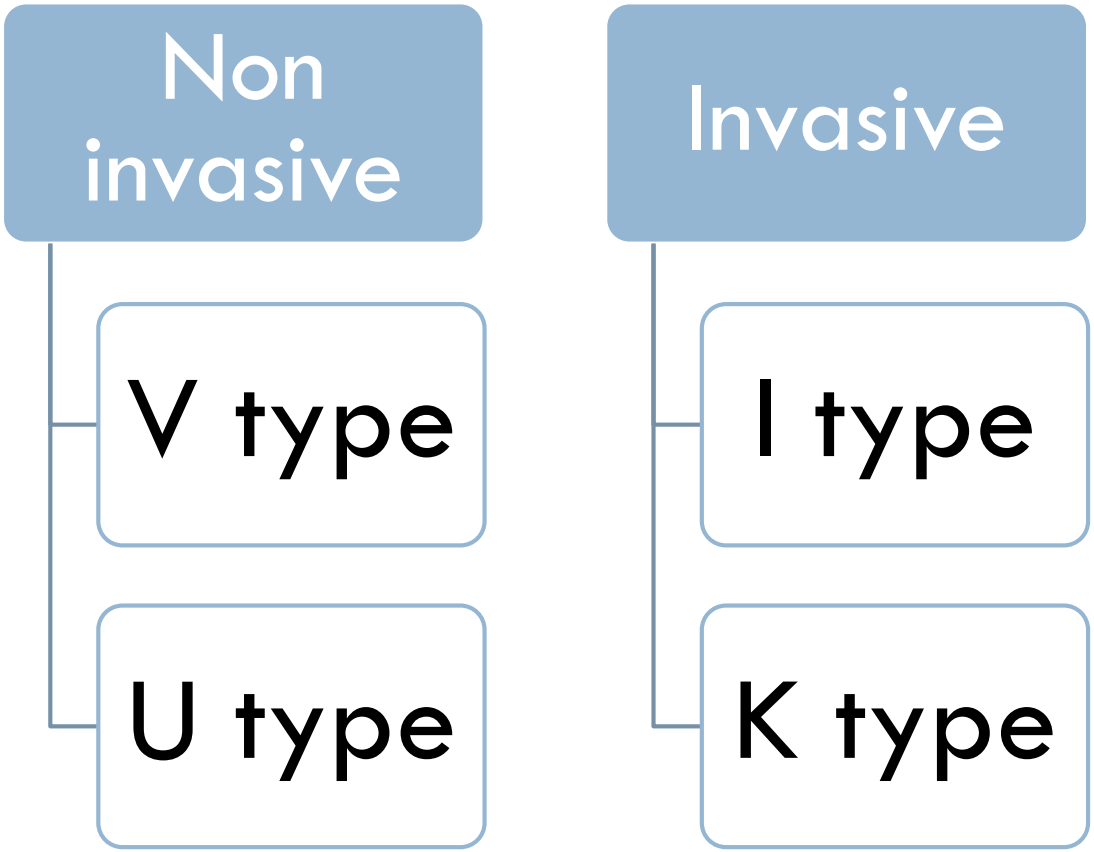
UNPROTECTED MOLAR
PRONE TO DECAY

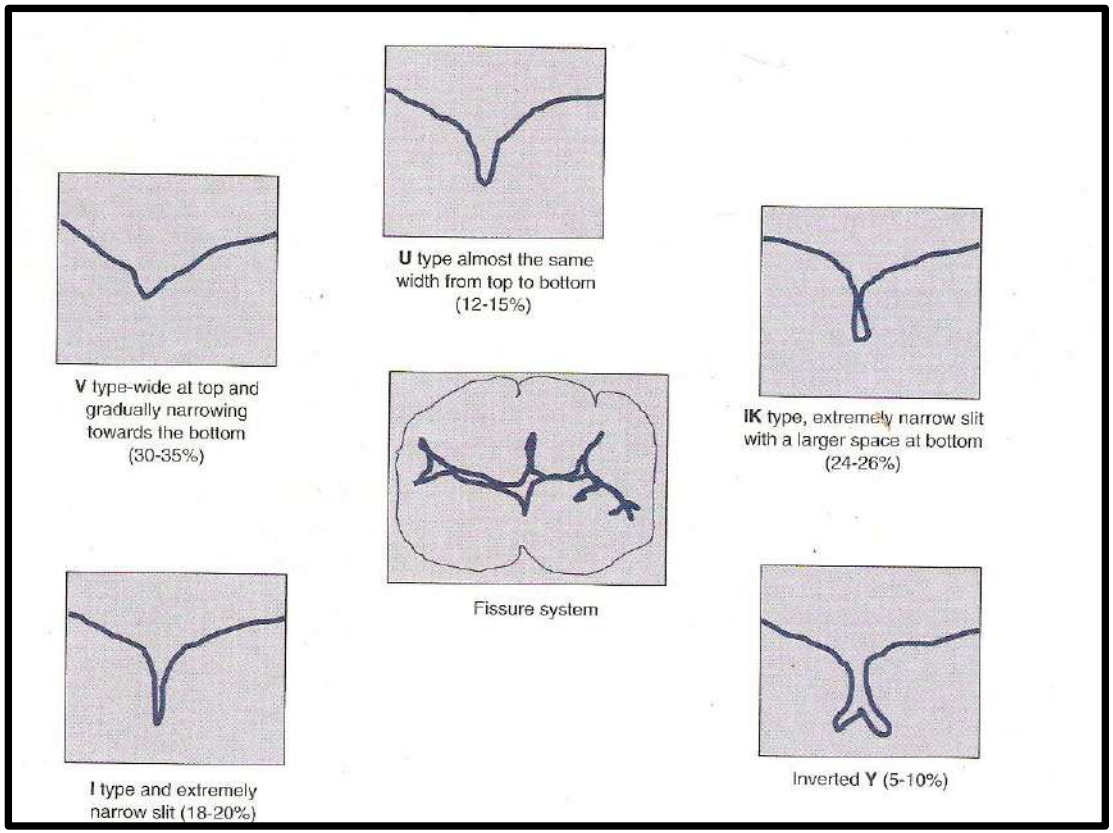
Morphology of Fissures

- Pit and fissures are enamel faults, narrow shafts or cracks of some length whose blind ends are directed more or less towards DEJ.

- Differs from grooves, as grooves are shallow linear depressions formed by perfect joining of different lobes.

Nango (1960) classified fissures into 4 types:




V type-wide at top and gradually narrowing towards the bottom (30-35%)
U type almost the same width from top to bottom (12-15%)
IK type, extremely narrow slit with a larger space at bottom (24-26%)
Fissure system
I type and extremely narrow slit (18-20%)
Inverted Y (5-10%)

Diagnosis of Pit and Fissure Caries

- The most important elements in diagnosis of pit and fissure caries are clinical judgment and experience.

- Diagnosis is based on tactile evaluation with an explorer and visual assessment of the enamel experience (visual – tactile inspection)

- Recently the use of explorer in the evaluation of pit and fissure caries has been eliminated because:

1. Fear of damaging the enamel lining of pit and fissure, resulting in caries development.
2. More rapid progression when enamel caries is present.
3. Probing is unreliable in caries detection.

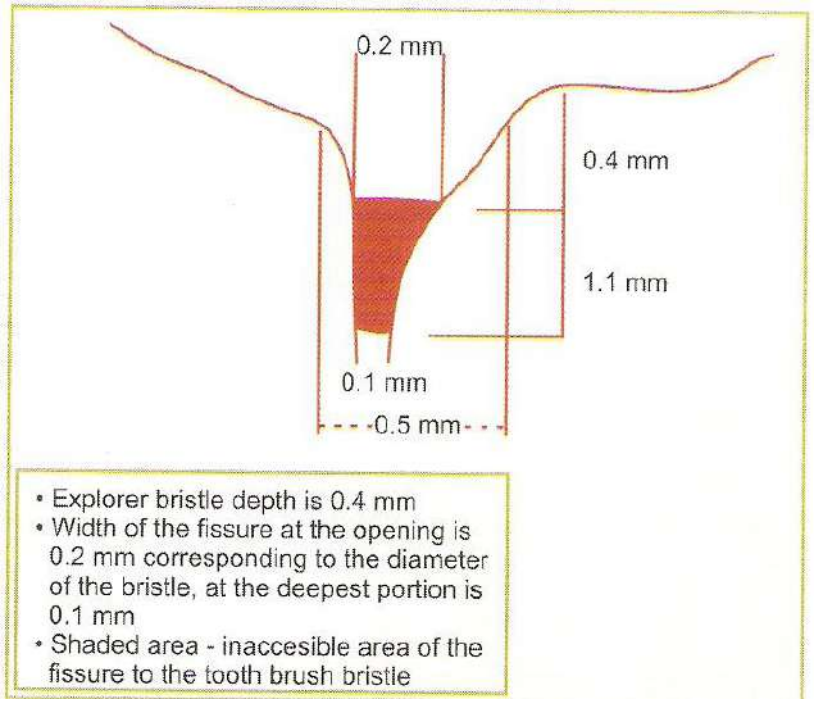
(Soderholm,1995; Workshop on Guidelines for Sealant Use, 1995)

- Currently, there are a number of techniques that aid the dentist in diagnosing pit and fissure caries such as :
    1. Conventional, xero-radiographic and digital radiography.
    2. Fibreoptic transillumination.
    3. Laser fluorescence.
    4. Electrical resistance.
    5. Electronic caries detector

    (Soderham, 1995; Workshop on Guidelines for Sealant Use, 1995; Angmar-Mansson and ten Bosch, 1993; Peers et al., 1993)

Why Pit & Fissures Are More Prone To Caries ??

Diagrammatic Representation Of A Deep Fissure



Pit and Fissure Treatment Alternatives

- With pit and fissure caries, a no. of treatment options are available to the dental practitioner:
  - Observation only.
  - Sealant placement.
  - Preventive resin restoration.
  - Preventive restorations (glass ionomer-resin preventive rest.)
  - Amalgam, glass ionomer or posterior composite restoration.

Fissure Sealants

- Fissure sealants are materials which are designed to prevent pit and fissure caries when they are applied to the occlusal surface of the teeth in order to obturate occlusal fissures and to remove sheltered environment in which caries may thrive.

  - Roide House

- Fissure sealants are plastic coatings placed on the occlusal surface of posterior teeth which forms a mechanical barrier between tooth and oral environment.

  - Dowe

Evolution of Pit and Fissure Sealants

- 1895 – Wilson, used dental cements in pit and fissures to prevent caries.
- 1923 – Hyatt, proposed a technique called prophylactic odontomy.
- 1929 – Boedecker, proposed technique called fissure eradication.
- 1939 – Gome, used polymers as sealants. Used solution of cellulose nitrate in organic solvent to fill surface enamel made porous by attack of acids.
- 1955 – Bunocore, advocated the filling of pit and fissures with bonded resins.

- Mid 1960's – First material used experimentally as sealants were based on cyanoacrylates. Never marketed.
- 1965 – Bower, reported Bis-GMA development.
- 1968 – Raydhorse, used Bis-GMA monomer using MMA diluent together with amine polymerization system. Noticed 30% reduction in caries.
- 1970 – Bunocore, used the same system with UV light system polymerization initiator i.e. Benzoin Methyl Ether.

Materials used as Sealants

- Cyanoacrylates :
    1. Discovered in late 1950's.
    2. Used as surgical adhesive and tooth sealant.
    3. In presence of moisture, they polymerize to hard and brittle polymer on etched teeth.
    4. Discontinued due to low shelf life and high unstability.

- Polyurethanes :
    1. Example : Epoxylite.
    2. Poor mechanical properties and oral durability.
    3. Toxicity.

- Dimethacrylates :
    1. MMA is highly volatile and lack penetration.
    2. Enamite, a new sealant utilizes MMA-PMMA system initiated by butyl boron.
    3. Binds better and less affected by water.

- Glass ionomer :
    1. Developed by Mclean and Wilson.
    2. Hydrophilic, good adhesion, fluoride release.
    3. Used as fissure sealant where orifice exceeds 100 um.

Classification

BASED ON	TYPES	CHARACTERSITICS
I. Curing	First Generation Sealants.	Activated by UV light of wavelength 350 nm. No more used, as a u-v light is harmful to the body. Example: Nuva seal, Nuva cote.
	Second Generation Sealants.	Self curing or Chemical curing resins, based on catalyst-accelerator system. e.g. Concise(3M)
	Third Generation Sealants.	Activated by visible light of wavelength 430 – 490 nm. Example: Fissurit (Voco) Delton (Johnson and Johnson)
	Fluoride containing Sealants	Double protection

II. FILLERS	1. (Unfilled) 2. Semi-filled 3. Filled	Flow is better. More resistant to wear.
III. COLOUR	1. Transparent / Clear	Esthetic but difficult to recall at interval examination.
	2. Tinted	Can be easily identified.
	3. Opaque	Can be easily identified.
	4. Pink	Fluoride releasing.

Requisites for an Efficient Sealer

- Given by Brauer in 1978.

1. Adequate viscosity.
2. Adequate working time.
3. Rapid cure.
4. Good and prolonged adhesion to enamel.
5. Low sorption and solubility.
6. Resistance to wear.
7. Cariostatic action.
8. Minimum irritation to tissues.

Age ranges for Sealant Application

- 3 - 4 years of age – Primary Molar.
- 6 – 7 years of age – First Permanent Molar.
- 11 – 13 years of age – Second Permanent Molars and Premolars.

Selected Patient Approach

- Given by Simonson in 1983.
- Classifies patients into 3 groups:

1. Group I : Caries free patient judged at no risk to decay.
2. Group II : Patients judged to be at moderate risk to decay.
3. Group III : Patient with rampant caries at high risk to decay.

Sealant placement should be done for Group II patients.

FACTORS IN LOW, MODERATE AND HIGH CARIES RISK ASSESSMENT.

CHILDREN	ADULTS
Low risk - no new or incipient carious lesions in the past year	**Low risk** - no new or incipient carious lesions
Moderate risk (any of the following) - one new, incipient or recurrent carious lesion in the past year - deep or noncoalesced pits and fissures - high caries experience in siblings or parents - history of pit and fissure caries - early childhood caries - frequent sugar exposures - decreased salivary flow - compromised oral hygiene - irregular dental visits - inadequate fluoride exposure - proximal radiolucency	**Moderate risk (any one of the following)** - one to two new, incipient or recurrent carious lesions during the past three years - history of numerous or severe caries - deep or noncoalesced pits and fissures - frequent sugar exposures - decreased salivary flow - irregular dental visits - inadequate fluoride exposure
High risk Two or more new, incipient or recurrent carious lesions in the past year, or two or more of the following: - deep or noncoalesced pits and fissures - siblings or parents with high caries rate - history of pit and fissure caries - early childhood caries - frequent sugar exposures - decreased salivary flow - compromised oral hygiene - irregular dental visits - inadequate fluoride exposure - proximal radiolucency	**High risk** Three or more carious lesions in the past three years, or two or more of the following: - history of numerous or severe caries - deep or noncoalesced pits and fissures - frequent sugar exposures - decreased salivary flow - irregular dental visits - inadequate fluoride exposure - compromised oral hygiene

Modified from American Dental Association Council on Access, Prevention and International Relations[5] and Niessen and DeSpain.[6]

Indications

Caries risk, regardless of the age of the patient, should be a major criterion for selecting teeth for selecting teeth for sealant application.

- Presence of deep occlusal pit and fissures of newly erupted teeth (molars and premolars).
- Presence of lingual pits or palatal pits in relation to upper lateral incisors and molars.
- Presence of incipient lesion in pit and fissures.
- Medical history with factors associated with increased caries incidence and xerostomic medications.

- The fossa selected for sealant placement is well isolated from another fossa with a restoration.
- The area selected is confined to a fully erupted fossa, even though the distal fossa is impossible to seal due to inadequate eruption.
- An intact occlusal surface is present where the contralateral tooth surface is carious or restored; this is because teeth on opposite sides of the mouth are usually equally prone to caries.

- Sealant material can be flowed over a conservative class I composite or amalgam to improve the marginal integrity, and into the remaining pits and fissures to achieve a extension for prevention.

Contra – Indications

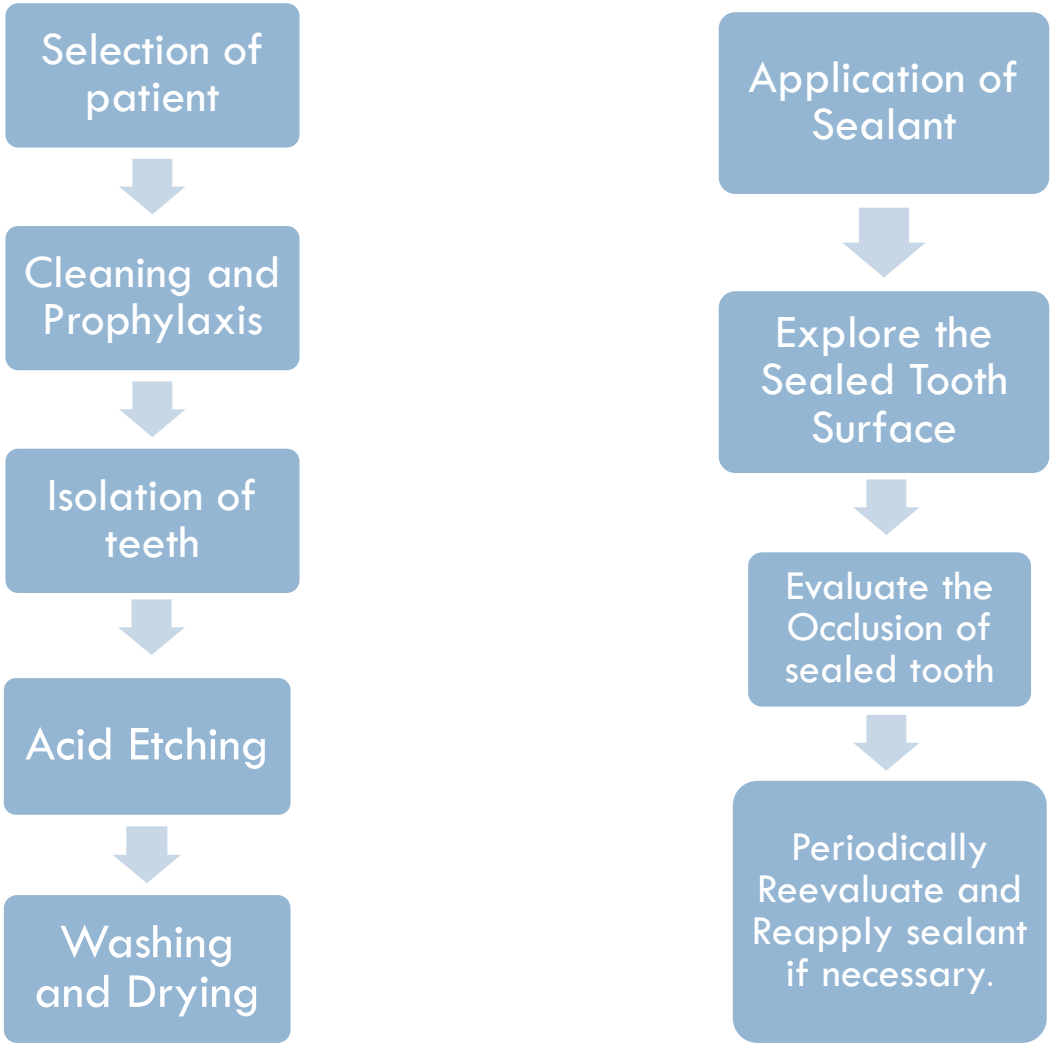
- An open occlusal carious lesion with extension into dentin..
- A large occlusal restoration is already present.
- Teeth cannot be isolated adequately such as partially erupted teeth.
- Presence of proximal caries extending on to occlusal surfaces.
- Patient's risk pattern (caries free or extensive caries pattern in both primary and deciduous dentition)

- Pit and fissure morphology not at risk for caries i.e. wide and self cleansing pits and fissures.

- Uncooperative children.(getting adequate dry field is a problem)

  - Recommendations from Workshop on Guidelines of Sealant Use: Journal of Public Health Dentistry 1995:55;259-302

Procedure for Application



Cleaning And Prophylaxis:

- Prophylaxis of the tooth surface to be sealed should be carried out via pumice slurry applied with a
    1. Rubber cup
    2. Pointed bristle brush in a prophy angle

- An alternative method is to clean the surface with a air-polishing device using a sodium bicarbonate slurry system. (Goldstein and Parkins, 1995).

- Rinse the tooth surface thoroughly to remove the prophylactic paste, slurry and oral debris.

- If sodium bicarbonate slurry has been used, it is necessary to neutralize the retained slurry with phosphoric acid for 5 to 10 seconds.

- Once the tooth surface is thoroughly cleaned, rinse and air dry the surface.

Note: Not to use a paste containing fluoride as it compromises with acid etching and thus sealant effectiveness.

Isolation of Teeth:

- The tooth should be isolated from salivary contamination by:

Rubber Dam Isolation

Cotton Roll Isolation

- Isolation of teeth is important because salivary contamination is the major cause of loss of sealants in one year.
    - Amir Azarpazhooh, Patricia A. Main. Pit and Fissure Sealants in the Prevention of Dental caries in Children and Adolescents: a Systematic Review. JCDA :March 2008, 8 (2)

Acid Etching:

- Occlusal surface of teeth etched with 30 – 50 % solution of phosphoric acid liquid / gel with a :
    1. Fine brush.
    2. Cotton pledget.
    3. Minisponge.

- Exposure time varies from:
    1. 20 seconds – permanent teeth.
    2. 30 seconds – primary teeth.
    3. Another 15 seconds – fluorosed teeth.

- (IADR Sealant Symposium, 1991)

- According to Norman O. Harris, Franklin Garcia – Goday, etching time for :
    1. Permanent teeth – 1 min.
    2. Primary teeth – 1 min 30 seconds.
    3. Fluorosed teeth – 1 min 45 secinds.

- Gently rub the etchant applicator over the tooth surface, including 2 to 3 mm of the cuspal inclines and reaching into any buccal and lingual pits and grooves that are present.

- Prevent spillage onto the inter-proximal surface as it causes gingival irritation and sealing of adjacent surfaces.

- Etching of the enamel surface produces microscopic porosities in enamel.
- Sound enamel etched with phosphoric acid is affected at 3 levels microscopically.

1. Etched zone :
   - Approximately 10 um in depth.
   - Increase in surface area and reduced surface tension that allows resin to wet the etched enamel more readily.
2. Qualitative Porous zone :
   - 20 um in depth.
   - Relatively large porosities are seen in this zone and can be distinguished qualitatively from adjacent sound enamel via polarized light microscopy.

3. Quantitative Porous zone :
    - 20 um in depth.
    - Relatively small porosities are created by the etching process.

- Clinical studies indicate that a 15 second etch is adequate for sealant retention and no additional benefit received from longer etching times of 45 or 60 seconds.
    - D. Locker and A. Jokovic. Prevention. Part 8: The use of pit and fissure sealants in preventing caries in the permanent dentition of children. British Dental Journal 2003:195(7)

Rinse And Dry Etched Tooth Surface :

- Rinse the etched tooth surface with an air water spray for 30 seconds.
- Removes the etching agent and reaction products from etched enamel surface.
- Dry the tooth surface for at least 15 seconds with uncontaminated compressed air.

- (IADR Sealant Symposium, 1991)

- Dried, etched enamel should have a frosted white appearance.

- If enamel does not have this appearance, repeat the etching process.
- If salivary contamination occurs at this stage, repeat the entire process.

Application of Sealant :

- Apply the sealant material to the etched tooth surface and allow the material to flow into the pits and fissures.
- Material is first placed in fissures where there is maximum depth.
- Should not only fill the fissures but should have some bulk over the fissures.
- After completely covered with the sealant, material is brought to a knife edge approximately half way up the inclined plane.

- Avoid incorporating air bubbles as they may lead to marginal leakage.
- If voids are present, additional sealant can be added without the need of additional etching.
- With autopolymerizing sealants, working time varies from 1 to 2 minutes.
- With photoactivated sealants, the setting reaction is initiated by exposing the sealant to visible light and usually requires 10 to 20 seconds for complete setting.

- American Dental Association Specification No. 39 for Pit and Fissure Sealants classifies sealants according to their curing method:
    1. Chemical (type I) and
    2. External-energy-cured (type II).

SAFETY AND EFFICACY DATA

- Specification No. 39 established the following requirements:

1. that the working time for type I sealants is not less than 45 seconds.

2. that the setting time is within 30 seconds of the manufacturer's instructions and does not exceed three minutes.

3. that the curing time for type II sealants is not more than 60 seconds.

4. that the depth of cure for type II sealants is not less than 0.75 millimeters.

5. that the uncured film thickness is not more than 0.1 mm.

Enamel – Resin Interface :

- Sealant materials do not simply bond to the enamel surface but actually penetrate into the micro - porosities created during the etching process.

- Infiltration of the etched enamel results in formation of resin tags, which provides the mechanical means of sealant retention.

- Resin tags penetrate to the depth of 25 to 50 um, with some tags penetrating to a depth of 100 um.

- Resin tags serve a number of functions:

1. Provide a mechanical means of retention in sealant.

2. Provide resistance to demineralization by acid products from plaque by surrounding the enamel crystals.

3. Creates a protective barrier against bacterial colonization of the sealed fissure and does not allow passage of nutriments into the fissure.

Explore the Sealed Tooth Surface :

- Explore the entire tooth surface for pits and fissures that may not have been sealed and for voids if any.

- If deficiency is present, apply additional sealant material.

Evaluate the Occlusion of Sealed Tooth Surface :

- To determine whether excessive sealant material is present and needs to be removed.

- Occlusal adjustment should be done to avoid discomfort due to excessive material.

MOLAR WITH PIT AND FISSURE SEALANT

- Also evaluate the interproximal regions for inadvertent sealant placement by performing tactile examination with an explorer and passing dental floss between contact regions.

- Periodically Reevaluate and Reapply Sealant as Necessary:
  - For loss of material.
  - Exposure of voids in the material.
  - Caries development.

- The need for reapplication of sealant material is highest during the first 6 months after placement.

Invasive Sealants

- The invasive sealant approach is commonly employed since micro-invasive treatment of the lateral fissure walls removes organic plus aprismatic enamel and surface debris, and thereby enhances adhesion of resin materials to the occlusal enamel.

- Any enamel caries is removed using a miniature high speed diamond bur, air abrasion particle beam or erbium laser, with care being taken to ensure that the preparation is conservative and remains within enamel.

- The enamel is then etched and a sealant placed. For more extensive lesions showing involvement of the DEJ, a preventive resin restoration (PRR) is undertaken.

Efficacy of Sealants

- For a sealant to be effective, first of all it should be retained which further depends upon:
    1. Technique of application.
    2. Type of sealant material.
    3. Morphology of tooth surface.
- With complete retention, sealed surfaces are virtually impervious to decay.
- Studies using chemically activated sealants report:

    92 – 96 % retention – after 1 year.

    67 – 82 % retention – after 5 years.

    41 – 57 % retention – after 10 years.

