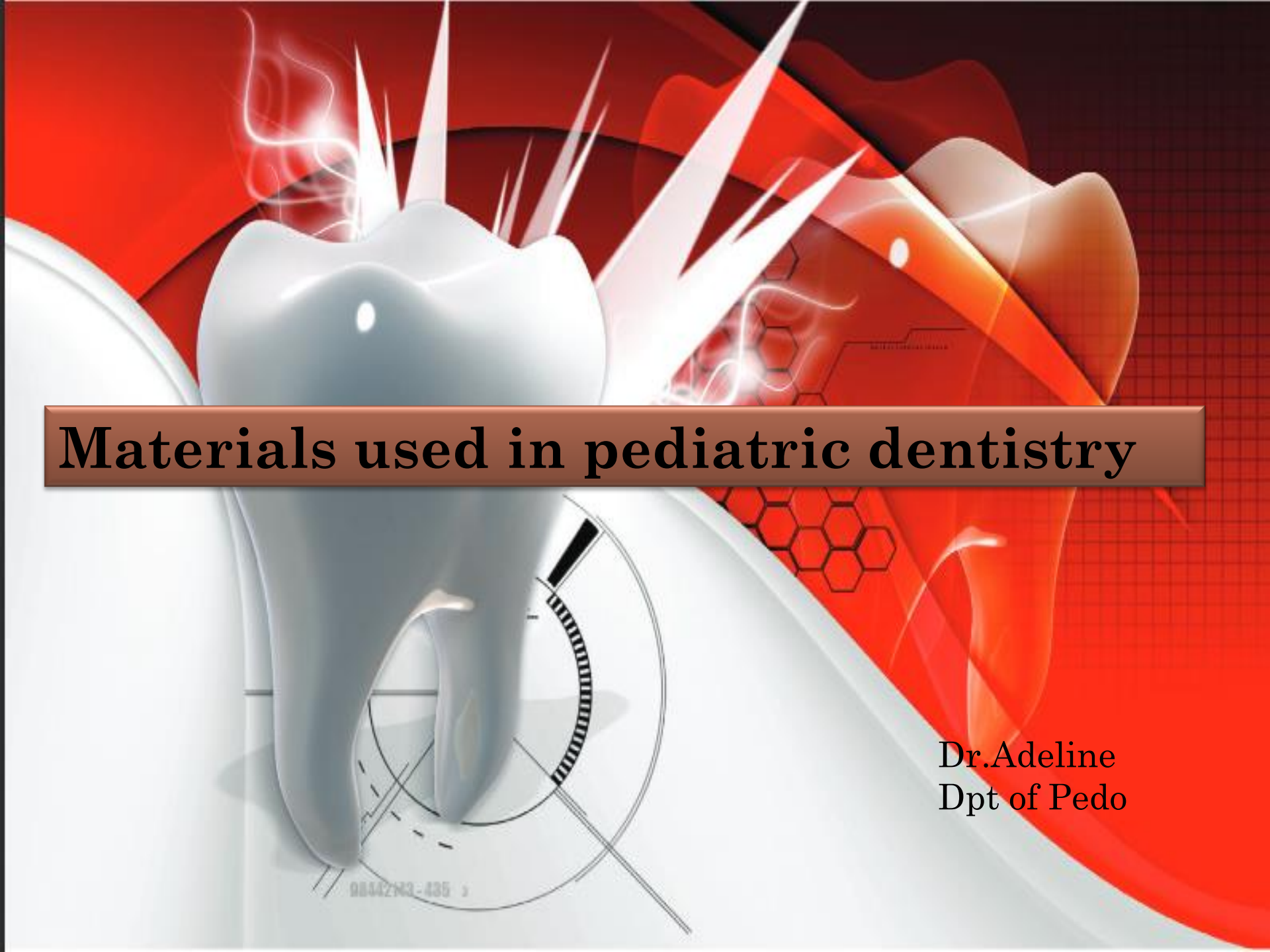
Materials used in pediatric dentistry



Dr.Adeline
Dpt of Pedo

CEMENTS

CONTENTS

- Introduction
- Definition
- History
- Classification
  - Based on ISO
  - Based on Ingredients & Application (Craig)
  - Based on Bonding Mechanism (William O'Brien)
  - Based on Setting Reaction (Anusavice)
- Types
- Factors affecting cements
- Requirements of cements
- Ideal properties
- Manipulation of cements
- Storage of cements
- Pulpal reactions to cements

- **Silicate cement**
- **Zinc phosphate cement**
  - **Modification**
    - **Fluoridated cement**
    - **Copper cement**
    - **Silicophosphate cement**
- **Zinc polycarboxylate cement**
- **Zinc Oxide Eugenol cement**
  - **Modification**
    - **Reinforced Zinc Oxide Eugenol**
    - **EBA**

- **Glass Ionomer Cement**
  - **Modification**
    - **Metal reinforced GIC**
    - **Resin modified GIC**
    - **Newer advances of GIC**
- **COMPOMER**
- **Calcium Hydroxide cement**
- **Resin cements**
- **Review Of Literature**
- **Conclusions**
- **References**

INTRODUCTION

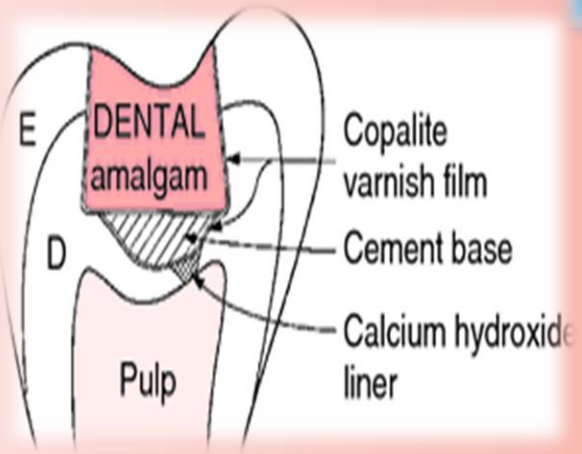
Objective of any restorative treatment :

- Restoring primary teeth ensures that the natural spaces in the child's primary dentition which are retained for the developing permanent teeth.

limit the damage of dental caries.

Restoration

Restore aesthetics



preserve remaining tooth structure.

Ease in maintaining good oral hygiene

DEFINITION

A cement is a substance that hardens to act as a base , liner, filling material or adhesive to bind devices or prosthesis to the tooth structure or to each other.

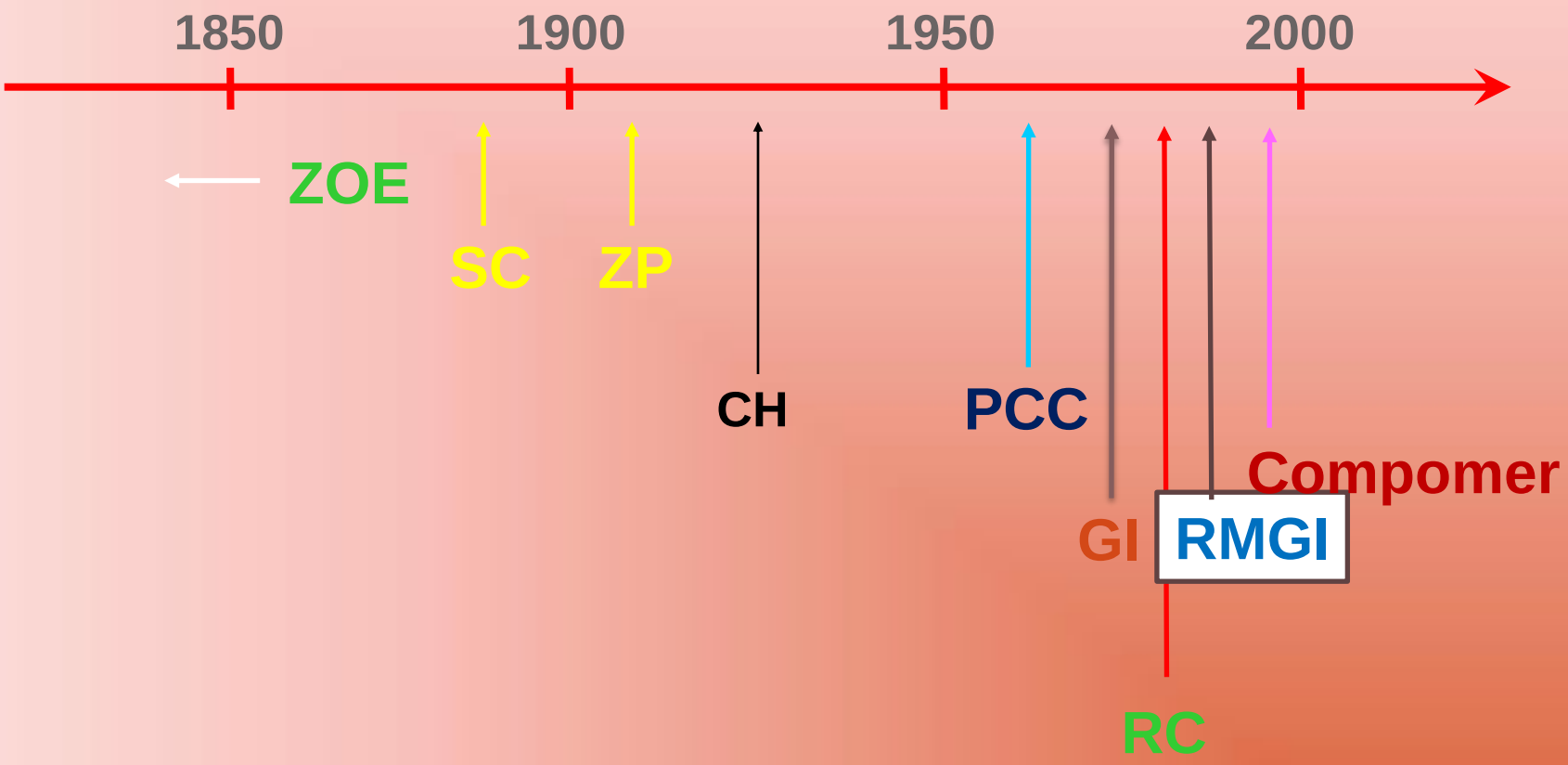
- **PHILIPS' SCIENCE OF DENTAL MATERIALS (12TH ED)**