- After 15 years, 1 study showed complete sealant retention of 27.6 % and partial retention of 35.4 %.
  - (Dental Sealants. Journal of American Dental Association 1997; 128: 485-488)
- Retention of sealants can be enhanced by :
  1. Proper isolation of teeth.
  2. Use of resin bonded materials.
  3. Application of sealants after complete eruption.
  4. Good operator techniques.

  - Amir Azarpazhooh, Patricia A. Main. Pit and Fissure Sealants in the Prevention of Dental caries in Children and Adolescents: a Systematic Review. JCDA :March 2008, 8 (2)

- Auto polymerizing sealants have high long term retention rates, with 60% of surfaces remaining covered after 5 to 7 years.

- Visible light curing sealants have retention rates similar to auto polymerizing sealants.

- Fluoride-containing visible light cured sealants have only been evaluated in short term studies but have retention rates similar to auto polymerizing and conventional light cured sealants for the equivalent follow-up periods.

- Retention rates for glass ionomer cements, both conventional and resin-reinforced, are significantly lower than that of resin based sealants and their use is not recommended.

  - D. Locker and A. Jokovic. Prevention. Part 8: The use of pit and fissure sealants in preventing caries in the permanent dentition of children. British Dental Journal 2003:195(7)

Sealant as Part of a Total Preventive Package

- Sealants are used to protect the occlusal surface.
- So, a major effort should be made to incorporate the use of sealants along with other primary preventive dentistry procedures, such as fluoride therapy.
- Whenever a sealant is placed, a topical application of fluoride should follow if at all possible.
- In this manner the whole tooth can be protected.

- Ripa and collegues conducted a 2-year study for children in second and third grades assessing the effectiveness of a 0.2% fluoride mouthrinse used alone compared with a rinse plus sealants.

- The study results showed that only 3 out of 84 subjects developed occlusal lesions receiving rinse plus sealants as compared to 24 occlusal lesions in in 51 rinse subjects.

- The conclusion was that caries could be completely eliminated by the combined use of these two preventive procedures.

Cost effectiveness of sealants

- Although sealants provide a significant degree of caries protection for pits and fissures, the use of sealants has been limited in the past owing to questions regarding cost – effectiveness.

- Bear in mind that not every tooth receiving a sealant would necessarily become carious, hence the cost of preventing a single carious lesion is greater than the cost of a single application.

- Sealants would be most cost-effective if they could be placed over only those teeth that are destined to become carious.

- In a clinical setting, it is estimated that it costs 4-6 times more to treat a tooth than to seal. However, the benefit-cost ratio for caries inactive subjects amounted to only 0.3, while for caries active group, it was 1.0.

- Hence, sealing of the fissures for the caries prone is beneficial.

- It is suggested that fissure sealants should not be routinely used in all children and all teeth, but based on individual risk evaluation.

- The cost of placing sealants may be further reduced by as much as 80% if sealants are placed by dental auxiliaries either in the dental office or in a school based public dentistry facility.

Several Studies on Pit & Fissure Sealants

First Author(s)	Pub. Year	Type of sealant	N at start	Age at start	Caries Risk Determination	Follow-up Years	% Full Retention (at final exam)	% Effectiveness (at final exam)
Buonocore	1970 1971	UV-light	60	4-15 (mean 9)	Caries-free individuals with well-coalesced occlusal surfaces excluded	2	87%	99% - permanent teeth 87% - primary teeth
McCune Horowitz	1973 1976 1977	UV-light Nuva-Seal	128 301 429	K, 1st, 6th, 7th grades, Total	Sealant placed on paired and unpaired teeth (usually homologue had already decayed)	5	42% (50% and 26% in paired and unpaired teeth after 4 years)	30% - younger group 38% - older group 98% - where sealant completely present 50% unpaired sealed teeth developed caries; 26% of paired sealed teeth, 41% paired control teeth
Brooks Mertz-Fairhurst	1976 1984	Nuva-Seal, Delton	385	6-8	Caries-free children excluded (about 48% of those screened). 79% of possible first permanent molar pairs treated.	7	31% Nuva-Seal, 66% Delton	12% Nuva-Seal, 55% Delton (10% of completely sealed teeth became carious-combined data from both sealant types)
Sheykholeslam Houpt	1978 1979 1983	Delton	205	6-10 (mean 7.5)	Evidence of caries and a pair of caries-free homologous first permanent molars (21% screened were eligible).	6	58%	56%
Charbeneau	1977 1979	Kerr, Chem-cured	143	5-8	81% of possible first permanent molar pairs included	4	52.4%	53.4%
McCune	1979	Delton	200	6-8	Child had at least one carious tooth	3	87%	85%
Thylstrup	1976 1978	Concise Chem.-polymer.	217	7	40% one first permanent molar pair; 60%; two pairs	2	60%	98% - full 50% - partial 10% - lost
Richardson Gibson	1980 1982	Chem-cure, pink colored	266	2nd grade	80% of eligible molars, teeth sealed if sound or "sticky"	5	67.4%	51.2%
Vrbirc	1983 1986	Contact Seal	244	6.8	76% of possible first permanent molar pairs	5	52%	55%

First Author	Pub. Date	Study design	Control/ comparison	Type of sealant	N at start	Age at start	Follow-up years	Caries Risk Determination	Outcome	Conclusions
Leverett	1983	Half-mouth, benefit/cost analysis	Sealants on one side, restorative care on other	Nuva-Seal	292	6-9	4	Caries-active (sealants placed on a carious surface) Caries-inactive (sealant placed on sound surface)	1 year retention – 52%, re-sealed; After 4 years, sealed surfaces 74% less caries increment than unsealed	Benefit cost ratios based on time or costs were more favorable for caries-active. Sealants should not be used unless evidence of past or current caries experience.
Weintraub	1993	Retrospective cohort, patient records, Life table analysis, cost-effectiveness	Children with none, any or 4 molars sealants; children with and without prior restorations	Varied	275	7.4	5.8 – mean (up to 11 years)	Restorations on first molars prior to sealant placement on remaining molars	8-year survival: sealed teeth with and without prior restoration – 85% and 94%; unsealed teeth – 23% and 46%	Cost savings from sealants was obtained within 4-6 years for children with prior restorations; after 8 years without prior restorations
Heller	1995	Retrospective cohort study, patient health center records	96 children with and 17 without sealants, sealed and unsealed teeth	Delton	113	1st grade	5	Tooth surfaces rated sound, "incipient," or frank caries	Decay rates for initially sound sealed and non-sealed surfaces were 0.81 and 0.125 (OR=1.63); for initially incipient surfaces, .108 and .518 (OR=8.88)	Initially sound teeth were unlikely to become carious in 5 years; sealants more effective in preventing further caries on surfaces initially with incipient lesions
Kumar	1997	Survival analysis	Sealed high risk first molars (65% sites) compared to unsealed low risk first molars (35% sites)	Helioseal, Delton	1,122	7-9	4	Eligibility required child's prior caries experience. Teeth with shallow anatomy, occlusal or proximal D or F excluded	Retention (with some resealing) – 65-82%; Time to restoration or caries similar for both groups. Cum. Survival rate for 4 years: .89-.94	Targeting approach was effective.
Carlsson	1997	Prospective study, tx based on caries risk assessment, radiographs used	High risk children (121) received sealant, low risk did not (83)	Helioseal-F (fluoride)	204	6-7	2	Risk based on salivary mutans streptococci, lactobacilli, buffer capacity, past caries experience, cariogenic diet	76.6% complete sealant retention, first molar DFS and dfs incidence lower for sealed group, but NS, enamel caries incidence sig diff in both dentitions	Two-year caries incidence was 11-70% lower in high risk sealed group (range based on dentition and outcome measure)
Mass	1999	Prospective study of two groups receiving sealants; sealant delayed 3 months on one side	Group 1 – mean deft =2.40 (low risk), Group 2 – mean deft = 6.60 (high risk);	Helioseal	52	6-8	0.5	Initially, deft "Microbial replica" measured occlusal *S. mutans*	For both groups, *S. mutans* was sig. reduced immediately after sealing and lasted up to six months.	Sealants reduced bacterial levels for both low and high risk groups.

Indian Studies

- SUBRAMANIAM P., KONDE S., MANDANNA D. K. in 2008 conducted a study to evaluate the retention of glass ionomer used as a fissure sealant when compared to a self-cure resin-based sealant.

- One hundred and seven children between the ages of 6-9 years, with all four newly erupted permanent first molars were selected.

- Two permanent first molars on one side of the mouth were sealed with Delton, a resin-based sealant, and the contra lateral two permanent first molars were sealed with Fuji VII glass ionomer cement.

- Evaluation of sealant retention was performed at regular intervals over 12 months.

- The following conclusions were drawn from the study:
  1. The retention of the resin sealant was superior to that of the glass ionomer cement at the end of 1 year.
  2. The retention of sealants on mandibular teeth was superior to that on maxillary teeth.

- MENON PREETHA V, SHASIHKIRAN N. D., REDDY V. V. S in 2007 conducted a study to assess the antibacterial properties of pit and fissure sealants and to compare the antibacterial properties of fluoride-releasing and non-fluoride pit and fissure sealants.

- The commercially available pit and fissure sealants used for the present study were as follows:
  1. Teethmate-F1 (Kuraray Co Ltd., Japan)
  2. Helioseal-F (Vivadent, Germany)
  3. Helioseal (Vivadent, Germany)

- The study revealed that Teethmate F-1 was the only sealant that showed zones of inhibition against both the bacteria i.e. and hence the only active material with antibacterial properties.

- The other 2 sealants used, namely, Helioseal-F and Helioseal failed to show zones of inhibition.

- The significant difference in antibacterial action by two fluoride-releasing sealants suggests that the formulation of the compound has an effect on the antibacterial property.

Ahovuo-Saloranta A, Hiiri A, Nordblad A, Mäkelä M, Worthington HV. Pit and fissure sealants for preventing dental decay in the permanent teeth of children and adolescents. *Cochrane Database of Systematic Reviews* 2008, Issue 3.

- In this systematic review, 16 studies were included; 7 studies provided data for comparison of sealant versus control without sealant and 10 studies for comparison of sealant versus sealant.

- It was concluded that sealing is a recommended procedure to prevent caries of the occlusal surfaces of permanent molars.

- The effectiveness of sealants is obvious at high caries risk but information on the benefits of sealing specific to different caries risks is lacking.

Hiiri A, Ahovuo-Saloranta A, Nordblad A, Mäkelä M. Pit and fissure sealants versus fluoride varnishes for preventing dental decay in children and adolescents (Review) 2007; *Cochrane Database of Systematic Reviews* 2008, Issue 3.

- Four studies were eligible for inclusion in the review. Three of the four studies compared the effectiveness of sealants with fluoride varnish application, and one study compared the effectiveness of sealants and fluoride varnish combination with fluoride varnish alone.

- The age of children in the included studies was 5 to 9 years.

- There was some evidence of the superiority of pit and fissure sealants over fluoride varnish application in the prevention of occlusal decays.

- However, it remained unclear to what extent there is difference between the effectiveness of pit and fissure sealants and fluoride varnishes. Therefore, more high quality research is needed.

- No recommendations for the clinical practice could be given and the benefit of pit and fissure sealants and fluoride varnishes should be considered locally and individually.

Muller-Bolla M, Lupi-Pe´gurier L, Tardieu C, Velly AM, Antomarchi C. Retention of resin-based pit and fissure sealants: a systematic review. Community Dent Oral Epidemiol 2006; 34: 321–36.

- One hundred and twenty-four studies were identified, 31 of which were included.
- The retention rate of auto-polymerized and light-cured RBSs did not differ significantly.
- Light-cured RBSs had a significantly higher retention rate than fluoride-containing light-cured RBSs at 48 months.

Beiruti N, Frencken JE, van 't Hof MA, van Palenstein Helderman WH. Cariespreventive effect of resin-based and glass ionomer sealants over time: a systematic review.

- The aim of this study was to carry out a systematic review on the caries-preventive effect of these two types of sealant materials.
- Based on five exclusion criteria, 12 publications were included.
- There is no evidence that either resin-based or glass ionomer sealant material is superior to the other in preventing dentine lesion development in pits and fissures over time.

Amir Azarpazhooh, Patricia A. Main. Pit and Fissure Sealants in the Prevention of Dental caries in Children and Adolescents: a Systematic Review. Journal of Canadian Dental Association 2008; 8(2)

- A total of 303 articles were identified by the literature search; relevance was determined by examining the title and abstract of the articles.
- Thirty-eight original research studies met the inclusion criteria and following recommendations were made:

1. Sealants should be placed on all permanent molar teeth without cavitation as soon after eruption as isolation can be achieved.

1. Sealants should not be placed on partially erupted teeth or teeth with cavitation or caries of the dentin.

3. Resin-based sealants should be preferred, until such time as glass ionomer cements with better retention capacity are developed.

4. Sealants should be placed as part of an overall prevention strategy based on assessment of caries risk.

5. Sealants should be placed on the primary molars of children who are susceptible to caries.

Advantages of Sealants

- Sealants are minimally invasive and require no patient compliance after they have been applied .
- Sealants can be applied by auxiliary personnel.
- Long term sealant retention rates are high.
- Fully retained sealants are 100% effective and have been proven to halt the caries process.

Public Health Sealant Programs

Seal America: The Prevention Invention

- Is either School based or School linked or a combination of both.
- American Dental Association in combination with other oral health agencies has developed a program.

Arizona Dental Sealant Program

- Objectives:
  1. Reduce dental caries experience in children.
  2. Increase sealants for 8 year-olds' first molars and 14 year-olds' first and second molars.

Seal Dane

- School-based dental sealant program designed to provide free dental sealants to targeted elementary students in Madison and Dane County schools.
- This preventive program is held in various schools throughout the school year.
- Information regarding these programs is sent home with children from participating schools.

Halloween Sealant Day

- A one-day event on the last Friday of October coinciding with Wisconsin State Teacher's Convention when students have no school.
- This program offers free dental sealants to children whose families do not have dental insurance and who find it financially difficult to provide dental care for their children.
- Sealant services are provided through collaboration with Madison Area Technical College Dental Hygiene Program.

Children's Dental Health Program

- A unique program whose primary purpose is to teach children and their families how to have a healthy mouth and teeth for a lifetime. This program also provides comprehensive ongoing dental care for children enrolled in the program.

- **Initial dental appointments are 2-3 hours in length and include:**

1. dental health education information for child and parent.
2. dental exam and professional teeth cleaning.
3. fluoride treatment, x-rays or sealants as recommended – and with parent approval.

- Follow-up appointments: are made for children needing dental work with the clinic dentist (such as fillings or extractions). This will require another visit to the clinic with appointment times lasting about an hour .

Dental Sealant Grant Program (DSGP)

- Sponsored by the Southern Illinois University Carbondale (SIUC) Dental Hygiene Program.

- SIUC DSGP has been providing care in school settings for second and sixth grade children who are enrolled in free or reduced-cost lunch programs.

- While the DSGP stayed quite busy during the school year, the program was extended as a way to provide outreach to other organizations that work with children during the summer when school is not in session..

Summary

- The majority of all carious lesions that occur in the mouth occur on the occlusal surfaces. Which teeth will become carious cannot be predicted; however, if the surface is sealed with a pit-and-fissure sealant, no caries will develop as long as the sealant remains in place.

- Recent studies indicate an approximate 90% retention rate of sealants 1-year after placement. Even when sealants are eventually lost, most studies indicate that the caries incidence for teeth that have lost sealants is less than that of control surfaces that had never been sealed.

- Sealants are easy to apply, but the application of sealants is an extremely sensitive technique.

- The surfaces that are to receive the sealant must he completely isolated from the saliva during the entire procedure, and etching, flushing, and drying procedures must he timed to ensure adequate preparation of the surface for the sealant.

- Sealants are comparable to amalgam restorations for longevity and do not require the cutting of tooth structure. Sealants do not cost as much to place as amalgams.

- Relative to the potential for appropriate sealant use, however, actual placement is low.

- Public health departments have to work actively to establish school based or school linked sealant programs for children with limited access to preventive dental care.

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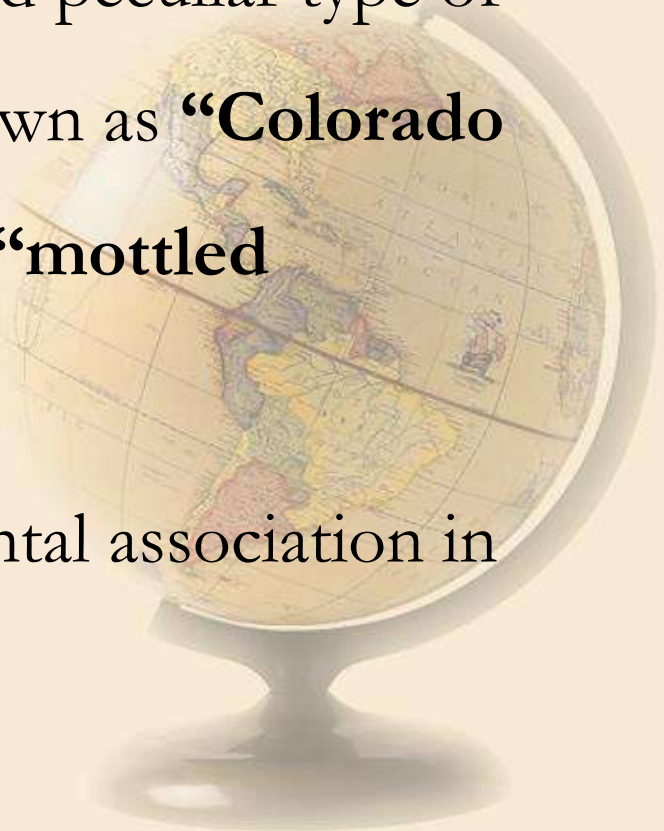
Thank You

FLUORIDES

History of fluorides

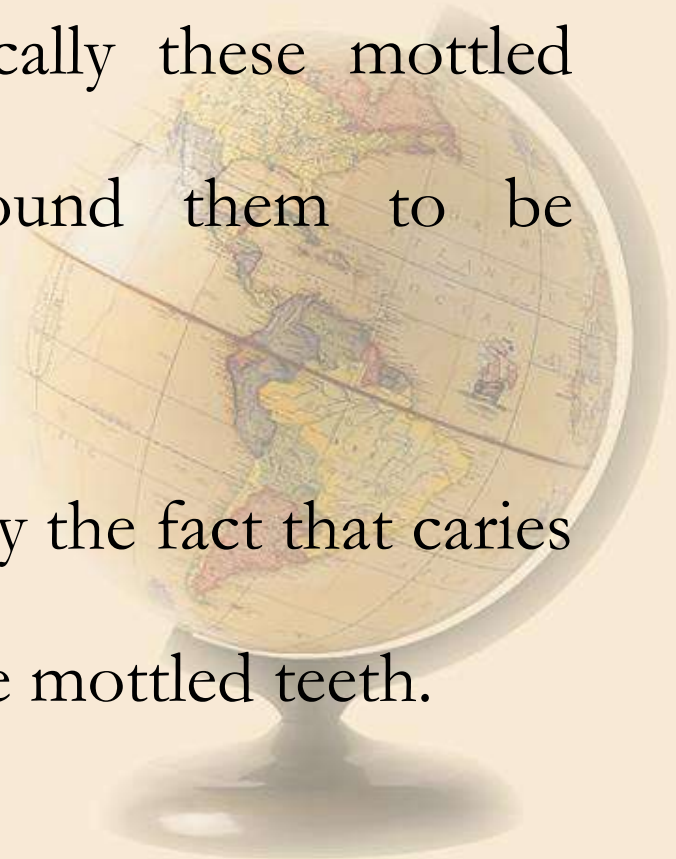
- 26th June 1886 → Henri Moissan
- Dr Fredrick Mckay - 1901- noticed peculiar type of stains on his patients. Locally, known as **"Colorado stains"** and he called these stains **"mottled enamel".**

  1908 –presented a case in state dental association in Boulder



1916 –Mckay and GV Black examined & reported that 85% of people were affected in colorado springs

- **Sir** G.V.Black studied histologically these mottled teeth sent by McKay and found them to be hypocalcified.
- **Meanwhile,** McKay was struck by the fact that caries experience was not higher in these mottled teeth.



Cause of mottled teeth……? McKay's observations

- occurrence of mottled enamel was localized in definite geographical areas, both in rich and poor areas.

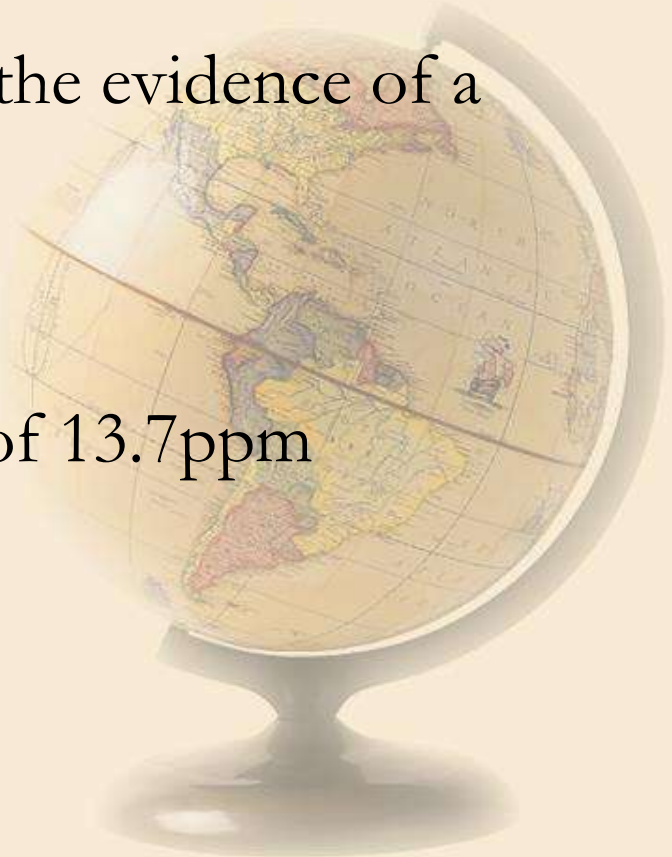
- high proportion of children were affected; only who had been born and lived all their lives in these endemic areas.

- 3 cities in Arkansas, where mottling occurred received water supply from one source, Fountain Creek.

- **These facts led him to believe that diet or environment was not the cause but something in the water supply might be responsible.**

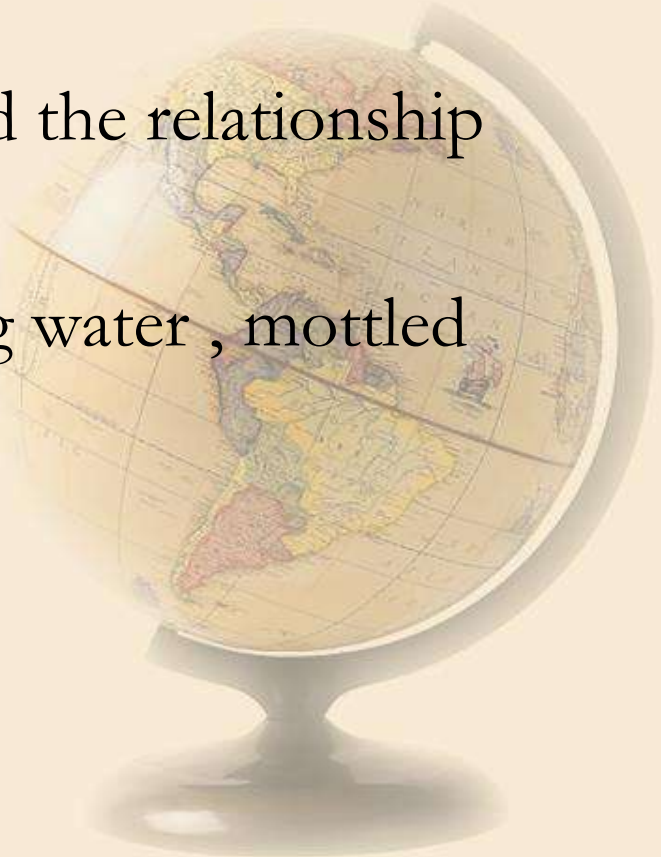
1931—Samples of water collected from Dakota, Bauxite and Colorado when examined by a chief chemist, Mr. H V Churchill, gave the evidence of a high level of Fluoride.

→ fluoride in bauxite water at level of 13.7ppm



SHOE LEATHER SURVEY

- Dr H Trendley Dean, in 1931carried out the famous Shoe Leather Survey which studied the relationship between Fluoride conc. in drinking water , mottled enamel and dental caries



- He concluded that water containing

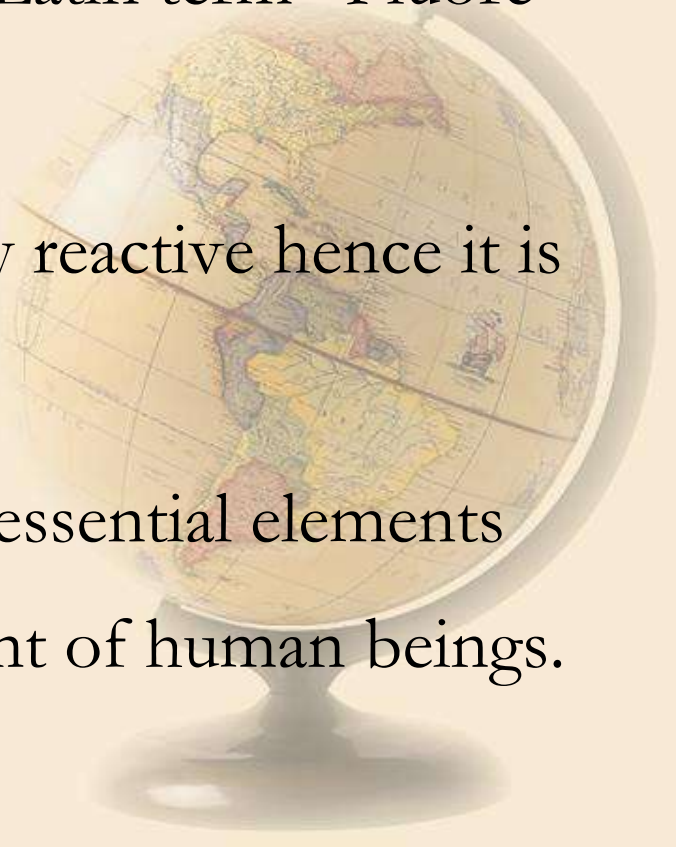
  > 1 ppm of Fluoride - mildest form of mottled enamel

  Higher the conc. - More severe the mottling

But an optimum level of fluoride upto 1ppm showed anticariogenic property without any mottling of teeth.