A non metallic material , used for luting, filling permanent or temporary restorative purposes, made by mixing components into a plastic mass that sets or as an adherent sealer in attaching various dental restorations in or on the tooth -**(CRAIG)**

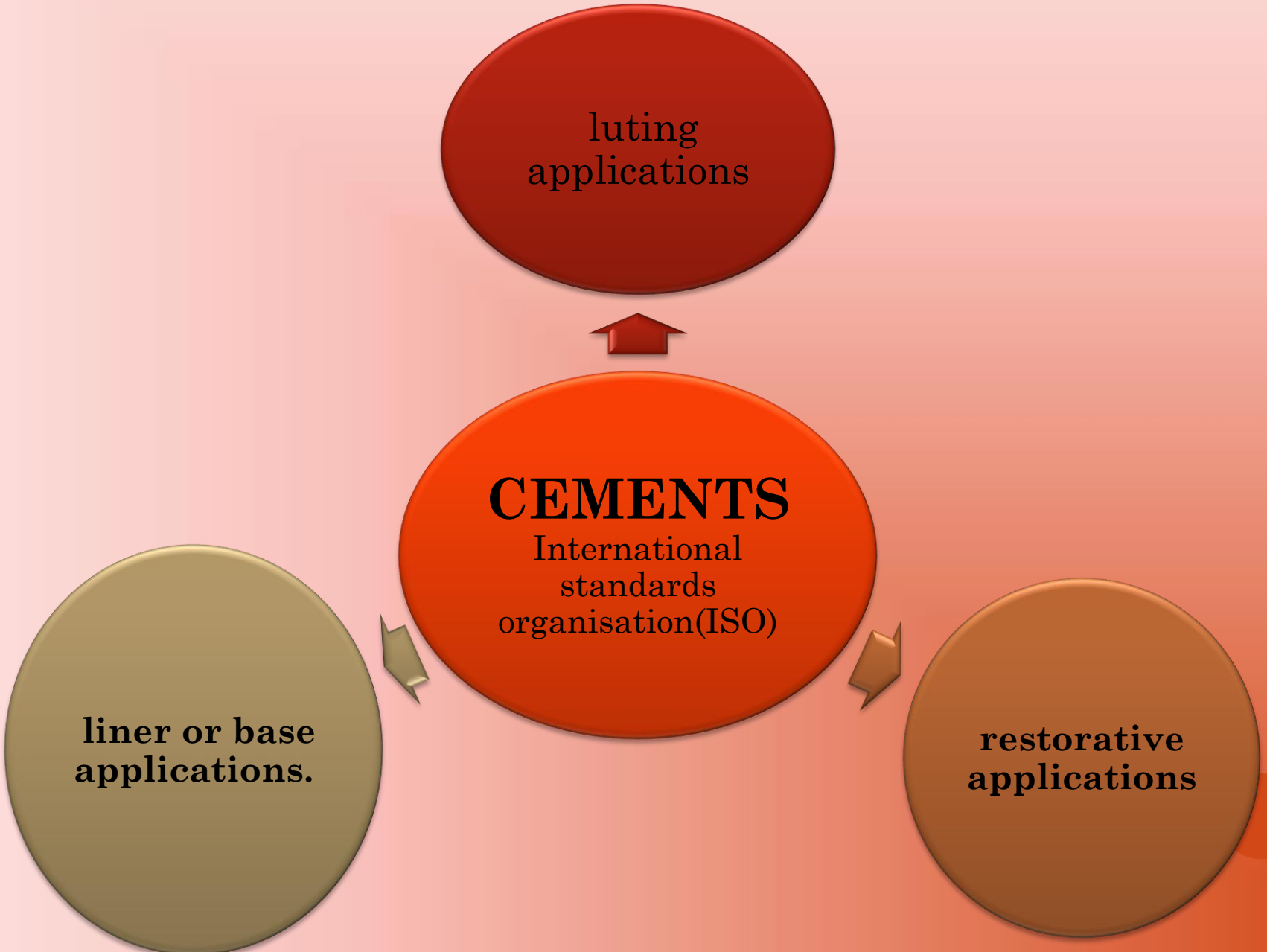
HISTORY

- 1873- **Silicate cement** by Fletcher
- 1873- **Zinc oxide** and **clove oil** by Chisolm
- 1879- **Zinc phosphate** cement by Dr Pierce
- 1930- **Calcium hydroxide** paste by Hermann
- 1968-**Polycarboxilic** cement by Dennis Smith
- 1971-**Glass ionomer** cement by Wilson and Kent

Dental Cement Timeline



CLASSIFICATION



Based on Ingredients & Application
(Craig 12th edition)

Water based cements

- Glass & Resin modified glass ionomer
- Zinc Polyacrylate
- Zinc Phosphate

Resin based cements

- Composite & adhesive resin
- Compomers

Oil based cements

- Zinc Oxide Eugenol
- Non Eugenol -Zinc Oxide

Based on the bonding mechanism (Williams O'Brien. 2002 & Richard van Noort)

Phosphate based :

- Zinc phosphate cement
- Modified zinc phosphate cement
- Fluoridated cement
- Copper cement
- Silicophosphate cement

Phenolate based :

- Zinc oxide eugenol cement
- Reinforced zinc oxide eugenol
- EBA and other chelate cements
- Calcium hydroxide chelate cement

Polycarboxylate based:

- Zinc polycarboxylate cement
- Glass ionomer cement

Methacrylate based:

- Acrylic cements
- BIS-GMA type cements

CLASSIFICATION BASED ON SETTING REACTION (SKINNERS)

Acid Base Reaction –

- Zinc phosphate
- Zinc polycarboxylate
- Zinc oxide eugenol
- Glass ionomer cement

Light / Chemical activities

Polymerization and acid base reaction- RMGIC

Compomer

Resin cement.

TYPES

Conventional cement

- Zinc phosphate cement
- Zinc oxide-eugenol cement
- Polycarboxylate cement
- Glass ionomer cement

Resin-base cement

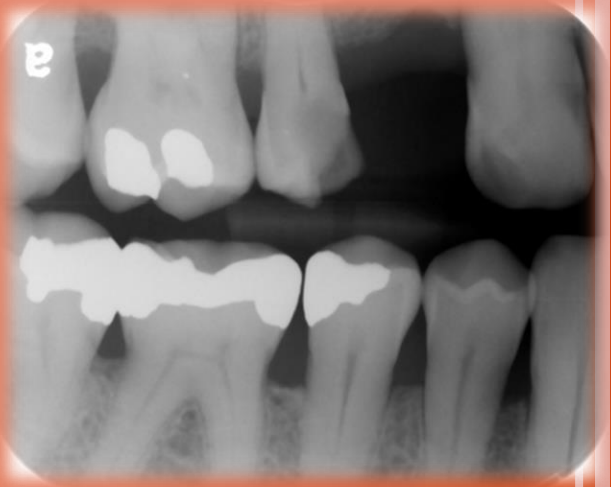
- Resin cement
- Resin modified glass ionomer cement