FLUORINE

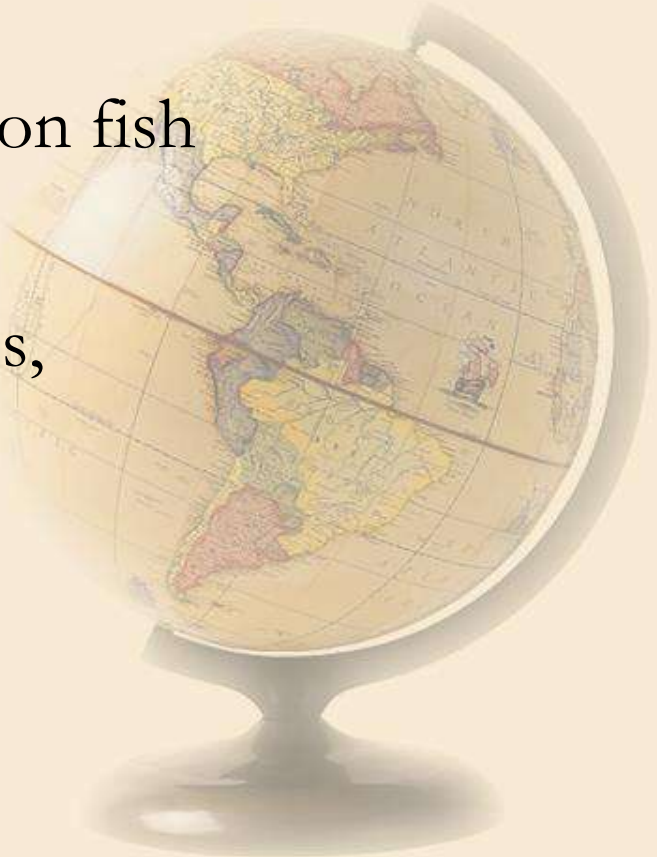
- Member of halogen with atomic weight 19 and atomic no 9
- Word fluorine is derived from the Latin term “Fluore” meaning “to flow”
- Most electronegative and extremely reactive hence it is rarely found in elemental state.
- One among the 14 physiologically essential elements for normal growth and development of human beings.



Source

- Minerals – Fluorspar, Cryolite,
  Fluorosilicates

- Food – Dried Mackerel, Salmon fish
  Tea leaves , milk , meat
  Vegetables like cabbages,
  potato and lettuce
  Cereals like Jowar
  Fruits like banana

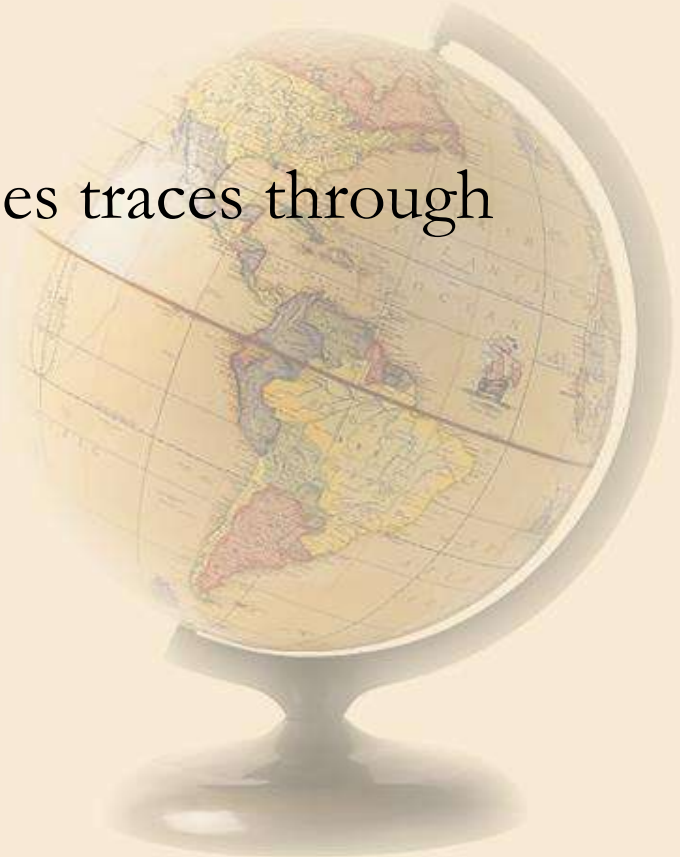


Metabolism

- Absorption – readily absorbed, mainly through stomach, lungs and rarely through skin.

- Excretion – urine, sweat, and faeces traces through milk, saliva, hair, tears

- Storage – Bone and Teeth



Conc. in ppm **Vs** Effects

- What is ppm? - 1mg in 1ltr of water.

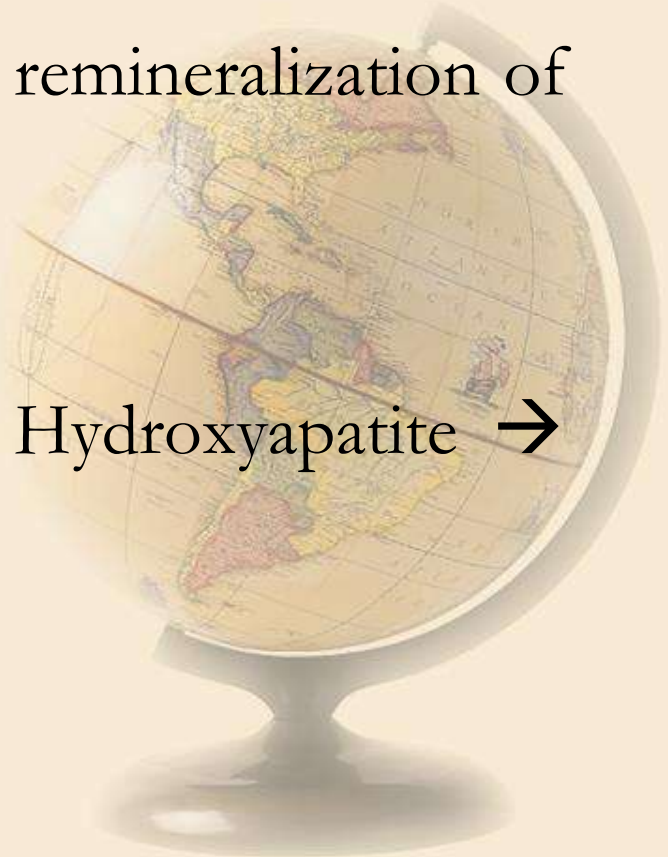
0.7 -1.2ppm	**Depending upon the temperature of the area**	**Prevents dental caries No dental/ skeletal fluorosis**
1.5 – 3.0 ppm	**Consumed over a period of 5 – 10 yrs or more**	**Dental fluorosis (milder form)**
4.0 – 8.0 ppm	**Consumed over a period of 15 – 20 yrs**	**Dental fluorosis (severe form) Skeletal fluorosis (milder form)**
> 8.0 ppm	**Consumed over a period of 5 – 10 yrs or more**	**Dental fluorosis (severe form) Skeletal fluorosis (severe form)**

Benefits of fluoride

- Two primary bio-chemical actions

- Inhibition of demineralization and remineralization of carious enamel.

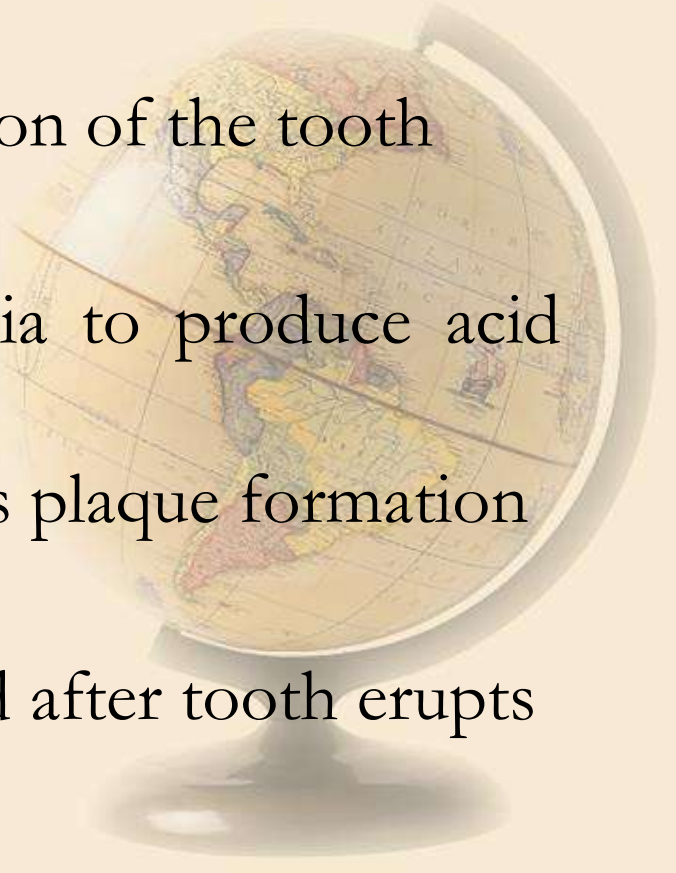
- Integration of fluoride ions into Hydroxyapatite → Fluorapatite



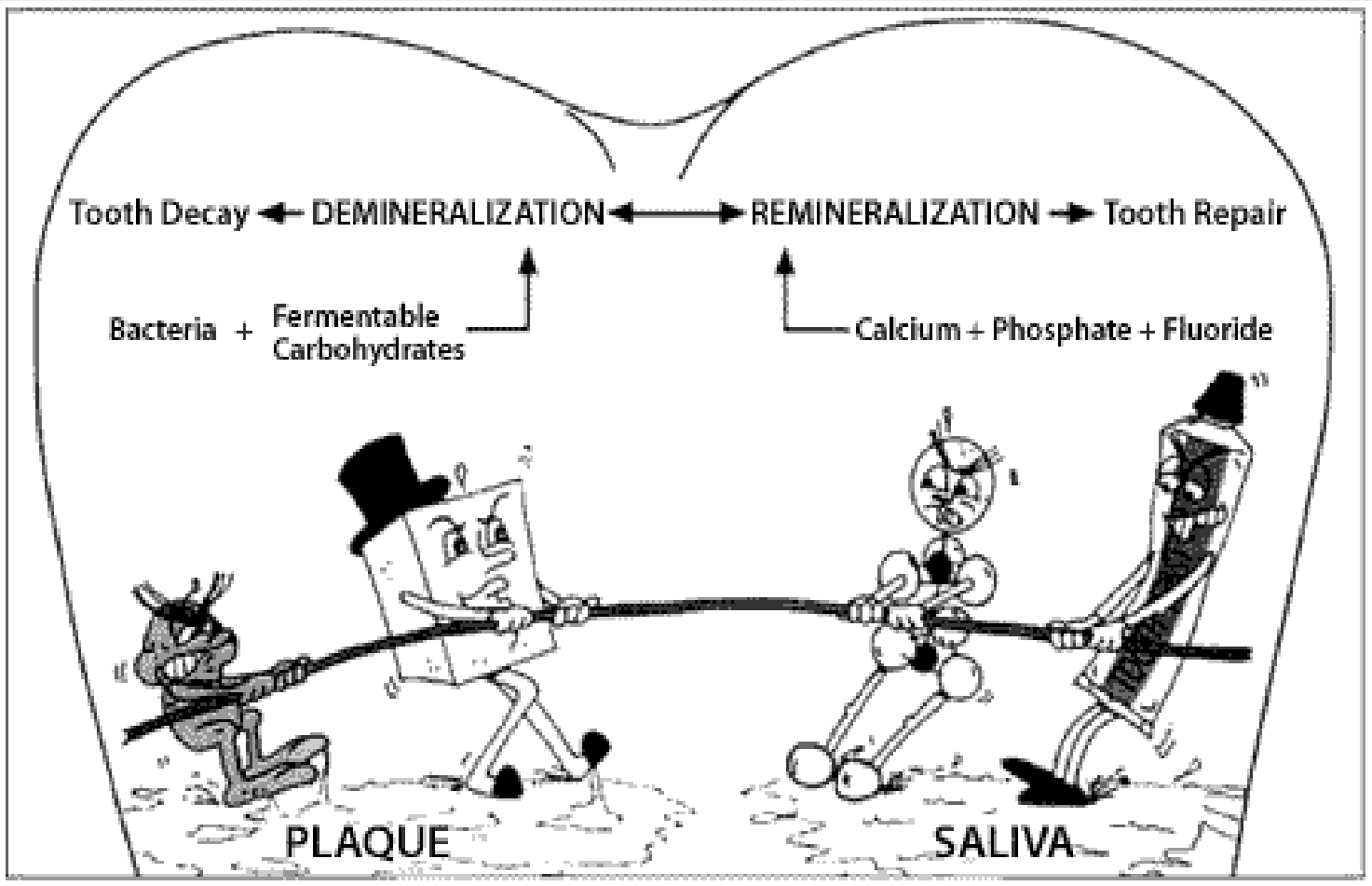
Mechanism of action of Fluoride

Fluoride protects teeth through three mechanisms

- Promotes remineralization and repair of the tooth surface and inhibits demineralization of the tooth
- Reduce the ability of oral bacteria to produce acid from carbohydrates, hence inhibits plaque formation
- Strengthens the enamel before and after tooth erupts



Opposing factors at WAR….!

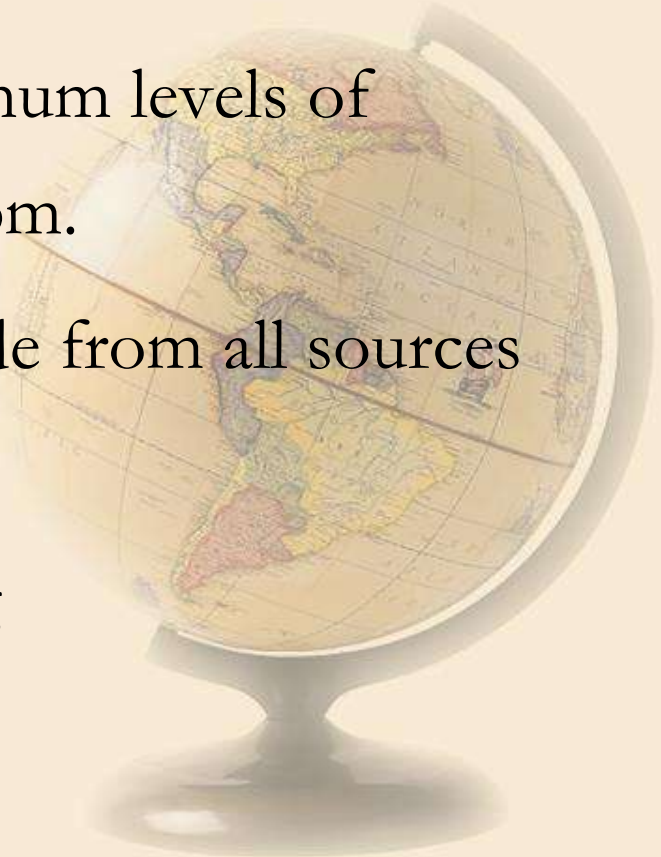


Safety aspects of fluoride in caries prevention

- Need for vigilance when employing fluoride therapy particularly in children.
- W.H.O. 1963 recommended optimum levels of fluorides for drinking water as 1ppm.
- The average daily intake of fluoride from all sources for

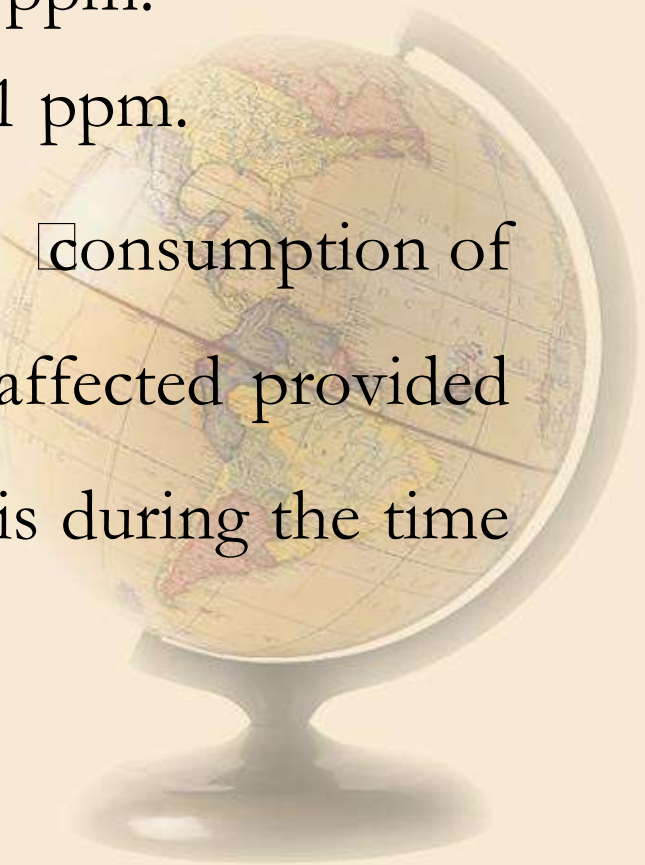
adults ------- 2 – 2.2 mg

children ------- 1.2 mg



Optimum fluoride levels

- In cold climate, recommended fluoride levels ----1.2 ppm
- In extremely hot climate, -------- 0.7 ppm.
- In moderate climate, ---------- 1 ppm.
- High temp - in mottling as there is consumption of water containing fluoride. Teeth affected provided the child lives in the area of fluorosis during the time of enamel mineralization.

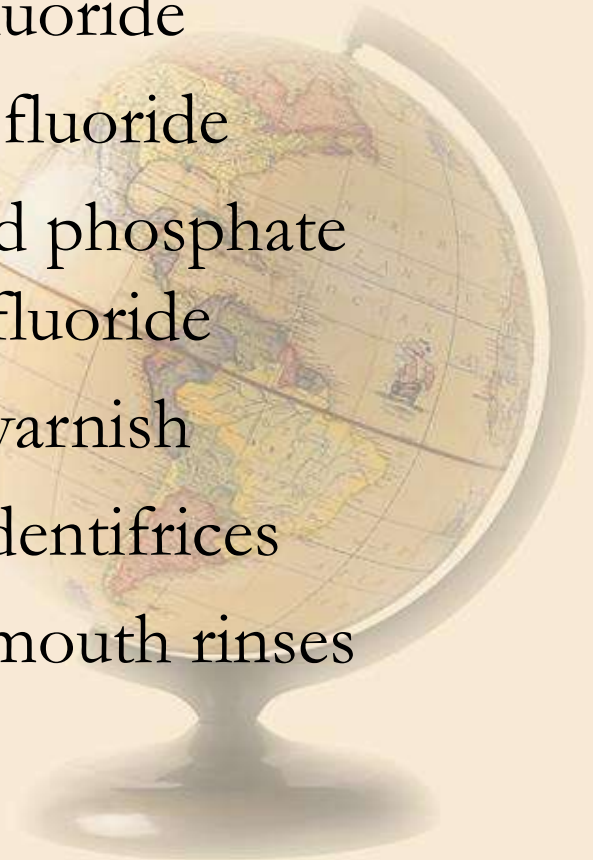


Routes of administration of fluorides

- **Systemic**
  - Water fluoridation
  - Salt fluoridation
  - Milk fluoridation
  - Fluoride tablets
  - Fluoride drops

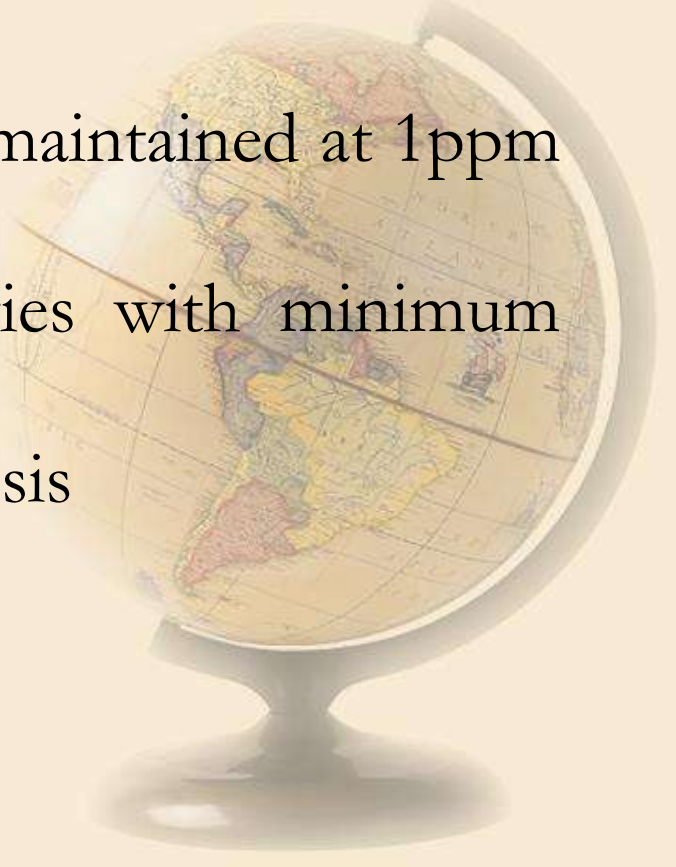
Topical

- Sodium fluoride
- Stannous fluoride
- Acidulated phosphate fluoride
- Fluoride varnish
- Fluoride dentifrices
- Fluoride mouth rinses



Water fluoridation

- Upward adjustment of fluoride ion conc in public water supply in such a way that the conc of fluoride ion in water may be consistently maintained at 1ppm by weight to prevent dental caries with minimum possibility of causing dental fluorosis



Controlled water fluoridation studies

- *Jan 25 1945*

  Grands Rapid (Michigan) Vs Muskegon

  Arnold .et.al (1953) – caries in 6 yr children

  - (after 6 ½ y) GR = ½ Muskegon

- *May 2 1945*

  Newburg (Newyork) Vs Kingston

  Ast et al (1956)

  - (after 10y) – 23.5 – 13.9% ↓

- *June 1945*

  Brantford (Ontario –Canada) Vs Sarnia

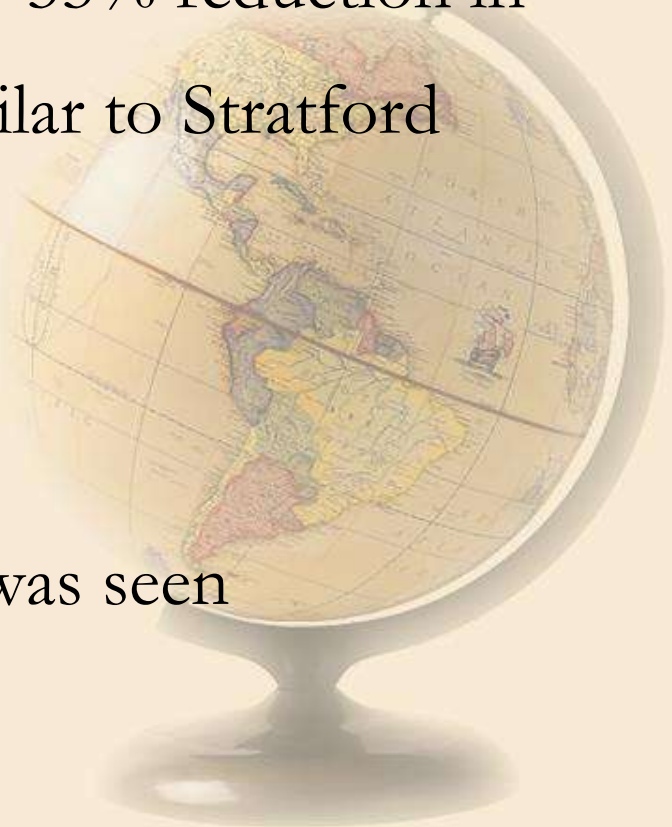
  Stratford – auxiliary control (1.3ppm)

  Brown & Poplove 1965 (after 17y) – 55% reduction in Ontario compared to Sarnia but similar to Stratford

- *Jan 1946*

  Evanston (Illinois) Vs Oak park

  after 14y – 49% reduction in caries was seen

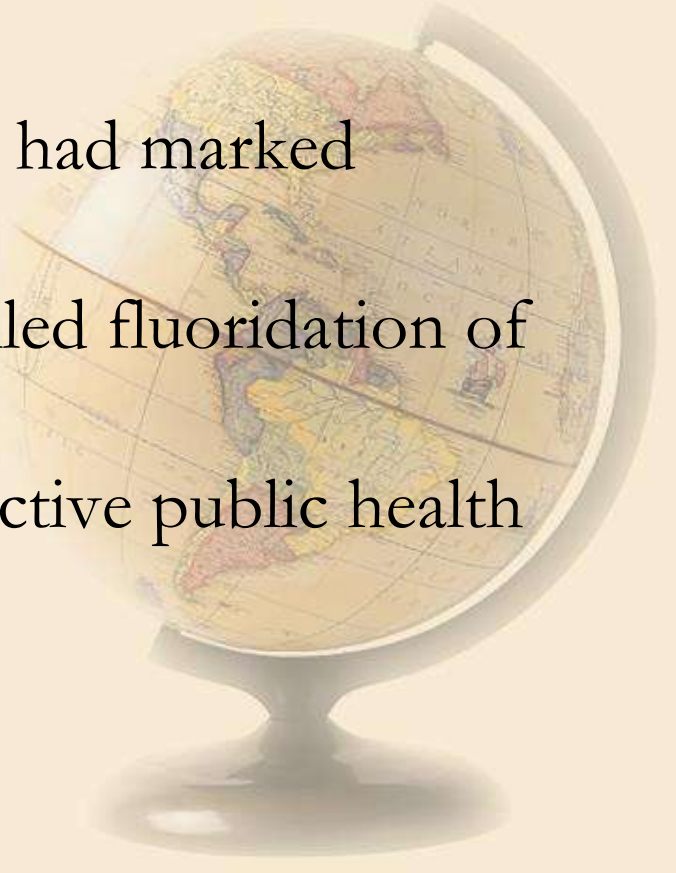


- *March 1953*

  Tiel (Netherlands) Vs Culumburg

  after 13y – 58% reduction

- *In 1958* – WHO – 1st report – 1ppm had marked preventive effect on caries & controlled fluoridation of drinking water was a practical & effective public health measure



Method of estimation of fluoride concentration in drinking water

- Sample collection
  - 500ml from the source
  - If storing→2cc 6N HCl →2.0PH
  - Determined before 2-3 months

Methods

1. Fluoride electrode coupled with standard PH meter

   - typical calibration curve

   - by applying electrode potential difference equation

   - direct PPM reading

2. Scot sanchis method

   – Zirconium alizarine (colorless)

↓

ZrF6 + alizarine sulfuric acid (yellow)

Fluoride compounds used in water fluoridation

(a) Fluorspar – (mineral containing varying amount of CaF_2)

(b) Sodium fluoride

(c) Silicofluoride

(d) Sodium silicofluoride

(e) Hydrofluorosilicic acid

(f) Ammonium silicofluoride

Types of equipment for water fluoridation

- **Saturator system:-**
  - 4% saturated solution of NaF

Limitations –

- high hard water level
- need to clean the gravel bed used for filtration

recomm – Small towns (< 3.8 million ltrs /day)

- **Dry feeder :-**
  - NaF / silicofluoride powder

Limitations –

- obstruction of pipes
- compacting of F while stocked in humid atmosphere

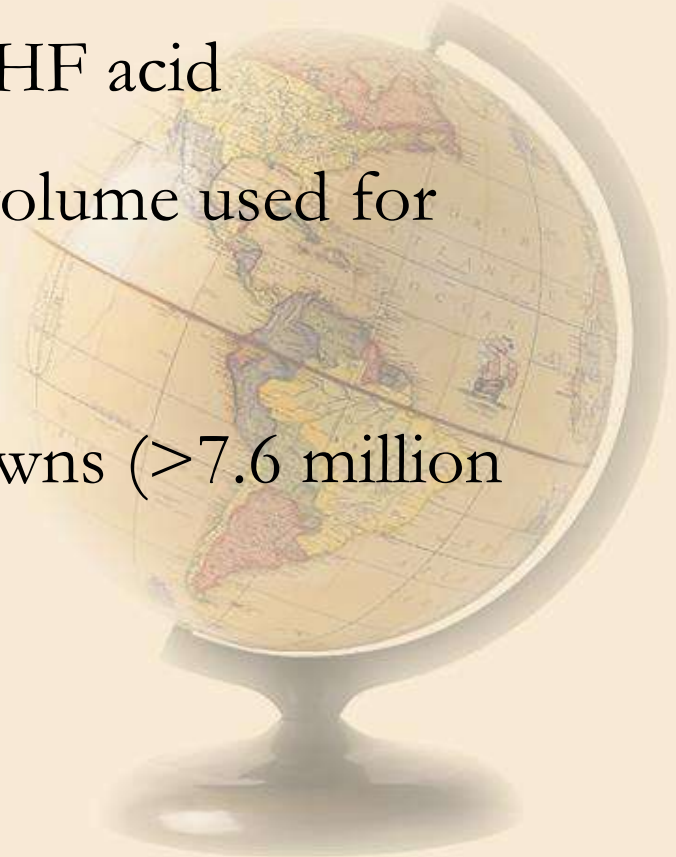
Recomm – medium sized town (3.8-19 millions ltrs /day)

- **<u>Solution feeder</u>:-**
  - Hydrofluorosilicic acid using volumetric pump

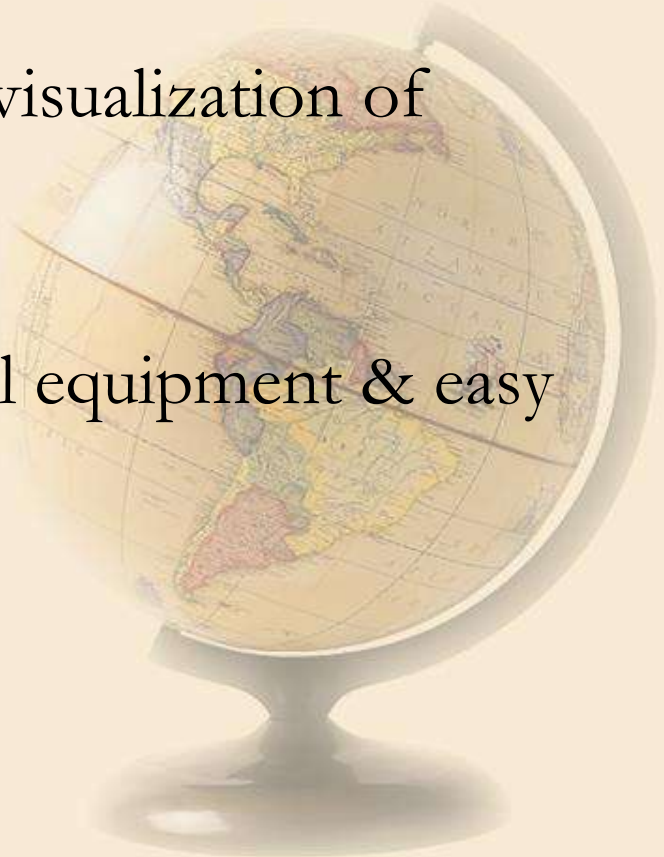
Limitations –

- equipment must be resistant to HF acid
- impricision in determining the volume used for small quantities

Recomm – medium sized & large towns (>7.6 million ltrs/ day)

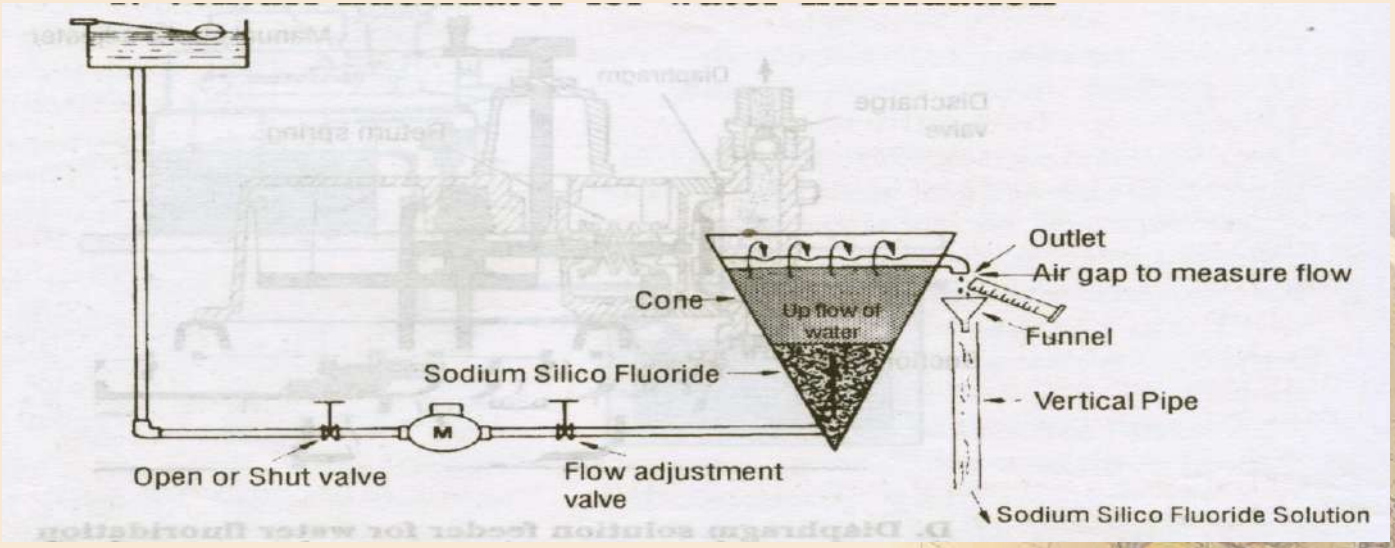


- **<u>Venturi fluoridation system</u> :-**
  - non electric system – J.N. Leo
  - activated by flow of water in main water lines
  - tank is made of plexiglass for visualization of chemical level
  - cost is 2/3 of the conventional equipment & easy to install



- **<u>Saturation – suspension cone</u>:-**

  Brazil – state of Rio Grande do sul

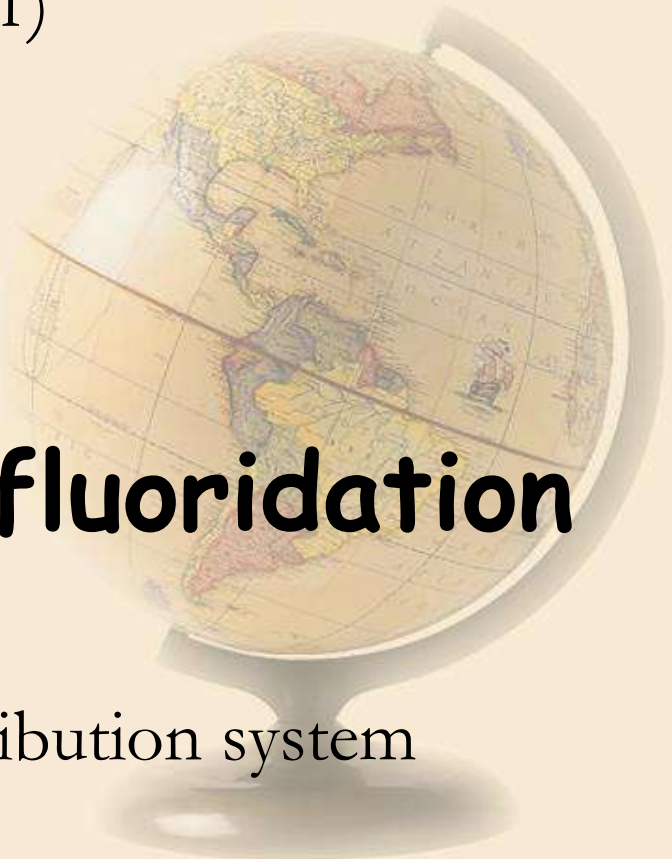


  – consists of upside down cone charged with a bag of sodium silicofluoride thro which a constant flow of water percolates

  – cone must of corrosion resistant material

Cost of water fluoridation

- In Hong Kong – annual cost of lab equipments – 7000 $/yr
  - 11% of total cost of chemicals – $ 0.002 /person /yr
- In USA, Us public health service (1981)
  - US $ 0.35 /person /yr
- In India , Rs 0.25/person /yr

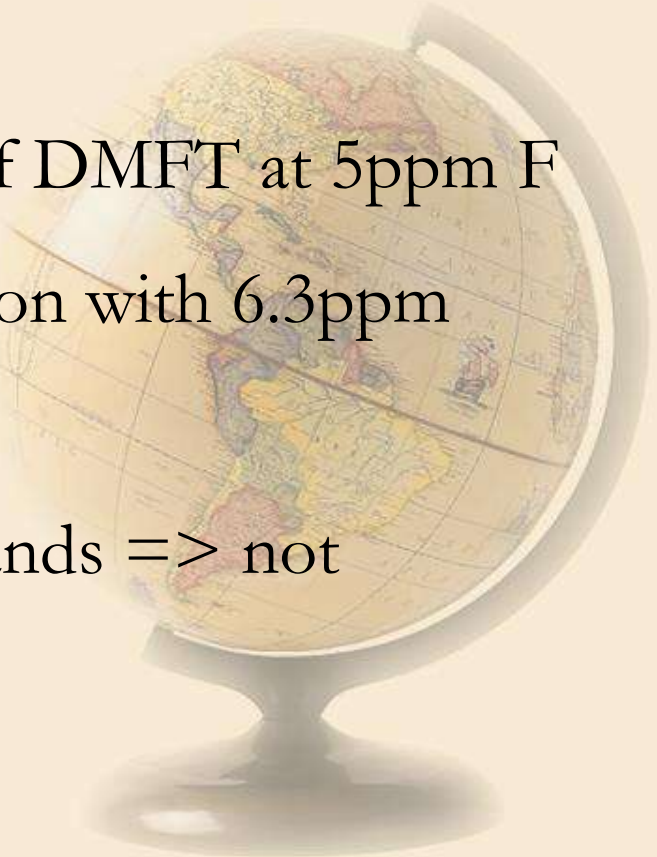


Limitation of water fluoridation

- Requires centralized pipe water distribution system

School water fluoridation

- Alternate to community water fluoridation
- Recommended fluoride level in school water – 4.5 -6.3 ppm F
- Effectiveness – 40-50% reduction of DMFT at 5ppm F
- Heifetz et al (1983) => 47% reduction with 6.3ppm compared to a control group
- 1st investigation – 1954 in Virgin islands => not satisfactory



- 1965 – Horowitz et al => 22% less DMFT in fluoridated school compared to other school
- 3 major studies – in Mainland, USA

Pike county, Kentucky
Elk lake, Pennsylvania
→ 1958 → Horowitz 1968
33% 35% ↓ after 8 yrs

Seagrove, North Carolina → 1968 → Heifetz et al in 1978
–none of them developed fluorosis
–after exposing to 6.3ppm F for 8 yrs

Salt fluoridation

- Switzerland since 1955; Wespi (1961) – 1st to promote the use of table salt as vehicle of fluoride
- By 1967 – ¾ of domestic salts in Switzerland - 90mg F / kg salt
- Recently – raised to 200, 250 and 350 mg F /kg salt
- Toth – 39% reduction in deft in 6yrs old Hungarian children with 250mgF/kg salt for 8 yrs compared to control group (7% ↑)
- Columbia, Hungary, Mexico & Switzerland

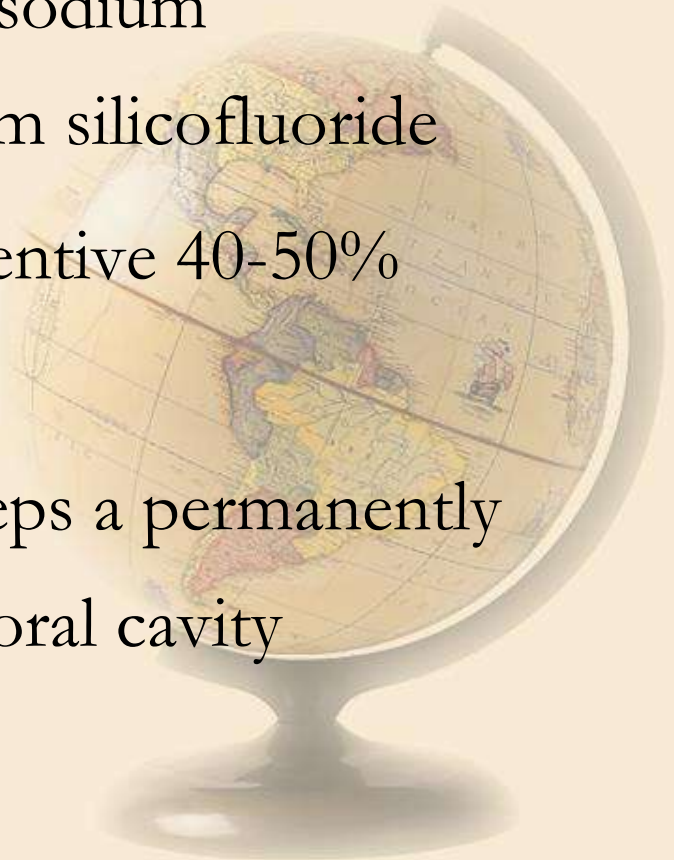
- Advantages
  - Holds good in developing countries in India where centralized water supply is not present
  - Permits individuals to accept or reject it
  - Inexpensive
- Disadvantages
  - F salt consumption is lowest when need for fluoride is more (early years of life)
  - Current view is that salt → Hypertension

Milk fluoridation

Liquid (pasteurized or sterilized)

Powder (containing variety of F agents)

- Compounds used – NaF, CaF, Disodium monofluorophosphate & Disodium silicofluoride
- Efficiency – moderate caries preventive 40-50% reduction with 5-15ppm F
- Reported that fluoridated milk keeps a permanently low level of ionized F with in the oral cavity promoting remineralization



Fluoride supplements

Tablets
Lozenges
Drops

→ NaF
→ APF

Tablets – available in dose of –

NaF →
- 2.2mg(1mgF)
- 1.1mg(0.5mgF)
- 0.55mg(0.25mgF)

Drops – 10 drops => 1mg F

Dosage acc to F conc of drinking water (Am acd of Peadrt)

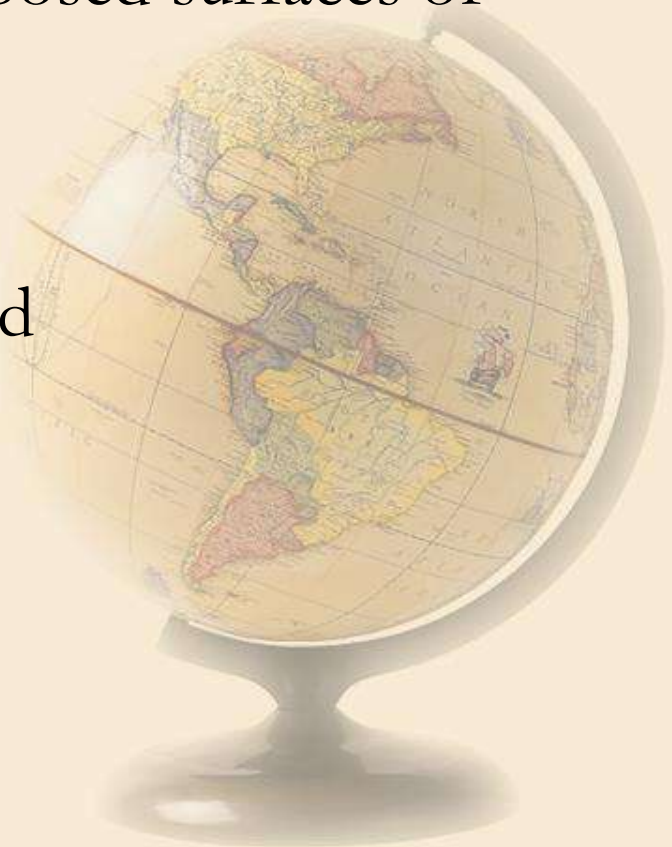
Age	< 0.3	0.3-0.7	>0.7
Birth – 2yrs	0.25	0	0
2-3yrs	0.5	0.25	0
3-14yrs	1.0	0.5	0

Topical fluorides

- Are delivery systems which provide fluoride for local chemical reaction to exposed surfaces of erupted dentition

→ Professionally applied

→ Self applied



Professionally applied Topical Fluorides

- Bibby in 1942 – repeated application of sodium & potassium fluoride reduced caries

NaF
APF
SnF2

-Aqueous solution
-Gel
-Prophylaxis paste
-Dental varnish

Comparison of Topical Fluoride agents

	NaF	SnF2	APF
Percent F	2%	8%	1.23%
ppm F	9,200	19,500	12,300
Frequency of application	4 weekly intervals at 3,7,11,&13yrs	1or 2/yr	1 or 2/yr
Taste	Bland	Disagreeable	Acidic
Stability	Stable	Unstable	Stable in plastic container
Tooth pigmentation	No	Yes	No
Gingival irritation	No	Occasional transient	No
Average effectiveness	29%	30%	28%

- Methods of application of topical F
  - Paint on technique
  - Tray technique
- Technique of topical F application

1) **Knutson's technique :-**

After prophylaxis → Thoroughly wetted with soln → Allowed to dry for 3-4 min → Three further applications With one week intervals

Recommended ages – 3,7,11 &13yrs

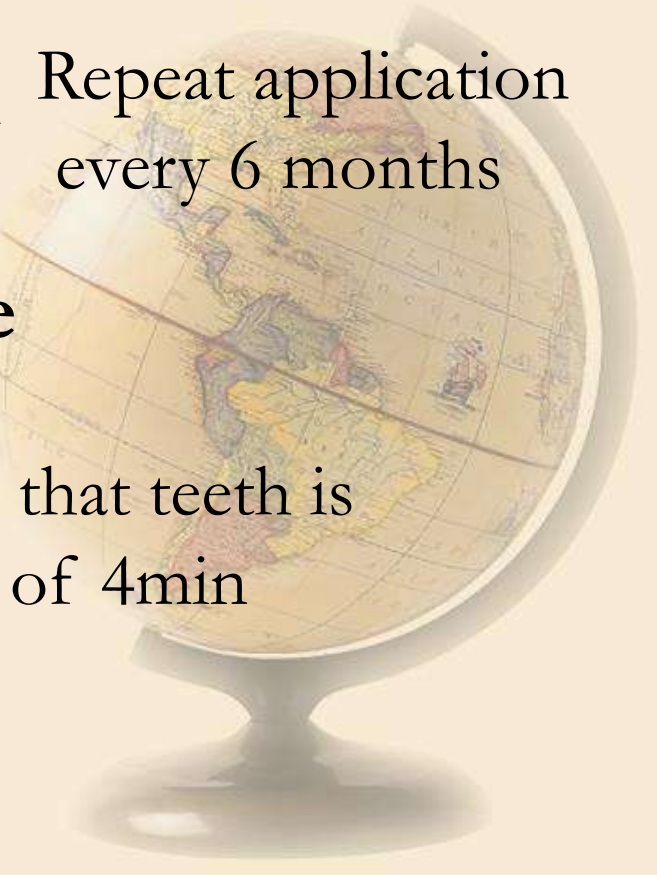
2) Muhler's single application technique

Through prophylaxis Including stripping of inter proximal surfaces → Teeth isolated & dried with Air

Kept moist with soln for 4min → Repeat application every 6 months

3) Mercer & Muhler technique

Same as Muhler's method except that teeth is kept moist for 30 sec instead of 4min



4) Dubbing & Muhler technique

Prophylaxis with SnF2 paste
(10 sec for each surface)
(unwaxed floss - interproximally)

+

4 min application of
standard Fluoride soln

5) Englader technique

-Soln or gel is applied in special maxillary & mandibular mouth pieces made of PVC

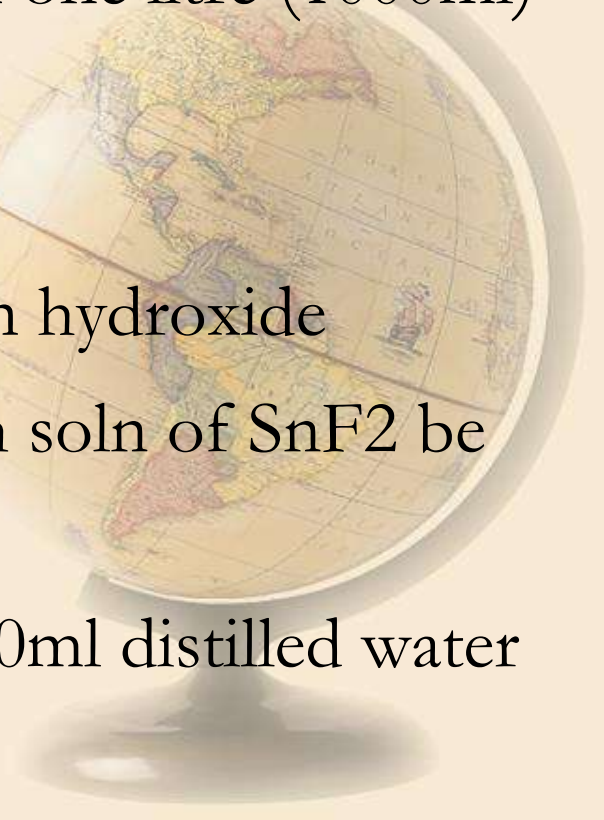
- Application time – 3min ; 3 times a week in schools

6) Szwejda – Knutson multiple chair technique

Same as Knutson's method , bit time taken per child is greatly reduced by using several chairs

Method of preparation of topical F

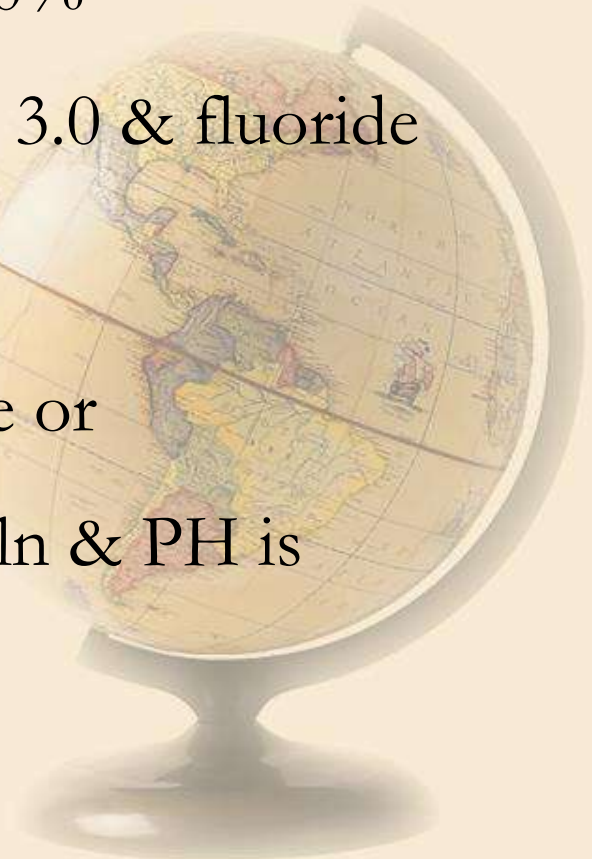
- **NaF –**
  - Available both in powder and liquid form. The compound recommended for use is 2% solution
  - Dissolving 20grms NaF powder in one litre (1000ml) distilled water in a bottle
- **SnF2 –**
  - Not stable – becomes cloudy – Tin hydroxide
  - Muhler et al - recommended fresh soln of SnF2 be prepared for each pt
  - 0.8 grms (1 capsule) dissolved in 10ml distilled water in plastic container



- **APF** – 1960 – Brudevold (at Forsyth dental center)

– Dissolving 20 grms of NaF in 1 ltrs of 0.1M Phosphoric acid & to this is added 50% hydrofluoric acid to adjust the PH at 3.0 & fluoride conc to 1.23% => Brudevold soln

– Gel – gelling agent – methyl cellulose or hydroxyethyl cellulose is added to soln & PH is adjusted b/n 4-5



Advantages

- **NaF**
  1) Acceptable taste.
  2) Stable if stored in plastic container and refrigerated.
- **SnF_2**
  1) Procedure frequency complies with 6 months recall appointment schedule
- **APF**
  1) Acceptable taste
  2) Stable if stored in Plastic container
  3) Procedure frequency complies with 6 months recall appointment schedule

Disadvantages of Topical fluorides

- NaF
  - Procedure requires FOUR visits to the dentist in a relatively short period of time
- SnF_2
  - Bitter metallic taste
  - Need to be freshly prepared for each application.
  - Not stable in solution
  - May cause reversible tissue irritations
  - Staining at margins of restorations

Fluoride varnishes

1) Duraphat :

- 1st Fluoride varnish in Germany
- Viscous yellow material containing 22600ppmF as NaF in a neutral colophonium base (NaF varnish containing 2.26% F in organic lacquer)

2) Fluorprotector

Clear polyurethane based product containing 7000 ppm F from an organic compound difluorosilane (silane fluoride with 0.7% F in a polyurethane based lacquer)

3) Carex

Contains lower fluoride conc than Duraphat (1.8% F)

Effectiveness :- Duraphat → Permanent → 30-40%
Primary → 7-44%

Fluorprotector → 1-7%

Carex → equivalent to Duraphat

Recommended application – Biannually

Technique

Oral prophylaxis

↓

Teeth are dried but not isolated with cotton rolls

↓

0.3-0.5 ml (6.9-11.5 mgF)

↓

Application is done on lower arch & then on upper arch

↓

Asked to keep mouth open for 4 min

↓

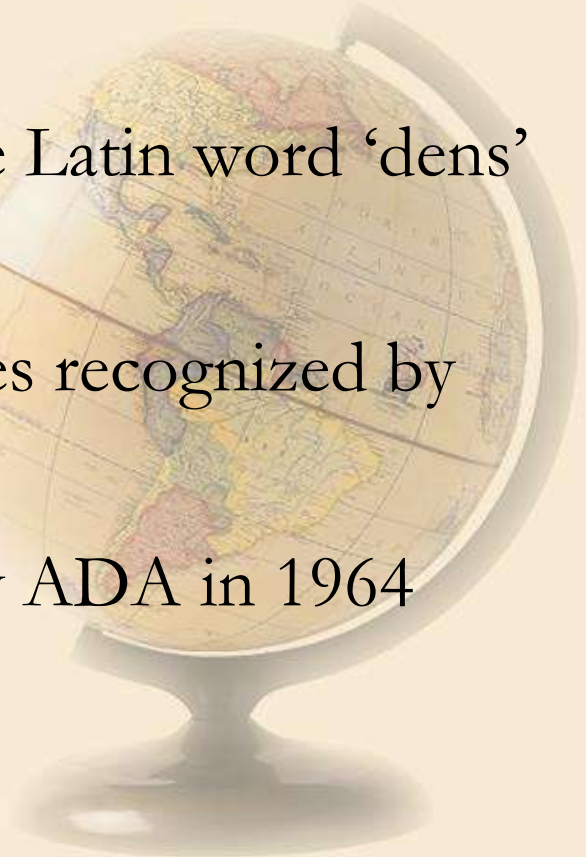
Pt asked not to eat or drink for 1hr & not to eat hard food till next day