Factors affecting cements

- **Mixing time**
- **Humidity**
- **Powder to liquid ratio**
- **Temperature**

Requirements of cements

- Biocompatibility
- Retention
- High tensile strength, fracture
- toughness, fatique strength
- Good marginal seal
- Low film thickness
- Ease of use
- Radiopacity
- Aesthetics



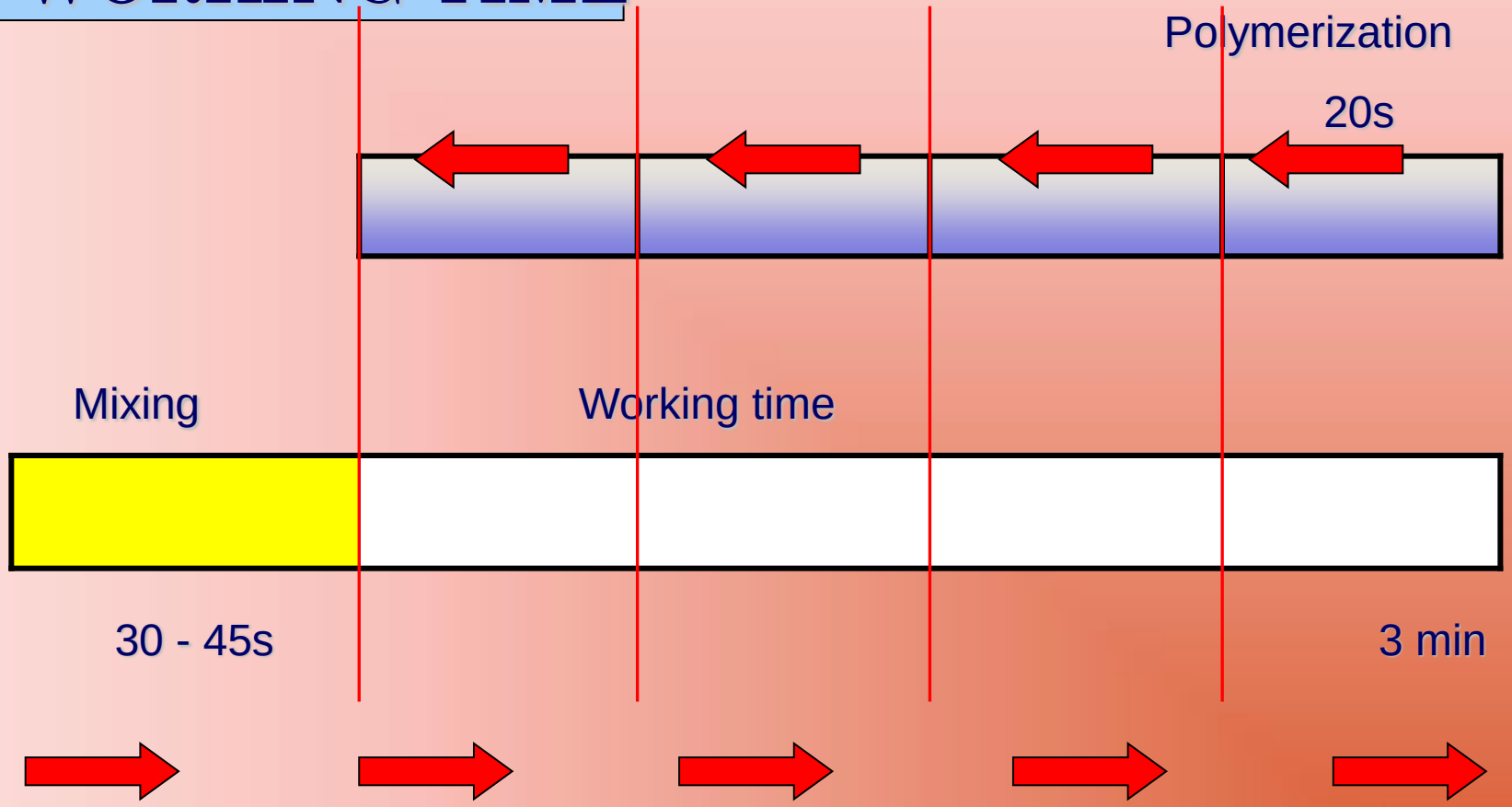
IDEAL PROPERTIES OF CEMENTS

- Should be strong and hard.
- Able to protect pulp
- Should be insoluble in saliva & liquids taken in mouth.
- Should be dimensionally stable.
- Should be adhesive .
- Should be non porous .
- Should be biocompatible and non irritant.
- Co-efficient of thermal expansion should be equal to the tooth structure.
- Should not be affected by thermal changes and moisture.
- Should be easy to manipulate.