Self applied topical F

- Dentifrices
- Gels
- Mouth rinses

F Dentifrices –

- The term 'dentifrice' derived from the Latin word 'dens' = tooth ; 'fricare' = to rub
- 1955 – SnF2 dentifrices – 1st dentifrices recognized by food & drug administration (FDA)
- 1st fluoride dentifrices was accepted by ADA in 1964

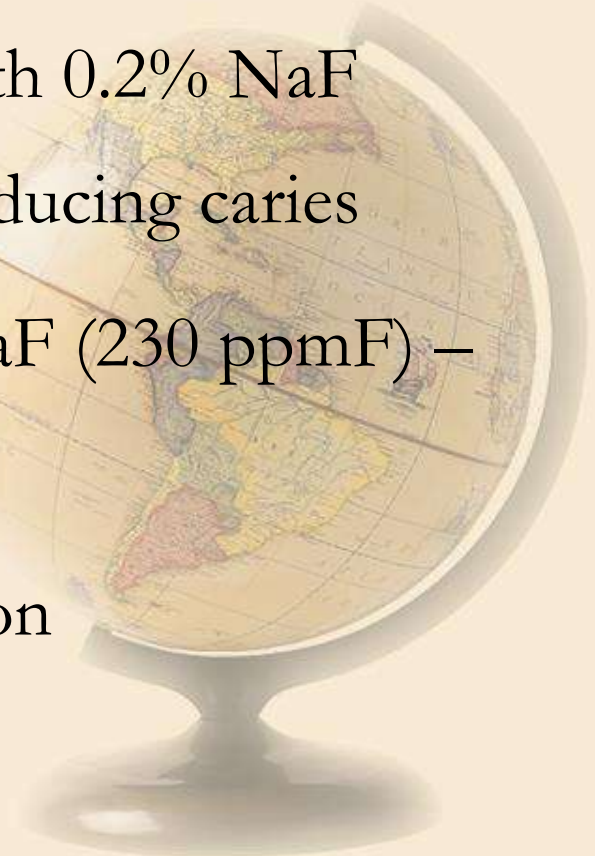


- Types of fluoride dentifrices
  1) NaF dentifrices
  2) SnF2 dentifrices
  3) Monofluorophosphate dentifrices
  4) Amine fluoride dentifrices
  5) Hexafluoro zirconate dentifrices

- Monofluorophosphate dentifrices
  - 1981 – most widely used agent in the world
  - Produced during 1940's in the research laboratories of Ozark Mahoning company in Tulsa, Okalahoma
  - Composed of one atom of phosphorus, 3 atoms of O2 & 1 atom of F
- Recommendation for F dentifrices use

Below 4 yrs	F toothpaste is not recommended
4-6 yrs	Brushing once daily with F paste & twice with out F paste
6-10 yrs	Brushing twice daily with F paste & once with out F paste
Above 10 yrs	Brushing twice daily with F paste

- **Fluoride mouth rinses**
  - Bibby et al in 1946
  - In mid 1960's – scandinavial researches – showed that biweekly rinse for 1 min with 0.2% NaF (1900 ppmF) was effective in reducing caries
  - Furthermore – daily – 0.05% NaF (230 ppmF) – gave – more caries protection
  - Effectiveness – 20-50% reduction



- Composition & usage

Source	F%	F ppm	Recommended usage
NaF	0.2	900	Weekly
NaF	0.02	100	Twice daily
NaF	0.05	225	Daily
APF	0.02	200	Daily
SnF2	0.1	243	Daily

Fluoride Dentifrices containing Anticalculus agent

-Pyrophosphates – prevents calcification of calculus by interfering with calcium & phosphate precipitation from saliva

Toxicity of Fluorides

Fluorides are extensively used in the practice of Dentistry to reduce the incidence of Dental caries.

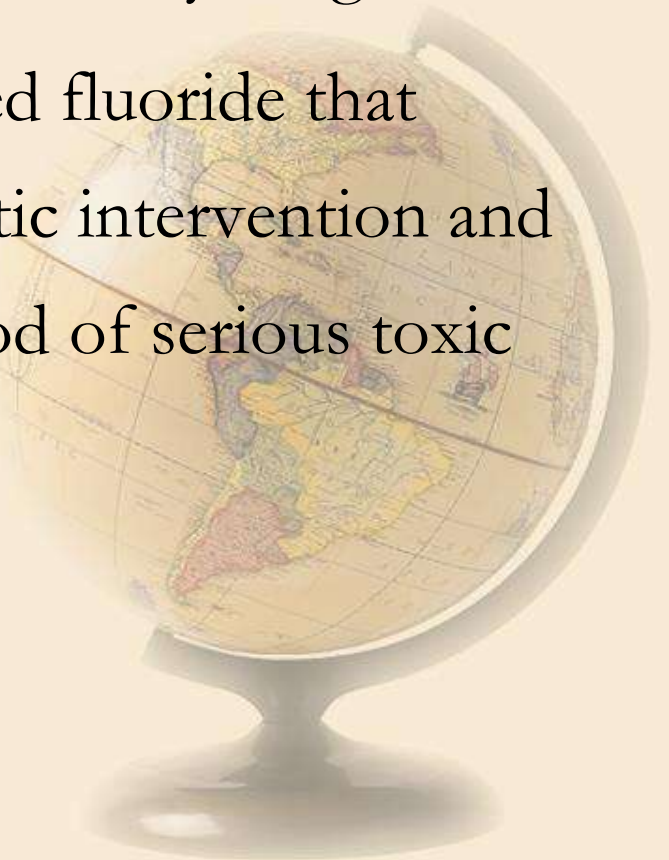
Used in excessive quantities, F. can produce toxic and even lethal outcome when ingested, inhaled or absorbed in to the body.

Toxicity of fluoride

- Probable toxic dose (PTD) : –

  5mgF/kg of body weight

- PTD is defined as "dose of ingested fluoride that should trigger immediate therapeutic intervention and hospitalization because of likelihood of serious toxic complications"

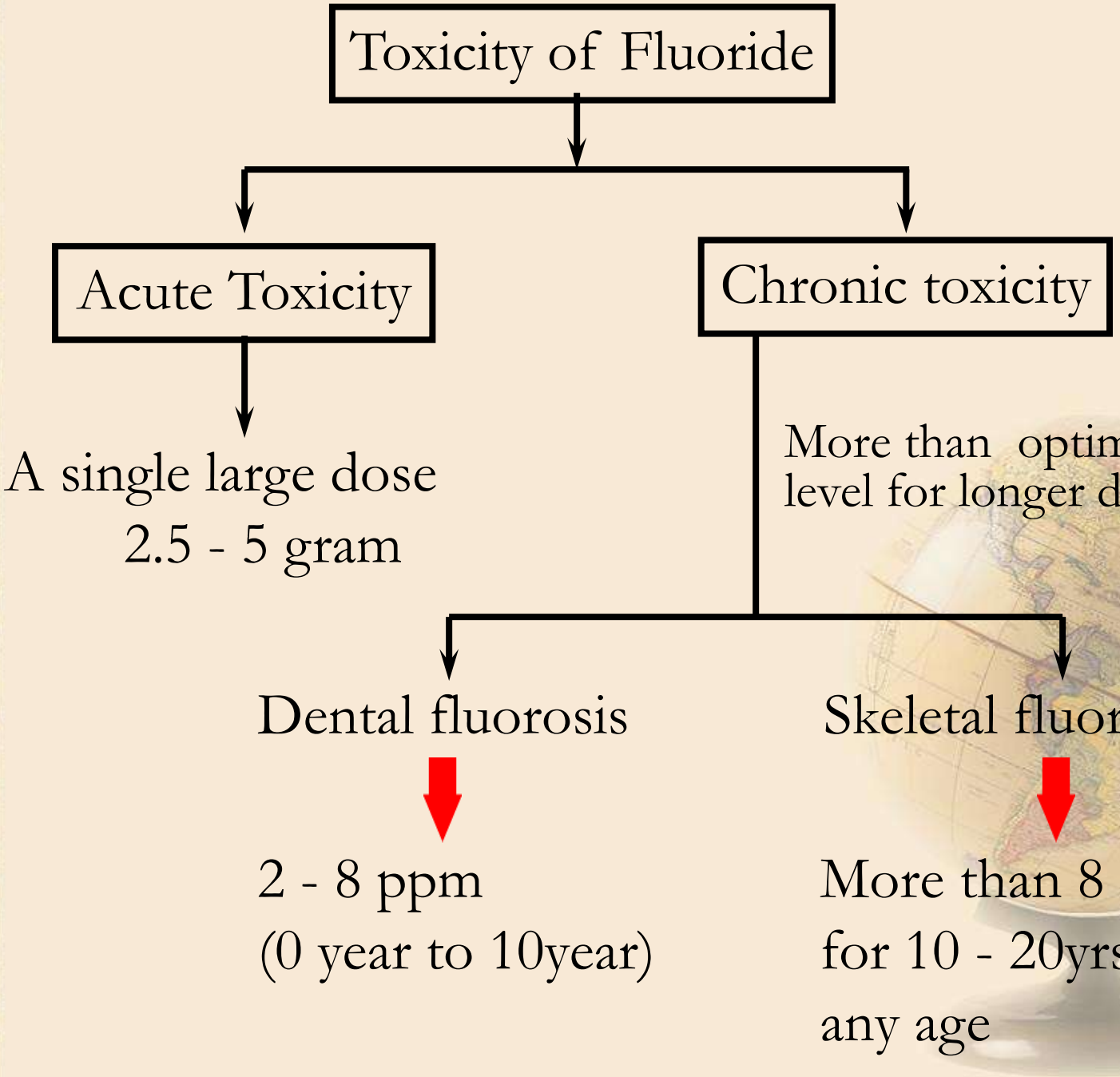


- STD (Safely Tolerated Dose): 8-16mg/kg body weight

"Dose that can be ingested without producing serious acute toxicity"

- Certainly lethal dose (CLD):70kgs →

5-10g(32-64mgF/kg)


Toxicity of Fluoride
Acute Toxicity
Chronic toxicity
A single large dose
2.5 - 5 gram
More than optimum
level for longer duration
Dental fluorosis
Skeletal fluorosis
2 - 8 ppm
(0 year to 10year)
More than 8 ppm
for 10 - 20yrs of
any age

Symptoms of Fluoride Toxicity

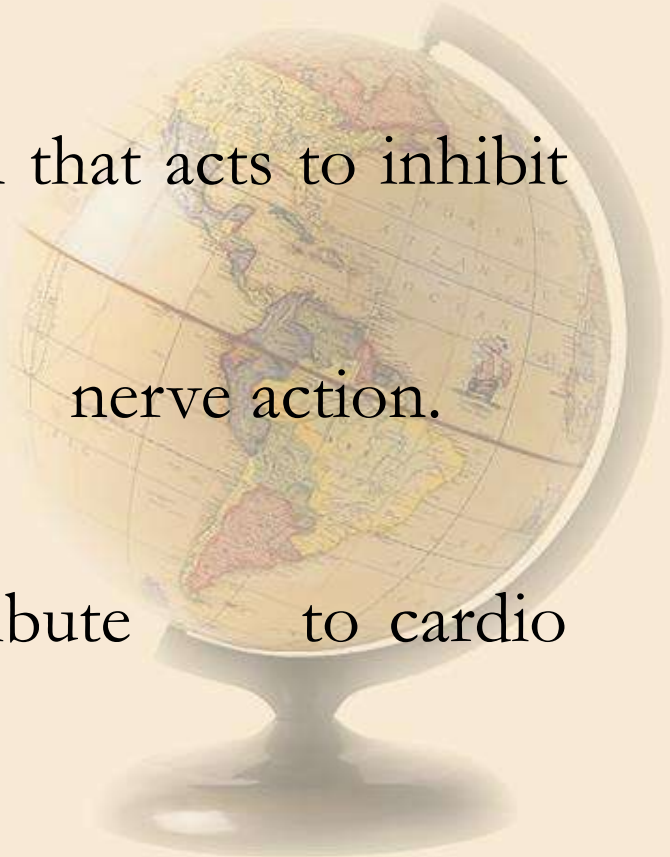
Fluoride acts in Four general ways

1) When F. Salts contact with moist skin or mucous membrane, Hydrofluoric acid forms cause chemical burn.

2) It is generally protoplasmic poison that acts to inhibit enzyme system.

3) It binds calcium that is needed for nerve action.

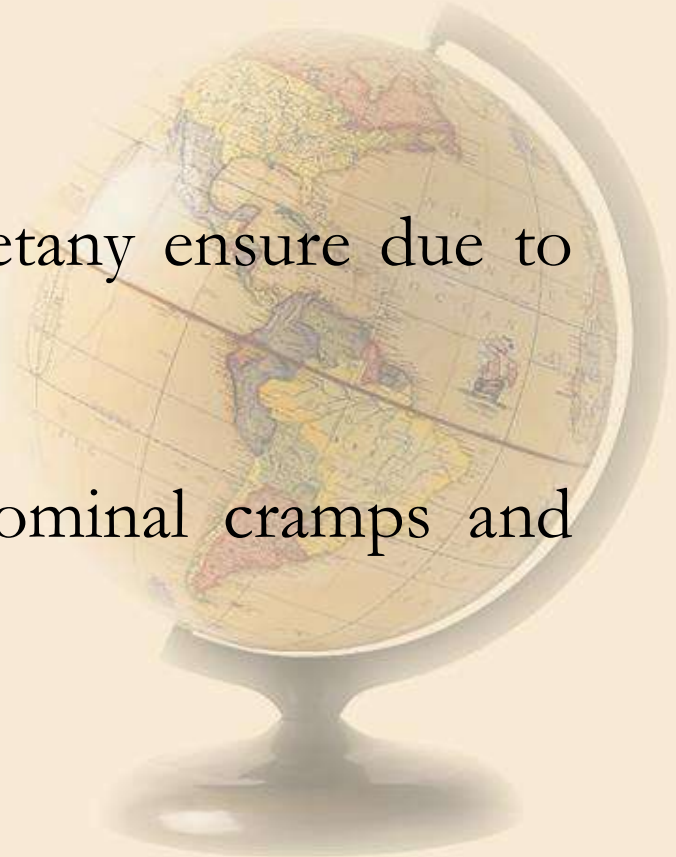
4) A hyperkalemia occurs that contribute to cardio toxicity.



Following ingestion of Fluoride, nausea and vomiting can occur. It is due to Production of Hydrofluoric acid in the acid environment of stomach, causes irritation of the stomach wall.

Local or general signs of muscle tetany ensure due to the drop of blood calcium.

This can be accompanied by abdominal cramps and pain.



Finally, hypocalcemia and hyperkalemia intensity results in either coma, convulsions or cardiac arrhythmia's.

Treatment of F. Toxicity

- Four actions.

1. Immediate treatment
2. Induced vomiting
3. Protection of stomach by binding F with orally Administered calcium.
4. Maintenance of blood calcium level with I.V. Calcium.

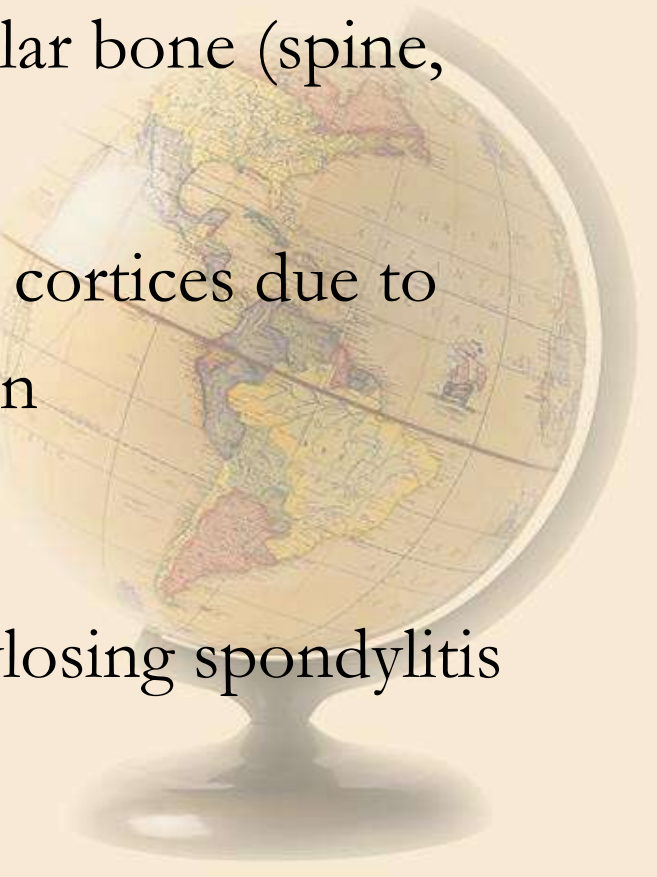
FLUOROSIS

A non-reversible, incurable disease weakening skeletal structures caused by high level of fluorides in water.

- skeletal fluorosis
- Dental fluorosis

Skeletal Fluorosis

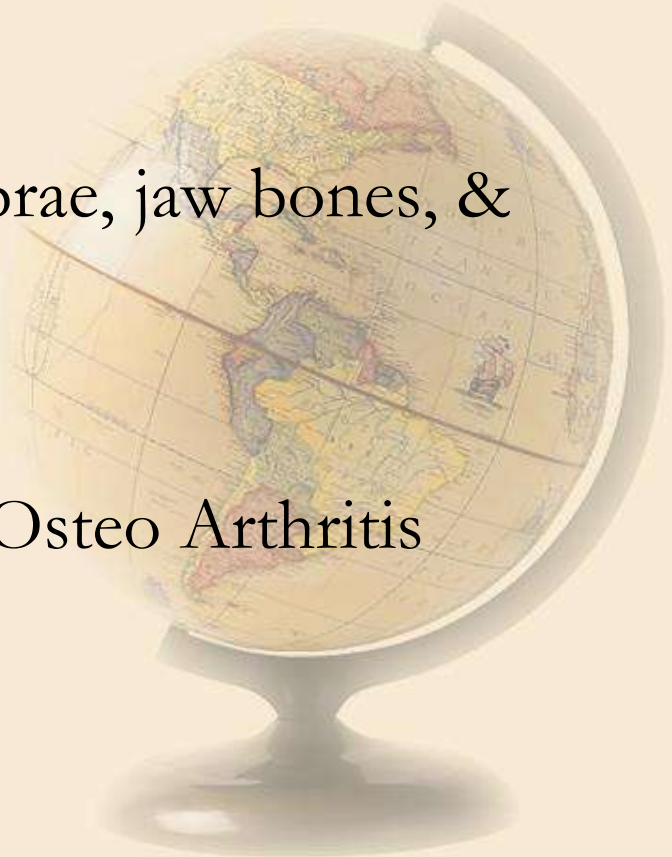
- A water fluoride level over 8ppm
- Characterized by
  - Increased x-ray density of trabecular bone (spine, pelvis)
  - Increased thickness of long bone cortices due to endosteal and periosteal apposition
- In more advanced cases
  - Calcification of ligaments → Ankylosing spondylitis



Skeletal Fluorosis..

- Other effects are-
  - Gastric complaints
  - Osteo sclerosis
  - Exostosis of long bones, vertebrae, jaw bones, & other flat bones.

Misdiagnosed as Rheumatoid or Osteo Arthritis

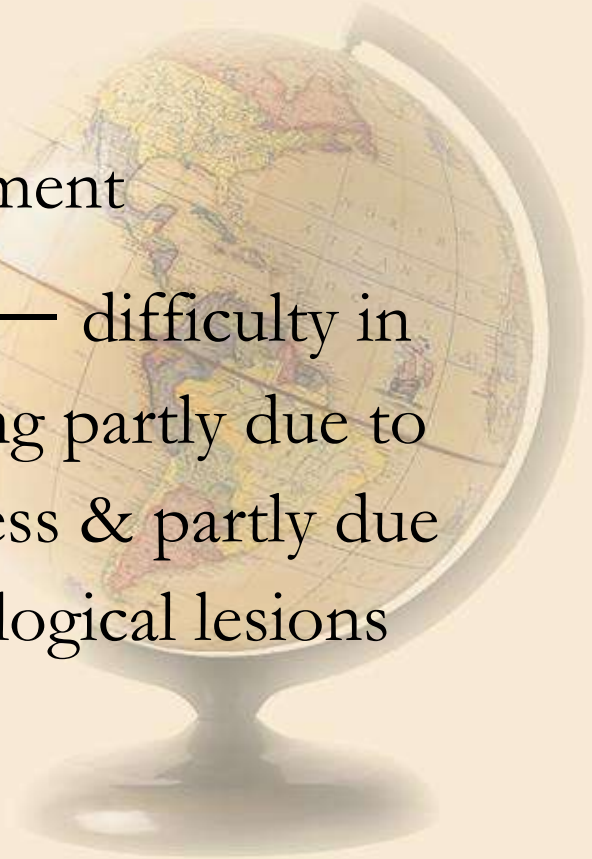


Skeletal Fluorosis..

Early cases— vague pain in small joints, knee and joints of spine

Later cases--- stiffness of spine & limitation of movement

Advanced cases---KYPHOSIS— difficulty in walking partly due to stiffness & partly due to neurological lesions



Dental Fluorosis

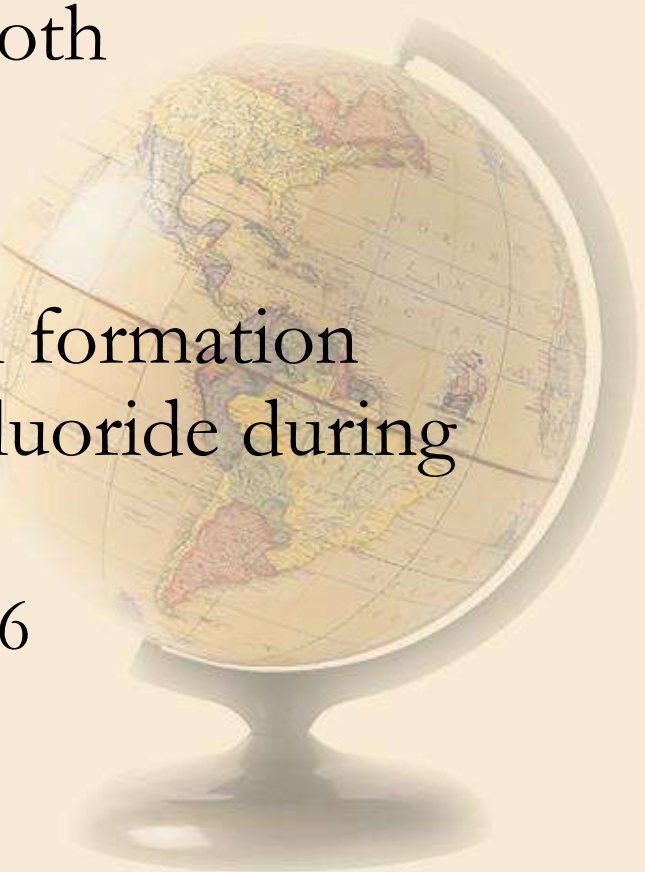
- *Definitions*

1. Hypo-mineralization of tooth enamel or dentin by the long continued ingestion of excessive amounts of fluorides during tooth development

   -Dean 1934

2. A specific disturbance of tooth formation caused by excessive intake of fluoride during formation period of dentition

   - Murray 1986



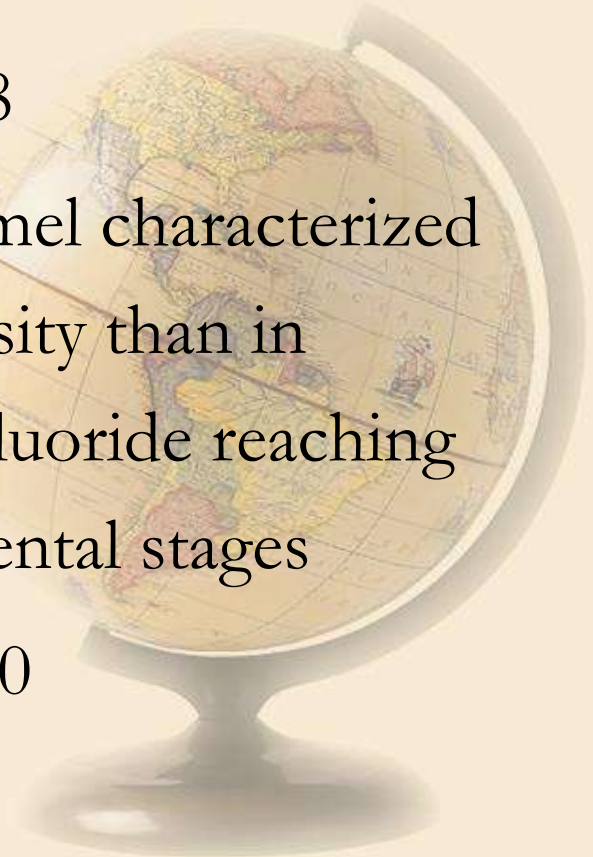
Dental Fluorosis..

3. Disturbance in tooth enamel formation caused by fluoride being present in tissue fluid over a prolonged period during tooth development

-fejerskov 1988

4. Permanent hypo mineralization of enamel characterized by greater surface and subsurface porosity than in normal enamel, resulting from excess fluoride reaching the developing tooth during developmental stages

- fejerskov 1990

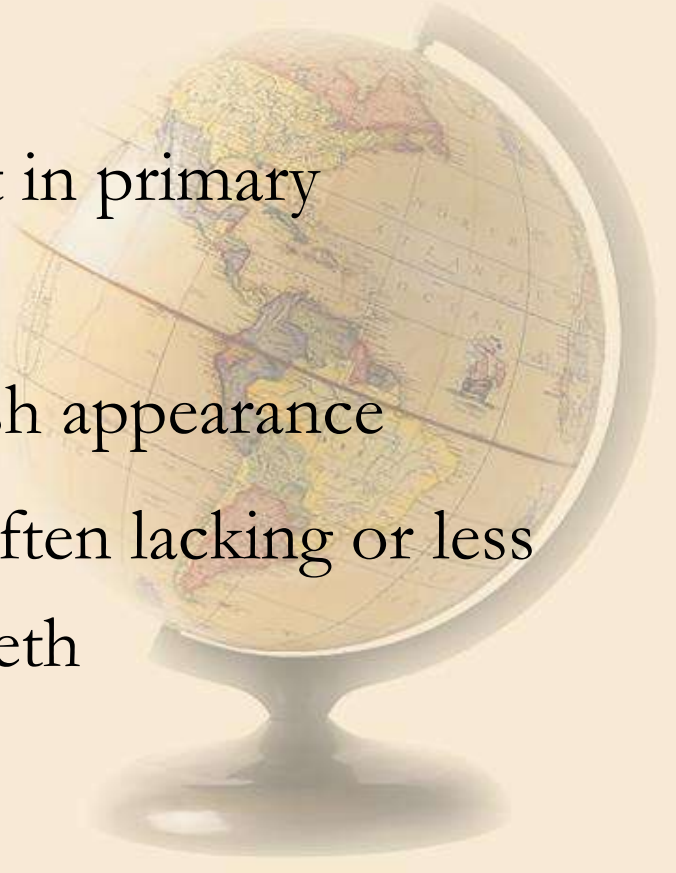


Distribution of fluorosis in permanent dentition

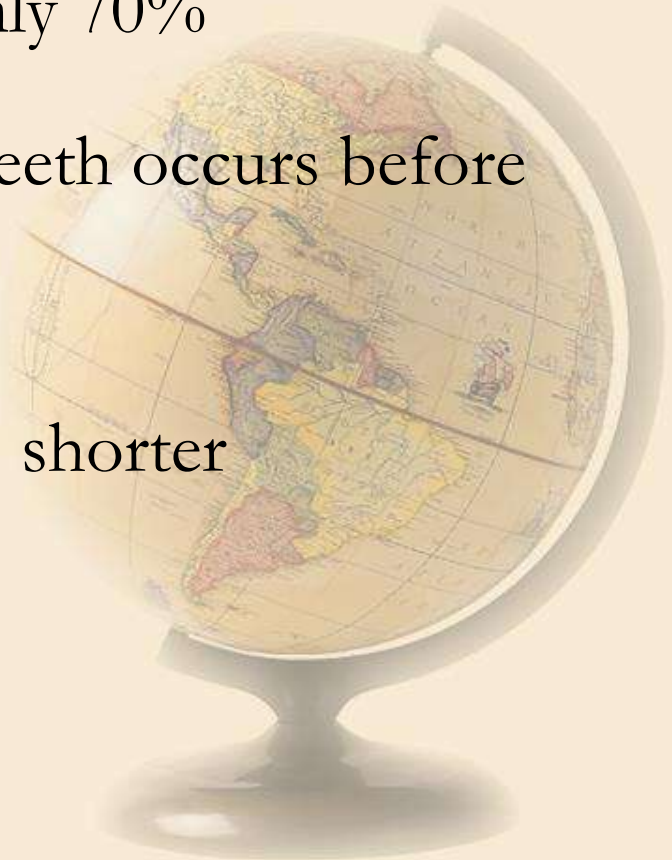
- Posterior teeth are more affected than anterior in both maxilla and mandible
- Fluorosis occurs symmetrically within the arch
- Premolar>2nd molar>max incisor>canine>1st molar> mandibular incisors

Distribution of fluorosis in primary dentition

- Exhibit less fluorosis than their permanent successors, but distribution within the dentition follows similar pattern
- Assessment of fluorosis is difficult in primary dentition bcoz:
  - Thinner enamel-→ more whitish appearance
  - Incremental lines of retzius is often lacking or less pronounced than permanent teeth



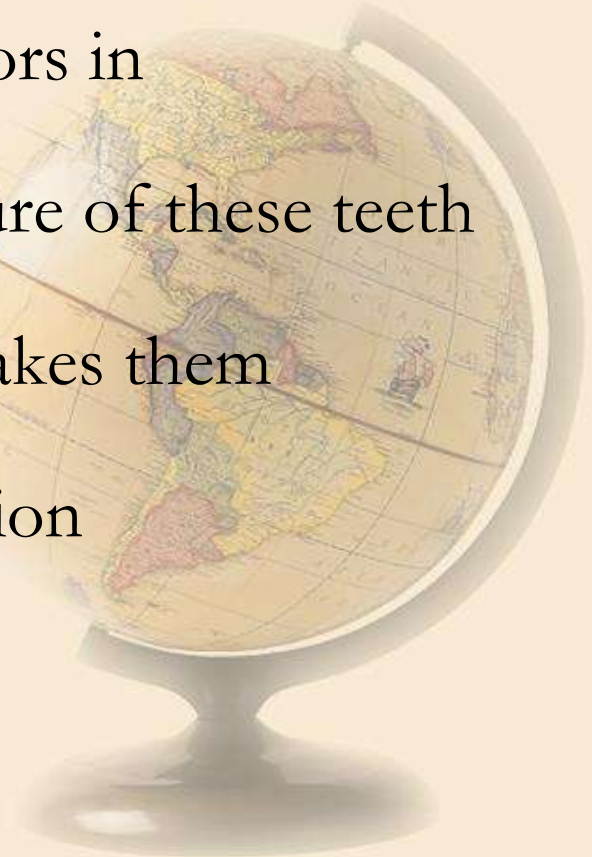
- Reasons for less appearance of fluorosis in primary dentition:
  - Placenta as selective barrier ---Only 70%
  - Most of calcification of primary teeth occurs before birth
  - Duration of enamel maturation is shorter
  - Thinner enamel



Post eruptive changes in dental fluorosis

- Changes are determined by degree of subsurface porosity
- Pitting occurs shortly after eruption depending on initial hypo-mineralization
- Very susceptible to enhanced attrition

- Porous enamel may take up stains
  - The shape usually follows the position of upper lip
  - Continuous drying out of max incisors in combination with immediate exposure of these teeth to any sort of staining from food makes them particularly susceptible to discoloration



- the severity of fluorosis :-

(i) Fluoride concentration in drinking water,

(ii) Period of exposure,

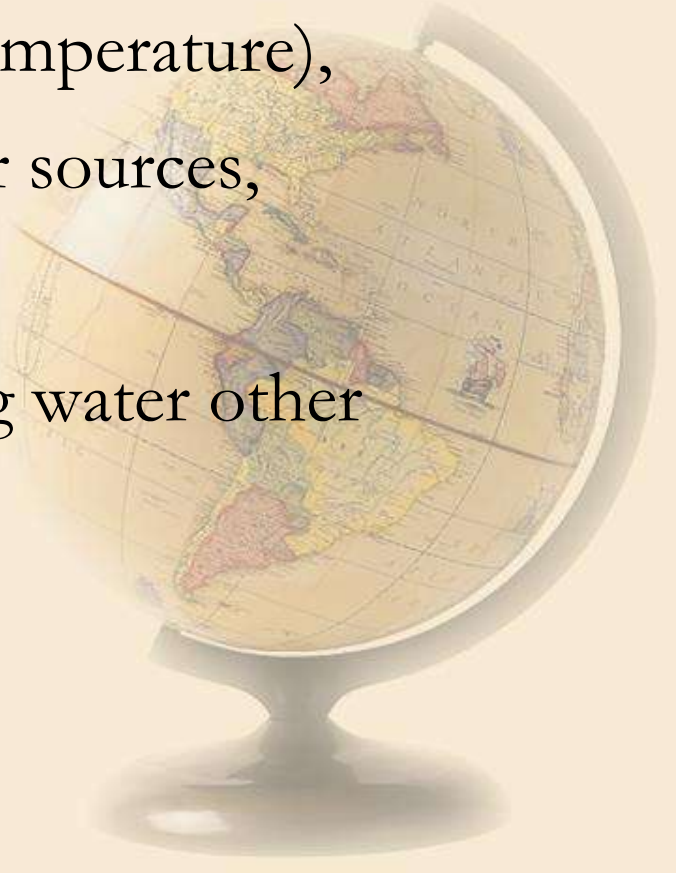
(iii) Climatic factors (for example Temperature),

(iv) Fluoride ingestion through other sources,

(v) Nutritional status,

(vi) Chemical constituent of drinking water other than fluoride, and

(vii) Occupation.

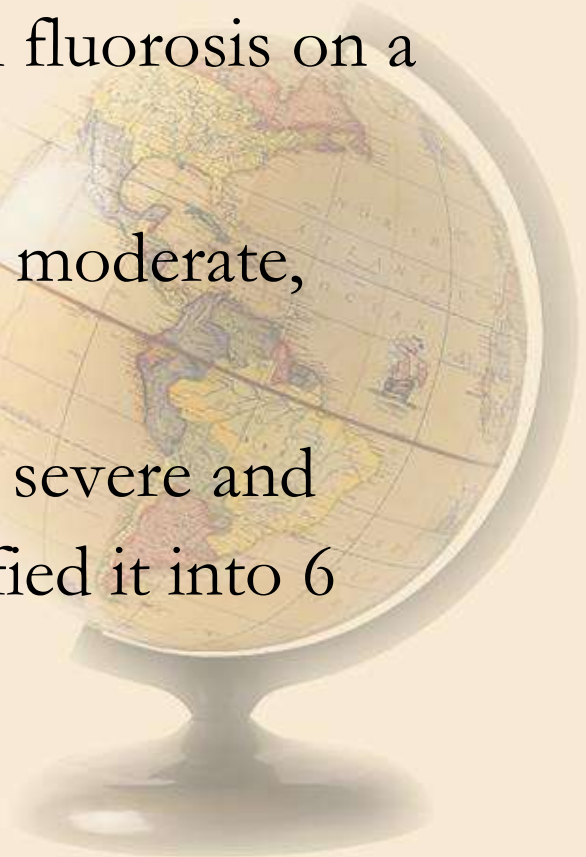


Classification systems of fluorosis

- Dean's index:
  - Trendly H. Dean in 1934
  - Initially this index categorized dental fluorosis on a seven point ordinal scale :-

Normal, questionable, very mild, mild, moderate, moderately severe, severe

  - In 1939 Dean combined moderately severe and severe as only severe and thus modified it into 6 point scale



Original Criteria- 1934

Normal

Questionable

Very mild

Mild

Moderate

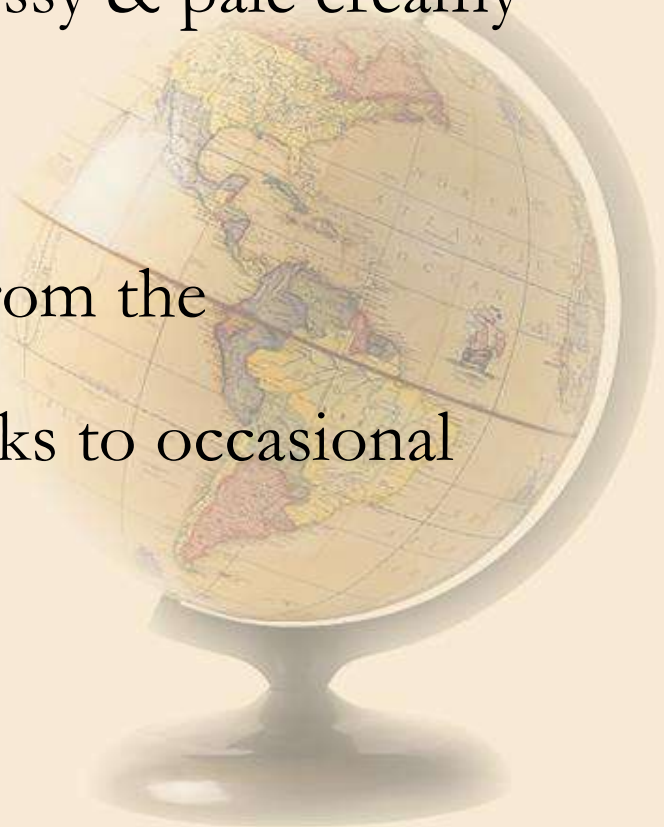
Moderately severe

Severe

Criteria of scoring:-

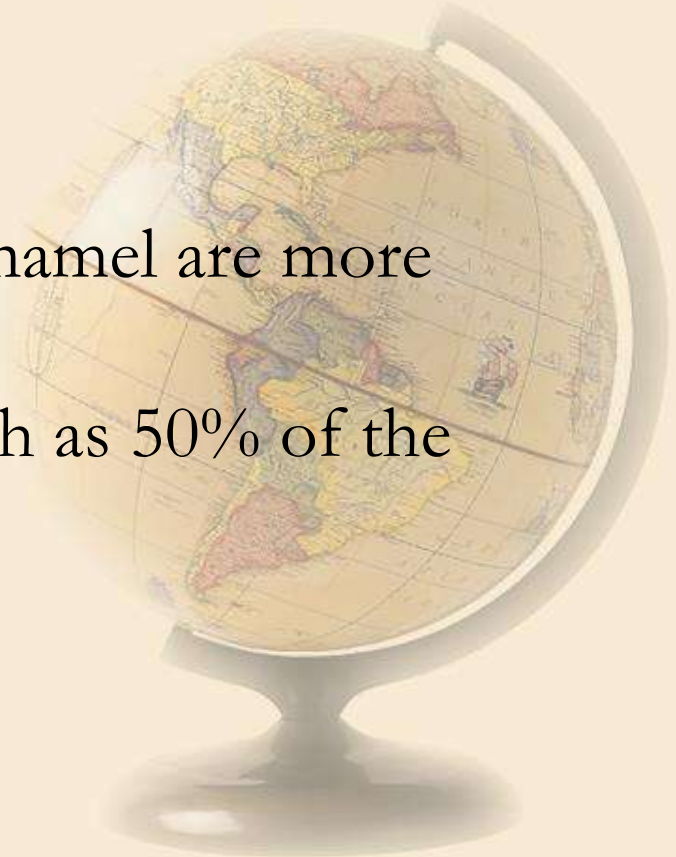
0 – Normal – enamel represents usual translucent semivitriform, surface is smooth, glossy & pale creamy white color

1 – Questionable – slight aberrations from the translucency ranging from white flecks to occasional white spots



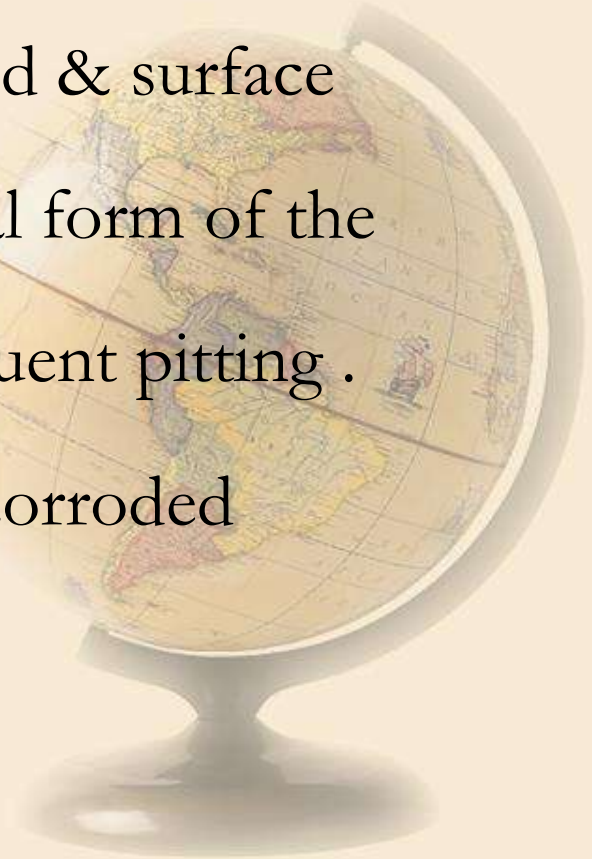
2 – Very Mild – small opaque paper white area scattered irregularly over the tooth showing no more than 1-2mm of white opacity

3 – Mild – white opaque areas in the enamel are more extensive but do not involve as much as 50% of the tooth



4 – Moderate – all enamel surface are affected & surfaces subjected to attrition show marked wear, brown stains are frequently a disfiguring feature

5 – Severe – all enamel surface are affected & surface hypoplasia is so marked that the general form of the tooth may be altered . discrete or confluent pitting . Brown stains are widespread & give a corroded appearance



"Very Mild"

"Mild"

"Moderate"

"Severe"

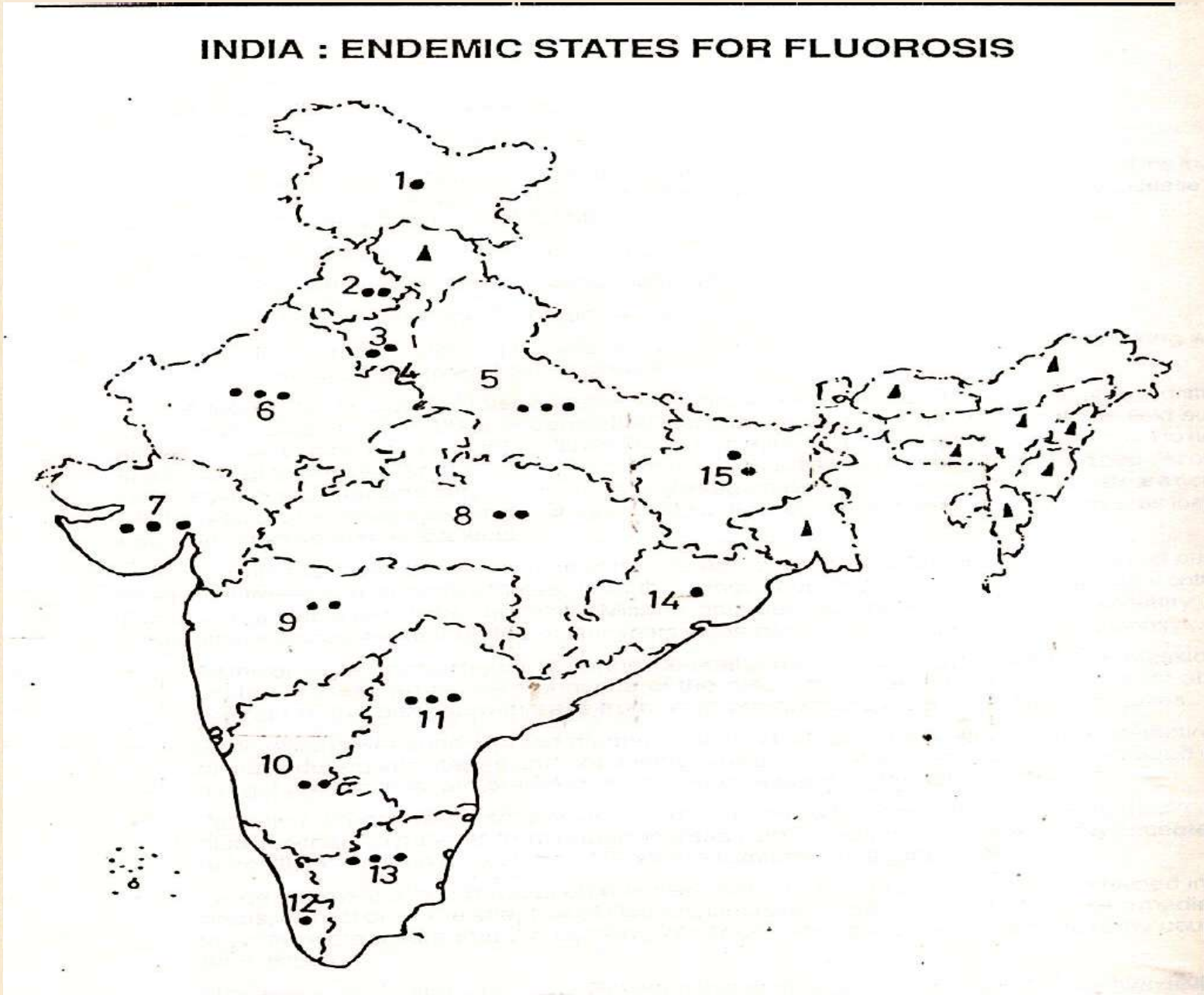
Differential diagnosis

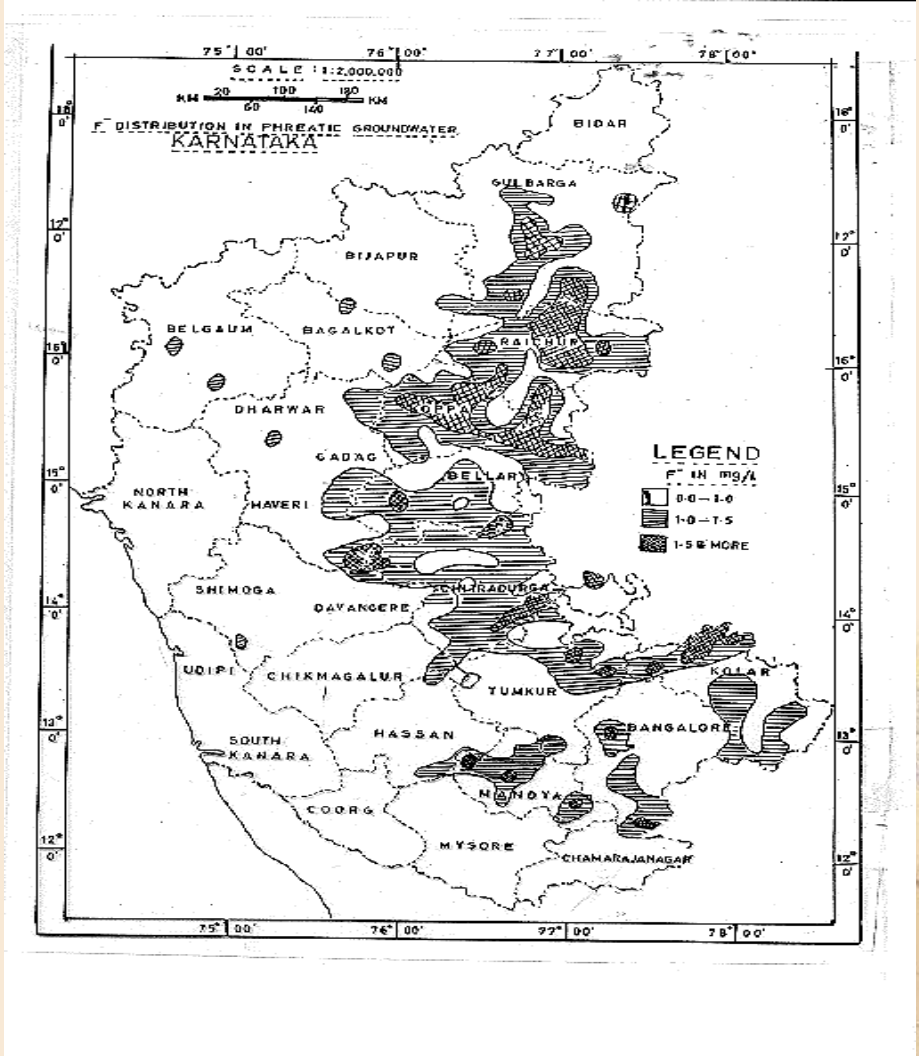
characteristics	Dental fluorosis	Enamel opacities
Area affected	all surfaces, often enhanced on or near tips of cusps or incisal edges	Usually centered in smooth surface of limited extent
Lesion shape	Line shading in pencil sketch which follow incremental lines OR cloudy appearance OR snow capping at cusp tips	Round or oval
Demarcation	Diffuse distribution of varying intensity	Clearly differentiated
Color	Paper white ,frosted appearance, stain at time of eruption	Creamy yellow to dark reddish orange at the time of eruption
Teeth affected	Always homologous teeth. Premolars & 2nd molars mostly affected	Labial surface of single tooth, mostly incisors

Effective treatment of dental fluorosis

- Bleaching
- Crown
- Veneers & laminates
- Composite restorations

Fluorosis in India





- eastern and southeastern belt of Karnataka, covering districts of Gulbarga, Raichur, Bellary, Chitradurga, Tumkur and Kolar and is scattered in rest of Karnataka

Prevention of fluorosis

1. Change the source of drinking water to the water containing optimum amount of fluorides
2. Defluoridation

Water quality analysis and provision of safe water

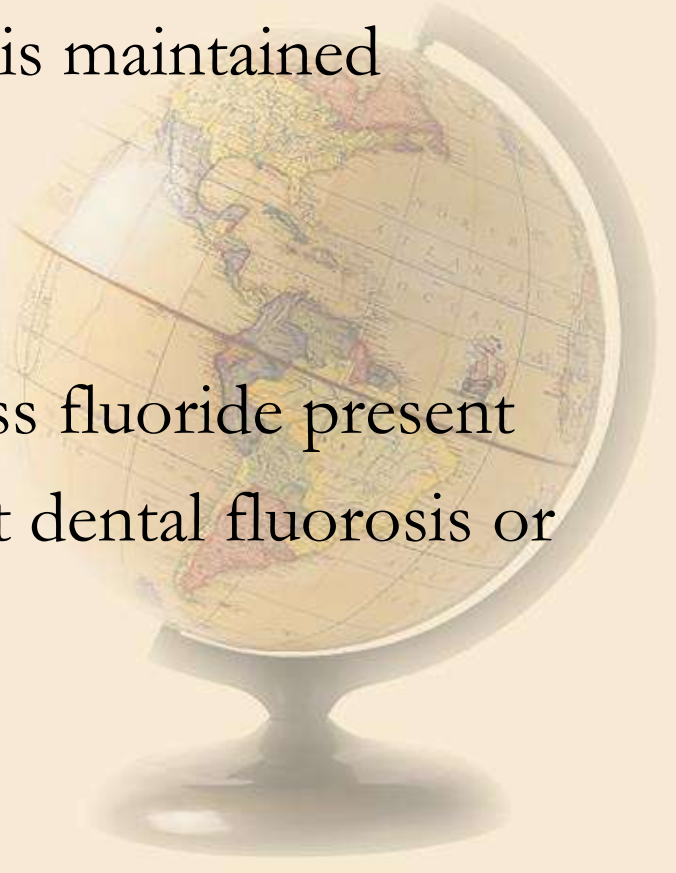
Safe F – 1mg/l	safe & unsafe source	Marginally contaminated 1.1-2.5mg/l	Highly contaminated F- >2.6mg/l
• Create Awareness • Advice not to change the source	• Label safe source and unsafe source • Use safe water for Consumption • Use unsafe water For other purpose	• Carry out health survey • No one may be sick(may be due to good nutrition) • Some are fluorosed divert the source & counsel on diet – increase Ca , vit C and anti oxidants	• digging tube well deeper if safe water can be obtained • Harvesting rainwater • Change of source • None of the above – go for defluoridation

Defluoridation

- Downward adjustment of concentration of fluoride ion in public water supply in such a way, that the concentration of fluoride in water is maintained constantly at 1ppm

OR

- It is the process of removing excess fluoride present in water supply in order to prevent dental fluorosis or more severe disability



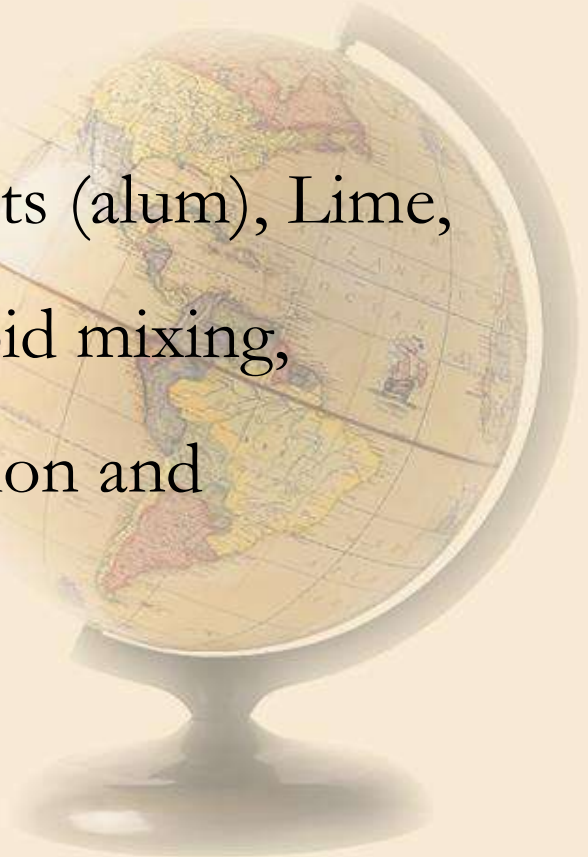
Defluoridation methods

1. Based on ion exchange process or adsorption
2. Based upon addition of chemicals to water during treatment

In India, the 1st defluoridation was taken by NEERI (National Environmental Engineering Research Institute) at Nagpur in 1961

Chemical method

- ***Nalgonda technique:-***
  - 1961– NEERI
  - Involves addition of aluminum salts (alum), Lime, Bleaching powder followed by rapid mixing, flocculation, sedimentation, filtration and disinfection.



- Aluminum salts may be → aluminum sulphate or chloride or combination of two
- Selection of aluminum sulphate or chloride depends on sulphate or chloride content of raw water to avoid exceeding permissible limit
- Dose of lime → $1/20^{th}$ dose of aluminum salts
- Lime facilitates dense flocs for rapid settling
- Bleaching powder → 3mg/l for disinfection

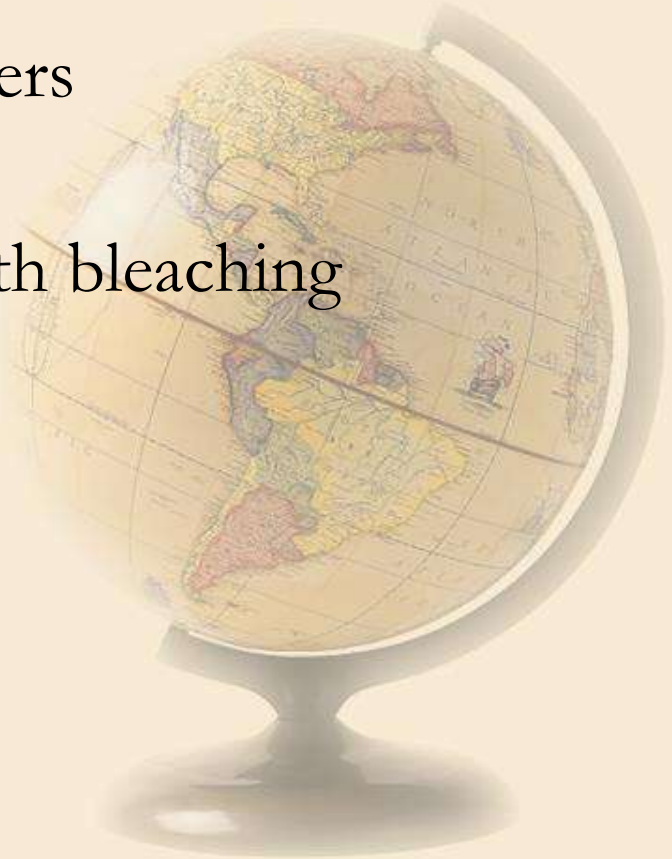
- Mechanism of Nalgonda technique
  - Rapid mix:- provides thorough mixing of chemicals
  - Flocculation:- gentle agitation

    - combination of poly hydroxy aluminum complexation with fluoride & their adsorption on polymeric aluminum hydroxides (flocs)

    - turbidity, color ,odour → removed; bacterial load reduces

    -Lime ensures that residual aluminum does not remain in treated water

- Sedimentation:- permits settling of flocs loaded with fluorides & other impurities
- Filtration:-rapid gravity sand filters
- Disinfection :- rechlorinated with bleaching powder before distribution



- Salient features of Nalgonda techniques:-
  - No regeneration of media
  - No handling of caustic acids & alkalies
  - Readily available chemicals
  - Adaptable to domestic use
  - Applicable in batches as well as in continuous operation

- Simplicity of design, construction, operation & maintainance
- Highly efficient removal of fluorides 1.5-20mg/l to desirable level
- Simultaneous removal of color, odour, turbidity, bacteria,
- Sludge generated is convertible to alum for use elsewhere
- Little wastage of water and least disposal problems

- Applicability Nalgonda technique
  - Absence of alternate low fluoride source for drinking water
  - Total dissolved solids → below 1500mg/l
    > 1500mg/l → desalination
  - Hardness → below 600mg/l
  - Alkalinity must be sufficient to ensure complete hydrolysis of alum added
  - Raw water fluoride → 1.5 – 20 mg/l

Ion exchange resins

I) Anion exchange resins

- polysterene anion exchange resins & strongly basic quaternary ammonium type resins

(tulsion A-27, Deacedite, FF-IP Lewatit, MIH-59 & Amberite,IRA-400)

- provide 20-145 bed volume of defluoridated water per cycle

- Loose their capacity on prolong use (10-15 cycles)-→ total replacement
- Drawbacks :
  - Costly (capital cost of plant– Rs 10,000)
  - Imparts unacceptable taste

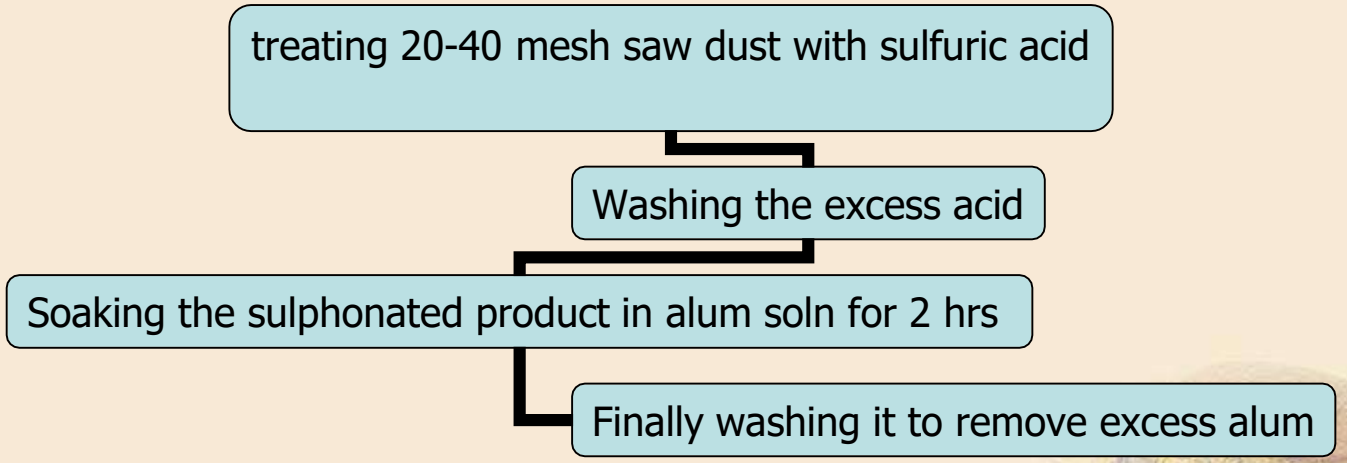
II cation exchange resins

a) Defluoron 1:-

- Bhakuni (1964,1970)

- sulphonated saw dust impregnate with 2% alum solution

prepared by:-



- Cost → Rs 0.60 / m3 of water containing 4.3mg/l fluoride
- Drawbacks :-
  - The medium had poor hydraulic properties
  - Suffered from heavy attritional losses

b) *carbion:-*

is a cation exchange resin of good durability and can be used for both sodium and hydrogen cycles

c) *magnesia:-*

- dose of 1500mg / lts &

contact period of 3hrs was required to reduce fluoride extent to 1mg /lts of water

-the study established that magnesia removed excess fluorides but PH of treated water was beyond 10 and its correction by acidification or recarbonation was necessary

- Acid requirement → $CaCO_3$ (300mg/lts)
- Drawbacks:
  - High cost of magnesia
  - Large conc required
  - Complexity of preparation
  - Alkaline PH of treated water

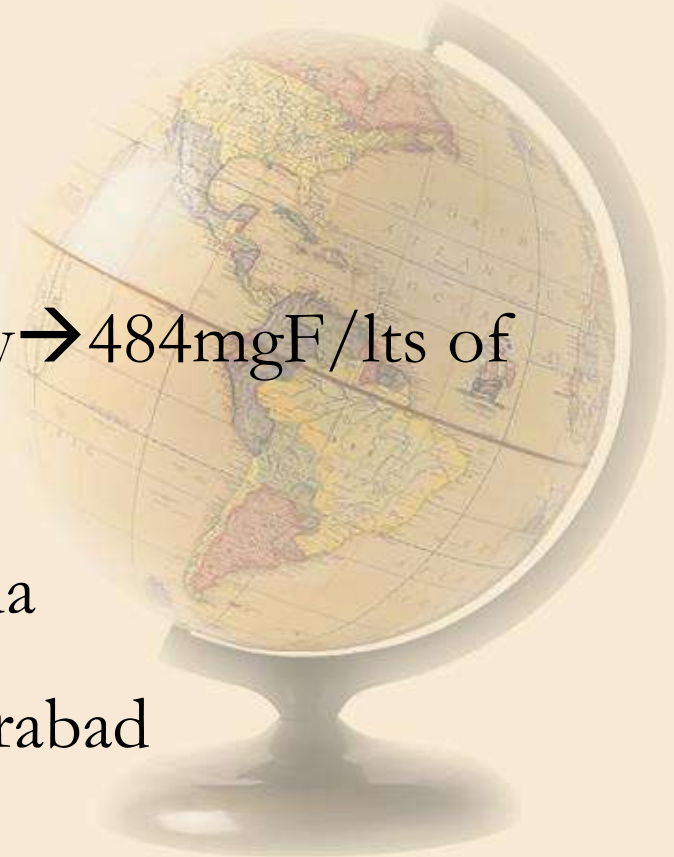
d) *Defluoron 2:-*

- developed in 1968

- is a Sulphonated Coal and works on Aluminum cycles

- life of medium 2-4 yrs

- average fluoride removal capacity → 484mgF/lts of defluoron2



Municipal corporation, Nalgonda

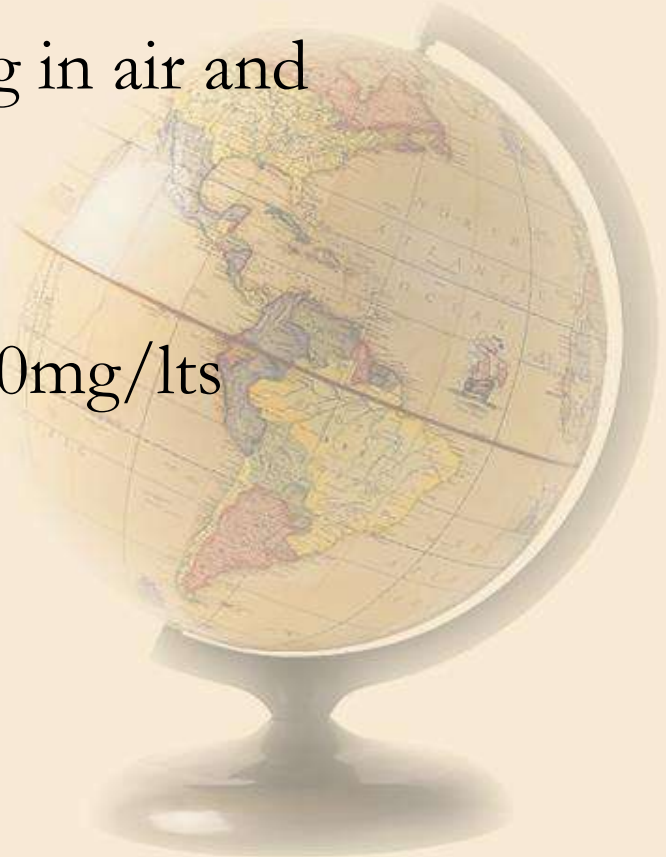
Central Training institute, Hyderabad

Adsorption

1. *Bone Charcoal:-*

The Bone is processed by burning in air and pulverizing it to fine powder

Fluoride removal capacity → 1000mg/lts

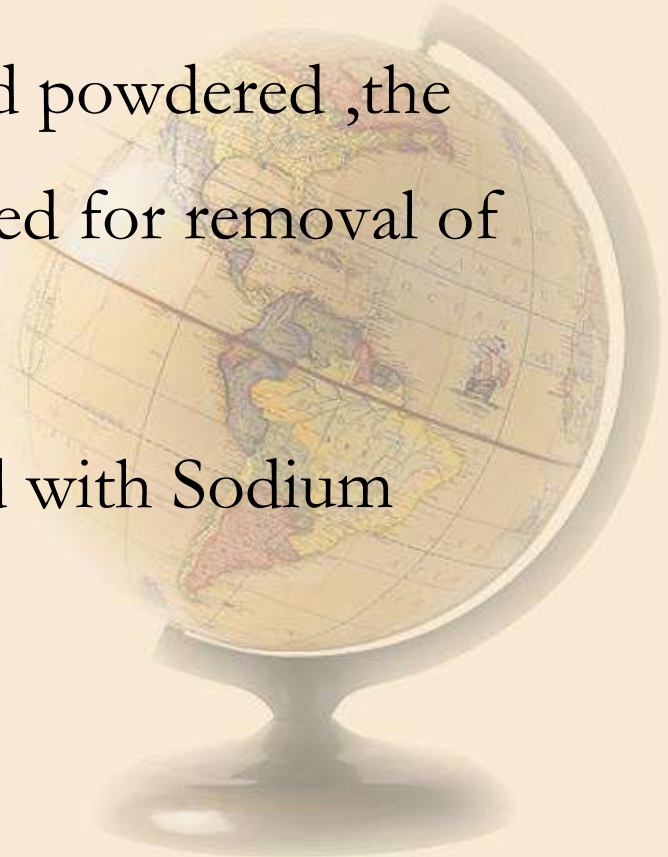


2. *Processed Bone:-*

- Bone contains Calcium Phosphate and has great affinity for Fluorides

- The bone is de-greased, dried and powdered ,the powder can be used as a contact bed for removal of Fluoride in water

- The exhausted bed is regenerated with Sodium Hydroxide solution.



3. ***Tricalcium phosphate:***

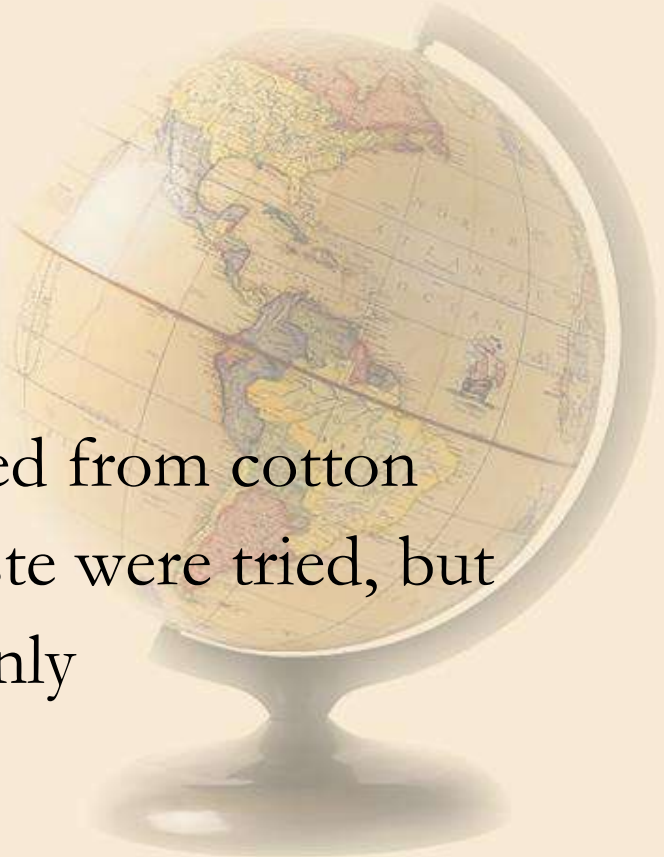
- natural or prepared synthetically by reacting milk of lime and phosphoric acid have been used for defluoridation.

4. ***Activated carbon :-***

- has high defluoridation capacity

- prepared from paddy husk

- similarly activated carbon prepared from cotton waste, coffee waste & coconut waste were tried, but all these are of academic interest only

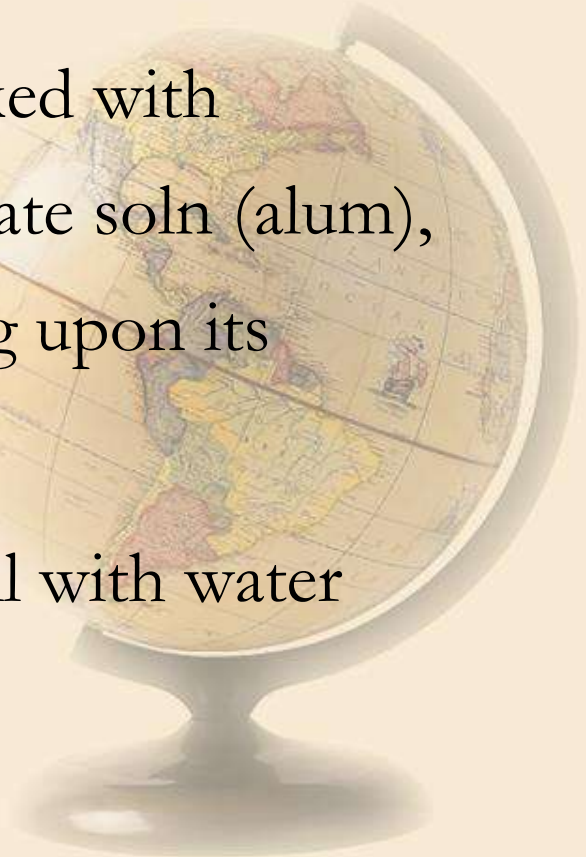


Nalgonda technique

- Domestic
- Fill and draw for small community
- Fill and draw for rural water supply

Domestic defluoridation

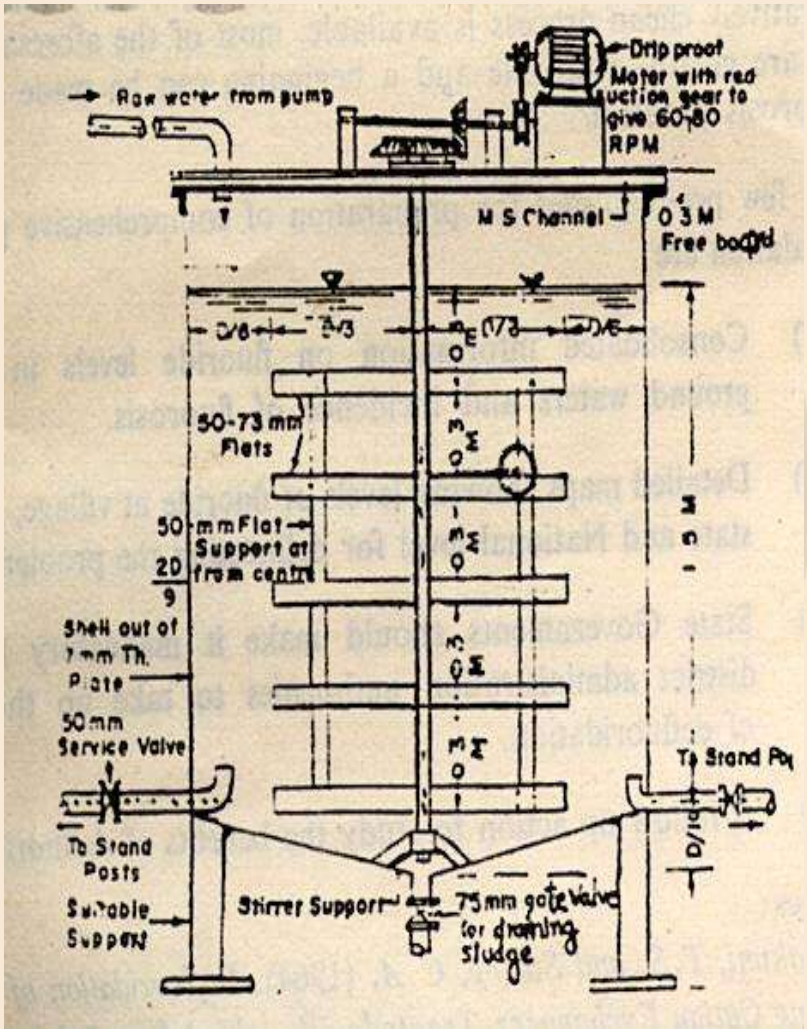
- Carried out in a container(bucket)– 60lts capacity with tap 3-5 cm above the bottom
- The raw water in the container is mixed with adequate amount of aluminum sulphate soln (alum), Lime, & bleaching powder depending upon its alkalinity & fluoride content
- Alum soln is added first & mixed well with water



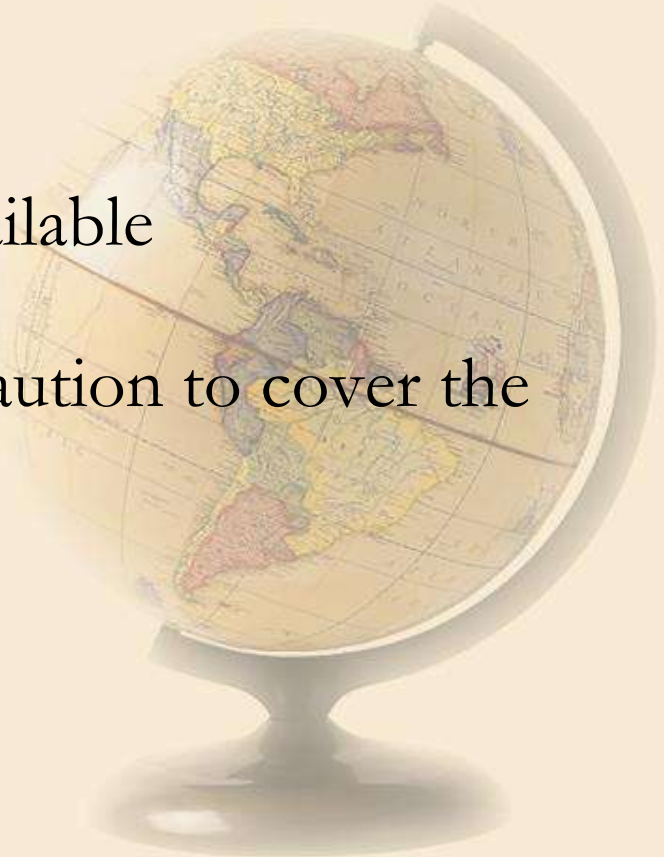
- Lime and bleaching powder is then added & stirred slowly for 20min
- Allowed to settle for nearly one hour
- The supernatant, which contains permissible amount of fluoride is withdrawn thro' the tap for consumption
- Alum soln => 1kg in 10 lts =➔ 1ml contains 100mg of alum
- Lime soln => 100mg in 10 lts =➔ 1 ml contains 10mg of lime

Fill and draw defluoridation for small community

- Batch method for communities with up to population 200
- Consists of a Hopper- bottom cylindrical tank with a depth of 2mts equipped with a hand operated or power driven stirring mechanism
- 5min and then allowed to settled for 1-2 hrs



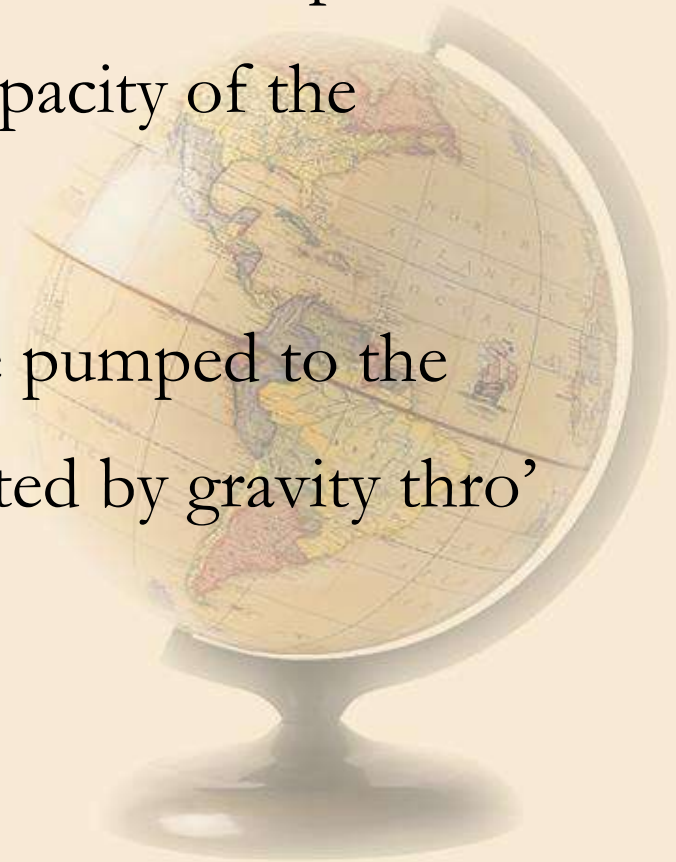
- Advantages:-
  - Completes in about 4hrs→ at least 3 batches in a day can be obtained
  - Accessories are few and easily available
  - Can be located in open with precaution to cover the motor



Fill and draw defluoridation for rural water supply

- Components:-
  - Reactor (s): it is reaction-cum-sedimentation tank equipped with power driven agitator assembly.
  - Sump well.
  - Sludge drying beds.
  - Elevated service reservoir.
  - Electric room.
  - Chemical store house

- Based on one to four operations in each reactor per day
- Each reactor will be of 10,20,30 m3 capacity
- The defluoridated water is collected in the sump well which is of capacity equal to total capacity of the reactors
- The defluoridated water will then be pumped to the elevated service reservoir & distributed by gravity thro' stand posts and house connections



PLANING AND EVALUATION

CONTENTS

- Introduction
- Uses of Planning
- Types of Health Planning
- Steps in the Planning process
- Evaluation
- Conclusion

INTRODUCTION

Planning is a systematic approach to defining the problem , setting priorities, developing specific goals and objectives and determining alternative strategies and methods of implementation.

- *Planning results in a formulation of plan .*

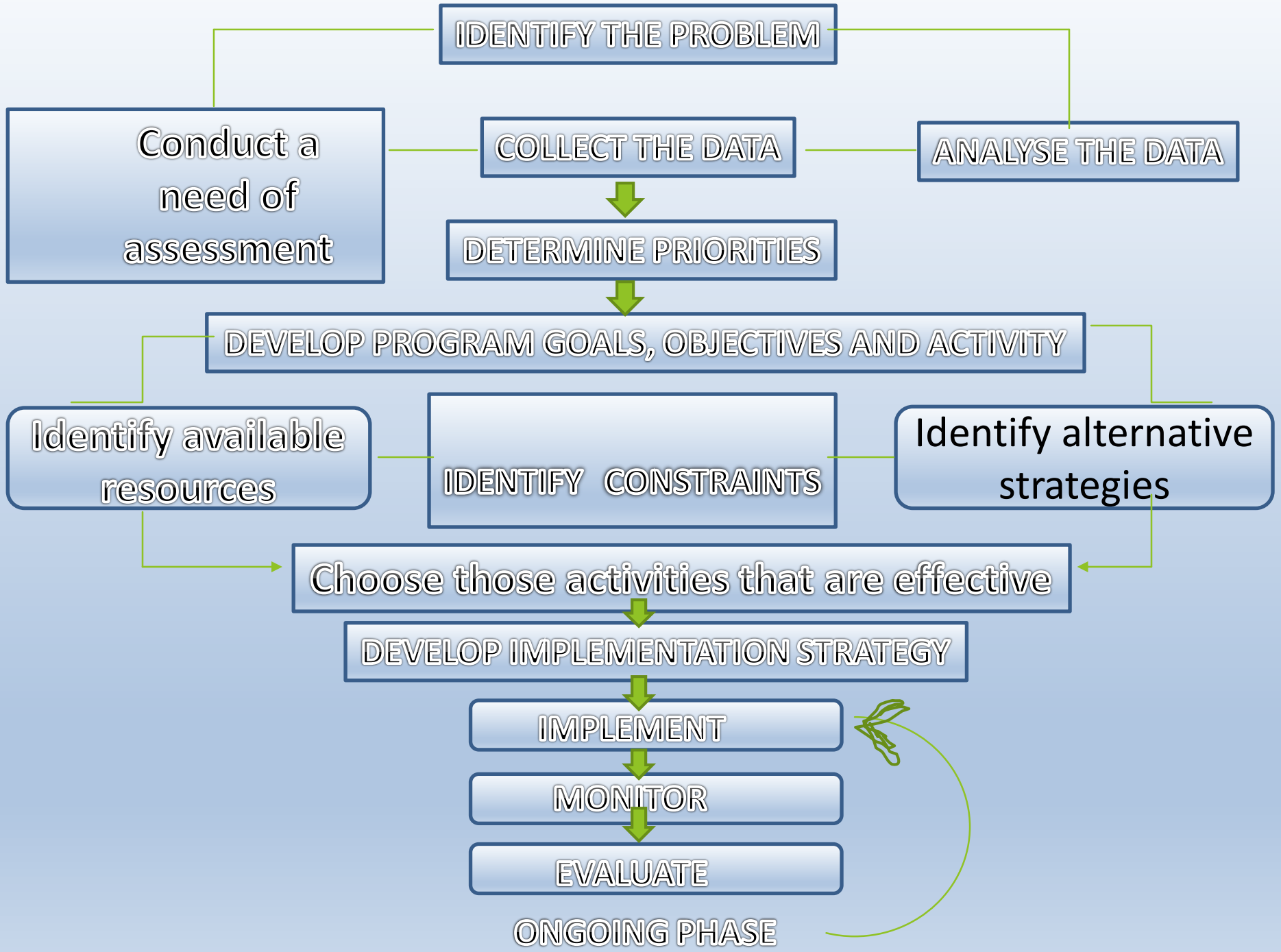
- *E.C. Banfield has presented a basic definition of the term plan : " Plan is a decision about a course of action ".*

USES

- **To match the limited resources with many problems .*
- **To eliminate wasteful expenditure or duplication of expenditure .*
- **To develop the best course of action to accomplish a defined objective .*

Types of Health planning

- 1. *Problem solving planning*
- 2. *Program planning*
- 3. *Coordination of efforts and activities planning*
- *4. Planning for the allocation of resources*


IDENTIFY THE PROBLEM
Conduct a need of assessment
COLLECT THE DATA
ANALYSE THE DATA
DETERMINE PRIORITIES
DEVELOP PROGRAM GOALS, OBJECTIVES AND ACTIVITY
Identify available resources
IDENTIFY CONSTRAINTS
Identify alternative strategies
Choose those activities that are effective
DEVELOP IMPLEMENTATION STRATEGY
IMPLEMENT
MONITOR
EVALUATE
ONGOING PHASE


Plan
Evaluate
The Action Cycle
Implement

Steps in a planning process ;

1. *Identify The Problem* :

- Conducting a needs assessment ;

The needs for conducting a needs assessment are-

- **To ascertain the cause of a problem .*
- **To identify the extent and severity of a problem*
- **To evaluate the effectiveness of a program by obtaining baseline information and measuring the amount of progress achieved in solving the specific problem .*

The information reqd. include :

- 1.No. of individuals in the population
- 2.Geographic distribution of the population
- 3.The rate of growth
- 4. Population density and degree of urbanization
- 5. Ethnic background
- 6. Diet and nutritional levels
- 7. Standard of living
- 8. Health care facilities available
- 9. Public and private school system
- 10. General health profile
- 11. Pattern and distribution of dental disease
- 12. History and current status of dental program
- 13. Fluoride content of water

Analysis of the data:

- *The age distribution of a community is imp. To consider because it tells the planner where the target groups are and thus helps in setting up priorities .*

- **The planner can determine the no. of schools, and the distribution of children among the school within the community.*
- *This information can assist the planner who is developing a school based program in the community. Schools are the ideal setting for dental programs . They can also be a good meeting place to use to open communication channels with the families and offer support services when needed.*

- *However planning a health awareness program centered around an educational institution would be successful , if people are attending schools and value the information received there.*

- ** Knowing the medial income of a community is very imp. To a health planner because it indicates the population's ability to purchase health services. It is important to look into the Socio-economic structure of the community.*

- *Health care must be geographically as well as financially accessible if people are going to utilize it .*

- *Looking at the health care facilities in the community will tell the planner what type of services are being provided, the amount of services, and cost of receiving those services.*

- *Although there are many dentist in the community , the planner must question whether the dentist are available for treatment .*

- *Knowing the fluoride content of water is imp. For the planner so that he can decide whether a fluoride supplement program is necessary or not .*

- *Knowing the political status of a community is also essential for dental planning . In most cases, the politics of a community will determine the direction the program will take.*

2. *Determining priorities*

- *"Priority distribution is a method of imposing people's values and judgement of what is important onto the raw data ".*

- *With limited resources, it becomes necessary to establish priorities so as to allow the most efficient allocation of resources.*

- *Planning with the community representation will aid in the program implementation and acceptance .*

- *When setting priorities for a community , the planner must ask :*

- ** How serious is the problem ?*

- **What %age of population affected by it ?*

- ** The no. of population affected most by the problem would be the group to which the problem would be targeted.*

3.Development of program goals, objectives and activities :

- *A goal is defined as a ultimate desired state towards which objectives and resources are directed.*

- *An objective is precise. It is either achieved or not. Program objectives are more specific than goals and describe in a measurable way , the desired end result of program activities.*

- *Objectives should specify the following :*
- *1. What – The nature of the situation or condition to be attained.*
- *2. Extent – the scope and magnitude of the condition*
- *3. Who- the particular group in which attainment is desired*
- *4. Where- the geographic area of the program*
- *5. When- the time ‘at’ or ‘by’ which the desired situation or condition is intended to exist.*

- *There are 2 types of objectives ;*

1. *Outcome objective*
2. *Process objective*

- ***Outcome objective*** *provides a means to measure quantitatively the outcome of the specific objective .*
- **Aids in establishing a realistic timetable for reducing principal heath problems .*

- *Process objective state a specific process by which a public health problem can be reduced and prevented .*

- *Program planning is referred to as program activities and it describes how the objectives will be accomplished . It include 3 components –*

1. *What is going to be done ?*
2. *Who will be doing it ?*
3. *When will it be done ?*

4. *Resource identification*

- **It implies the manpower, money, materials, skills, knowledge , techniques, and time needed or available for the support of action directed towards specified objective.**

- **Criteria used to determine what resources should be used are :**

1. *Appropriateness*
2. *Adequacy*
3. *Effectiveness*
4. *Efficiency*

5. Identifying constraints :

- ***When planning any program , there are usually many difficulties which might occur .***
- ***By identifying these constraints early in the planning , one can modify the design of the program , thereby creating a more practical and realistic plan .***
- ***Constraints may result from organizational policies, resource limitation, or characteristics of a community***
- ***Eg: Lack of funding , labor shortages , restrictive governmental policies , inadequate transportation systems , negative attitudes.***

6.Identify Alternative strategies

- ***It is important to generate the sufficient no. of alternatives that might be effective in attaining the objectives.***
- ***The planner must be aware of those alternative problem that sounds good on the surface but may have limitations when closely examined. He should choose the activity that is most effective.***

7.Develop implementation strategy

- An implementation strategy for each activity is complete when the following ques. Are answered :

1. *Why ?* The effect of the objective to be achieved.
2. *What*? The activities reqd. to achieve the objective.
3. *Who ?* Individuals responsible for each activity.
4. *When?* Chronological sequence of activities.
5. *How?* Materials , methods, techniques to be used.
6. *How much*? A cost estimate of materials and time.

8. IMPLEMENTATION

- 4 PHASES are-
- THE PILOT PHASE-whose development proceeds on a trial and error basis.
- THE CONTROLLED PHASE-where a model of a particular program strategy is run under regulated conditions to judge its effectiveness.
- THE ACTUALISATION PHASE-where a model of program strategy is subjected to realistic operating conditions.
- THE OPERATIONAL PHASE-where the program is an ongoing part of the structure.
- Only through team work between the individual and the environment can implementation be successful.

9. MONITORING

- ***There is considerable confusion about the use of the terms surveillance and monitoring.***
- ***Surveillance in french means "watching over". It denotes the maintenance of an ongoing watch over the status of a group or community.***
- ***It gives information about new and changing needs and provides a basis for appraising the effects of health care.***

- *Monitoring refers to the maintenance of an ongoing watch over the activities of a health services.*
- *Using the observations as a basis for continual modification of goals , plans, or activities.*
- *The data typically collected for monitoring include :*
- 1. *Input data*
- 2. *process data*
- 3. *Output data*

10.Evaluation

- *"Evaluation measures the degree to which objectives and targets are fulfilled and the quality of the results obtained. It makes possible the reallocation of priorities and of resources on the basis of changing health needs." - WHO 1967*

- **Evaluation is defined as the collection and analysis of information to determine program performance. It is mostly concerned with the final outcome and the factors associated with it .**

- **Measurement of the results may be direct or indirect .**

- *Direct measures are those which assess changes in oral health due to the program being evaluated.*
- *Indirect measures are necessary where it is not practicable to measure directly any changes in the health*
- *Criteria used in the evaluation of Dental Services (WHO 1972):*

1. *Effectiveness*
2. *Efficiency*
3. *Appropriateness*
4. *Adequacy*

- *Effectiveness:*
- "The ratio between the achievement of the program activity and the desired level which, during the planning process, the planners had proposed would result from the program ." –WHO 1974.

- *Three variables* are useful in evaluating effectiveness-
- 1.**Resources**:are evaluated by dividing the actual expenditure of resources by the planned expenditure.
- 2. **Activities**: are evaluated by dividing actual performance by planned performance .
- 3. **Objectives**: are evaluated by dividing actual attainment of objectives by planned attainment.

- *Efficiency:* **It has been defined as "*The result that might be achieved through expenditure of a specific amount of resources and the result that might be achieved through a minimum of expenditure .*" - *WHO 1974***

- **It express the relationship between the effects obtained and the resources spent (money, men, material, time)**

- *Appropriateness*: *carried out at 2 levels ;*

1. Whether the aims and objectives of the program are appropriate.

2. Whether the strategy of the program is appropriate.

- *Adequacy :*

-A measure of adequacy is the extent to which the population in need was covered by the services.

-The population must be provided with dental health services that are appropriate, effective, efficient and adequate and that can cope with dental needs and demands in a comprehensive manner by the best utilization of resources within given constraints.

Types of evaluation:

- *Formative Evaluation*
- *Summative Evaluation*

Other types of evaluation are-

1.Relevance evaluation

2. Process evaluation

3. Effectiveness evaluation

4.Impact evaluation

5. Efficiency evaluation

General steps of evaluation :

- *1.Determine what is to be evaluated.*
- *2. Establish standards and criteria.*
- *3. PLAN the methodology to be applied.*
- *4. Gather information.*
- *5.Analyze the results.*
- *6. Take action.*
- *7. Re-evaluate.*

1. Determine what is to be evaluated

- *3 types of evaluation :*

1. *Evaluation of structure : Evaluation of whether facilities, equipment , manpower, and organization meet a standard accepted by experts as good.*
2. *Evaluation of process: The process of medical care include the problems of recognition, diagnostic procedures, treatment and clinical management , care and prevention.*

3. Evaluation of outcome : Concerned with the end result , whether person using the services experience measurable benefits or not.

2.Establishment of standards and criteria

- This is necessary to determine how well , the desired objectives have been attained.
- *Structural criteria* : Eg: Physical facilities and equipments .
- *Process criteria* : *Eg*: Every school going child should receive dental checkup once in 6 months
- Outcome criteria : Eg: Alterations in health status { positive , negative} or behavior resulting from health care { satisfaction, dissatisfaction } or the educational process.

3. *Planning the methodology:*

- A format must be prepared for gathering the desired information .

4. *Gathering information;*

- The type and amount of information required will depend on the purpose of evaluation.

5. *Analysis of results :*

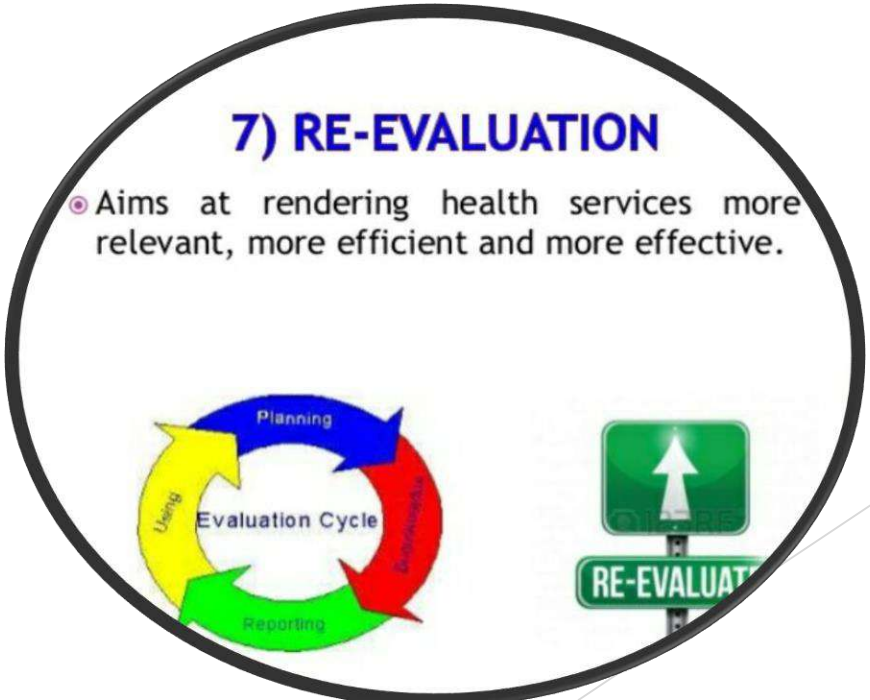
- ***The analysis and interpretation of data and feedback to all the individuals concerned should take place in the shortest time feasible .***

6. *Taking action :*

- ***For evaluation to be truly productive, actions designed to support , strengthen or otherwise modify the services involved , need to be taken.***

7. Re- evaluation

- *Evaluation is an ongoing process aimed mainly at rendering health activities more relevant , more efficient and more effective .*



CONCLUSION

- *A **plan** can play a vital role in helping to avoid mistakes or recognize hidden opportunities .. It bridges between where we are and where we want to go . Planning is looking ahead . However, planning is worthwhile only if change is seen to be necessary and if the plans are capable of being implemented.*

Reference

- *Essentials of preventive and community dentistry – Soben Peter (5th edition page no. 370 to 381)*
- *SS Hiremath (2nd edition page no.246 to 253)*

THANK YOU

EPIDEMIOLOGY OF PERIODONTAL DISEASE

CONTENTS:-

- INTRODUCTION :- definition of Epidemiology and Periodontal Disease
- CLASSIFICATION OF PERIODONTAL DISEASE
- NEED FOR EPIDEMIOLOGY?
- DISTRIBUTION OF PERIODONTAL DISEASE
- DETEREMINANTS OF PERIODONTAL DISEASE
- PREVENTION OF PERIODONTAL DISEASE.
- CONCLUSION

Introduction

- ***Epidemiology*** *is defined as the study of distribution and determinants of health related states or events in specified populations and application of this study to the control of health problems.*
- ***Periodontal disease*** *is defined as an inflammatory disease of the supporting tissues of the teeth caused by specific micro-organisms or groups of specific micro-organisms ,resulting in progressive destruction of the periodontal ligament and alveolar bone with pocket formation, recession or both.*

CLASSIFICATION OF PERIODONTAL DISEASES:- ***By AMERICAN ACADEMY OF PERIODONTOLOGY, in 1999.***

- GINGIVAL DISEASES

PLAQUE INDUCED GINGIVAL DISEASES

NON-PLAQUE INDUCED GINGIVAL DISEASES

- PERIODONTAL DISEASES

CHRONIC PERIODONTITIS

LOCALISED GENERALISED

AGGRESSIVE PERIODONTITIS

LOCALISED GENERALISED

PERIODONTITIS AS A MANIFESTATION OF SYSTEMIC DISEASE

Need for the epidemiological studies?

- ✓ describe the health status of populations.
- ✓ elucidate the etiology of diseases.
- ✓ identify risk factors.
- ✓ forecast disease occurrence.
- ✓ assist in disease prevention and control.

DISTRIBUTION OF PERIODONTAL DISEASE:-

INDIAN STUDIES

Sr.no.	Authors name.	Year	Population	finding
1	Srikanth G etal	2000	300 subjects aged 15 years and above of a fishermen community at coastal Malpe village in Udupi.	Prevalence of periodontal disease was 91% and there was dominance of calculus (66%) as the most frequently recorded score.
2	Christensen LB ,Petersen PE, Bhambal A.	2003	11-13 year- olds in Bhopal .	15% of the children had healthy gingiva and 91% of rural children had maximum CPI score 2. Mean no.of sextants with CPI score 0 was 3.5 among children in urban areas and 0.6 for children in slum

MEASUREMENT OF PERIODONTITIS

- GINGIVAL BLEEDING.

  BY CIRCUMFERENTIAL WALKING OF WILLIAM'S PERIODONTAL PROBE.
- RADIOGRAPHIC ASSESSMENT OF BONE LOSS.
- CLINICAL ATTACHMENT LOSS.

  BY CPITN PROBE
- PROBING DEPTH.

DETERMINANTS OF PERIODONTAL DISEASE

- Agent factors/Etiologic factors
- Host factors
- Environmental factors.

- **AGENT FACTORS/ETIOLOGIC FACTORS** :-

  PLAQUE HYPOTHESIS

  NON-SPECIFIC PLAQUE HYPOTHESIS

  SPECIFIC PLAQUE HYPOTHESIS

  THE “ECOLOGICAL PLAQUE HYPOTHESIS”

NON-SPECIFIC PLAQUE HYPOTHESIS

- According to this theory , periodontal disease results from the elaboration of noxious products by the entire plaque flora.

- When large amounts of plaque are present periodontal disease results otherwise small amounts are neutralised by host.

LIMITATION OF THE THEORY:-

•some individuals with considerable amounts of plaque,calculus and gingivitis never developed destructive periodontitis.

•individuals with periodontitis showed site specificity i.e. some areas being unaffected and some showing advanced disease

SPECIFIC PLAQUE HYPOTHESIS

•ACCORDING TO THIS THEORY presence of only specific bacteria makes plaque pathogenic.

The “ecological plaque hypothesis”

- In this hypothesis ,it is proposed that a change in a key environmental factor,triggers shift in the balance of resident plaque microflora,and therefore, predisposes a site to disease.
- Microbial specificity in disease would be due to the fact that only certain species are competitive under the new (changed) environmental conditions.
- Thus ,a disease could be prevented not only by inhibiting the periodontopathogens directly but also by interfering with the factors driving the transition.

Agent factors:-

materia alba, dental plaque, plaque biofilm, calculus

- Materia alba:-refers to the soft accumulations of bacteria ,desquamated epithelial cells, leukocytes and salivary proteins and lipids.

  It lacks the organised structure of dental plaque and can be removed by rinsing.
- Dental Plaque:-defined as a structured , resilient, yellow-greyish substance that adheres tenaciously to the intra-oral hard surfaces ,including removable and fixed restorations.

- Plaque is composed of bacteria in a matrix of salivary glycoproteins and extracellular polysaccharides.

thus ,because of this matrix plaque cannot be removed by rinsing.

• 1gram of plaque (wet weight)	approximately 10^{11} bacteria.
• Healthy gingival crevice	from 10^{3} bacteria.
• Deep periodontal pocket	$>10^{8}$ bacteria.

Dental plaque is classified as:-

1. Supragingival plaque:- marginal plaque
   :- found at or coronal to the gingival margin.

2. Subgingival plaque:- found apical to the gingival margin.

Key micro-organisms in periodontal diseases:-

Actinobacillus acetomycetemcomitans

Tannerella forsythia

Porphyromonas gingivalis

Calculus:- hard deposit formed by mineralisation of dental plaque and is usually covered by a layer of unmineralised plaque.

- Calculus can be classified as :-

Supragingival calculus:-located coronal to gingival margin, whitish yellow,hard clay like consistency.

:-easily detached from tooth.

Subgingival calculus:- located below the crest of marginal gingiva,dark brown/ greyish black in colour , hard and dense

:-firmly attached to tooth.

Host factors in periodontal disease:-

- Age
- Gender
- Socio-economic status
- Diet and nutrition
- Anatomy - tooth and soft tissue
- Habits –unilateral mastication
  -abnormal habits
- Local irritants - mechanical irritants
  -chemical irritants
  -atmospheric irritants
- Systemic factors

- ***AGE***:-prevalence of periodontal disease increase with increasing age.However, this increase in prevalence with increasing age is because of the cumulative progression of cases over time, and not because of the increased susceptibility of the disease.
- ***GENDER***:-epidemiologic studies show male predominance for the prevalence and severity of the disease, while pathogenesis of disease shows equal predominance.
- ***SOCIOECONOMIC STATUS:-***lower socioeconomic status results in a poor diet, poor oral hygiene, and in general lack of dental awareness.

- ***DIET and NUTRITION:-*** sticky food stuff adheres to the tooth and is difficult to remove ,thus self cleansing action of oral cavity is hindered and predisposing tooth to the periodontal disease.

Nutrients like vitamin c; B complex;vitamin a; vitamin d; proteins; calorie and calcium ; phosphorous are highly associated with periodontal diseases.

- ***ANATOMY:-***usually the normal contour of the tooth protects the underlying tissues.

Tooth :poor cusp anatomy, uneven marginal ridge,lack of contact between teeth and crowding causes food impaction and accumulation ;causing irritation and inflammation to the underlying gingival tissue thus resulting in periodontal disease.

Soft tissue: the proximity of frenum to the marginal gingiva interferes with the proper use of tooth brush in the area.

- ***HABITS:-***

Unilateral mastication :as a result of this ,one side of the mouth is in normal function , the teeth are clean ,the gingiva are stimulated and in good health where as on the neglected side there is loss of tissue tone, accumulation of food debris and calculus.

Abnormal habits: like, biting a pencil, finger nail, tooth pick etc. ,cause traumatic injury of periodontium.

- ***LOCAL IRRITANTS:-***

Mechanical irritants:include, faulty tooth brushing causes abrasion or recession of the gingival tissues and irritate already inflamed tissues;

Faulty dentistry which includes ,overhanging restorations and open cavity margins impinge on the gingiva or irritate them;

Faulty orthodontic treatment i.e. too rapid movement,too vigorous pressure ;also results in root resorption as well as alveolar bone loss and mobility.

Chemical irritants;include alcohol ,tobacco, which directly lowers tissue resistance and increases gingival susceptibility to gingivitis and periodontal diseases.

Atmospheric irritants: because of the nasal obstruction ,habit,malocclusion, systemic disturbances and psychosomatic factors ; some patients breathe through the mouth. This leads to the dehydration of mucous membrane of the mouth and lowered tissue resistance.

Thus the tissue enlarged and become fibrotic ,resulting in gingival enlargement/inflammation.

- ***SYSTEMIC FACTORS:-***certain systemic disorders and conditions like; anemia, puberty, pregnancy gingivitis, hyperparathyroidism, radiation and drugs like ,dilantin sodium ; alters host tissue , reducing the host defense to periodontal infection resulting in more destructive disease.

Environmental Factors in Periodontal disease

- ***GEOGRAPHIC VARIATION:-***the WHO Global Oral Health Data Bank doesnot suggest any difference between nations.
- ***DEGREE OF URBANISATION:-***people living in rural areas had a significant higher prevalence of periodontal disease.
- ***PSYCHOLOGICAL AND CULTURAL FACTORS:-*** anxiety,fear of the dentist, lack of knowledge about the diseases and their treatment are some of the relevant psychological factors.

Certain cultures veiw dental problems and loss of teeth solely as an extension of aging process .

PREVENTION OF PERIODONTAL DISEASE

	PRIMARY		SECONDARY	TERTIARY	
LEVELS OF PREVENTION	HEALTH PROMOTION	SPECIFIC PROTECTION	EARLY DIAGNOSIS AND PROMPT TREATMENT	DISABILITY LIMITATION	REHABILITATION
Services provided by the individual.	Periodic visits to dental office.Demand for preventive services.	Oral hygiene practices.	Self examination and referral utilisation of dental services.	Utilisation of dental services.	Utilisation of dental services.
Services provided by the community.	Dental health education programes ,promotion of research.	Provision of oral hygiene,aids,SUPER-VISITED school brushing programs.	Periodic screening and referral provision of dental services.	Provision of dental services.	Provision of dental services.
Services provided by the dental professional.	Patient education. recall; Reinforcement.	Plaque control program;correction of malaligned teeth;prophylaxis.	Complete examination,scaling and curettage,corrective restorative and occlusal services.	Deep curettage ;root planing and splinting.Periodontal surgery;Selective extractions	Removable/fixed partial dentures.Minor tooth movement.

CONCLUSION:-

- Periodontal disease accounts for a majority of missing teeth in adults and results in tremendous economic and social burdens both to individual and society.
- Periodontal disease is so prevalent that only possible solution to the problem is “PREVENTION”
- Available data suggests that faithful adherence to proper oral hygiene practices should be atleast as effective, in controlling periodontal disease as fluoride has been in controlling dental caries.
- To be effective, prevention requires responsible action on the part of individuals themselves,government and society in general.
- Consumers and providers of health services have to become involved and there must be improved access to comprehensive care.

REFERENCE

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