Manipulation of cements

- **Divide the powder into increments**
- Mix powder and liquid using a plastic or stainless spatula at the shortest possible time (max. 30 – 45 s.)
- Properly prepared cement is homogenous, flexible and non-adhesive material

WORKING TIME



STORING CEMENTS

- **In a cold and dry place in a well sealed inner container**
- **at temperature 5 ºC to 25 ºC**
- **avoid temperature higher than 25 ºC**

!!! Seal the bottle and the jar carefully after withdrawing powder and liquid !!!!

PULPAL REACTIONS TO CEMENTS

Cements that are irritant to pulp tissue:

Resin ≈ zinc phosphate > GIC > Polycarboxylate >ZOE ≈ CaoH

- Fuji IX GIC- Good biocompatibility and harmless effect on pulp
  J.dent 2000;28(6):413-22

- RMGIC > ZOE (RMGIC has more adverse reaction on pulp)

- Silicate cement- Causes irritation to the pulp

- Ca0H- low grade irritation due to coagulative necrosis caused by Ca (0H)2 leading to pulp calcification.

- Direct pulp capping with dentin bonding agents followed by the total etch technique in primary teeth are not recommended.

Trade Names Of Various Dental Cements commonly Used In Practice

Glass Ionomer	Resin Modified Ionomer	Resin Cement Chemically Cured	Resin Cement Dual Cured	Zinc Phosphate	Zinc Poly-carboxylate	Zinc Oxide-Eugenol
Fuji (GC)	Advance (Caulk)	Panavia 21 (J. Morita)	Resinomer (Bisco)	Tenacin (Caulk)	Durelon (ESPE)	Tem-Bond (Kerr)
Ketac-Cem (ESPE)	Vitremer Luting (3M)	Clearfil CR Inlay (J. Morita)	Enforce (Dentsply)	Fleck's (Mizzy)	Tylok Plus (Caulk)	Fynal (Caulk)

SILICATE CEMENT

SILICATES:

- Introduced -1903 as anterior filling materials.
- Silicates are attacked by oral fluids and in time degrade, they may not be considered permanent restoration.
- The uses of silicate cements diminished with the advent of composite resins and development of GIC.

Composition

Powder

- Silica
- Alumina
- Fluoride compounds
- Calcium salts-Fluoride Flux -To permit proper sintering of the other ingredients.

Liquid

- Phosphoric acid
- Water
- Buffer salts

Setting Reaction

Powder mixed with liquid

Powder attacked by acid liquid releasing Ca, Al, Fl ions

Metal ions precipitate as phosphate

cement matrix inclusive of Fl salts

Properties :

- Silicate cement is strongest of all dental cements (182 MPa)
- It has anticariogenic property due to the presence of 15% F.

(At the time of insertion it has a pH of 2.0 and even after one month, it remains below 7)

Advantages

- It exhibit good esthetic qualities .
- Anti-cariogenic property.
- Analogues to topical applied fluoride solution.

Disadvantages

- It lacks stability in oral fluids with loss of esthetic qualities
- Rubber dam is essential for successful silicate restoration.
- Irritant to pulp.
- Contraindicated in mouth breathers

ZINC PHOSPHATE CEMENT

Zinc Phosphate cement

- Introduced over a century ago and it is the oldest luting cement.

- Synonyms `Crown and Bridge' and "Zinc oxyphosphate'

POWDER

Zinc Oxide	Principle Ingredient
Magnesium Oxide	reduces the temp. of calcification process
Oxides of Bismuth or Calcium	Impact a smoothness to freshly mixed
Silicon Dioxide-	In active filler

LIQUID

Phosphoric acid	45-64% Reacts with ZnO
Water	30 – 55% Increases Rate of reaction
Aluminum	2.3% Essential to the cement forming reaction
Zinc	0.9% Moderates reaction between powder and Liquid allows adequate working time

Classification (anusavice 12th edition)

- Type I

  -Fine grained for luting
  -Film thickness should be less than 25 um

- Type II -

  - Medium grained for luting and filling
  - Film thickness should be more than 40um

Manipulation

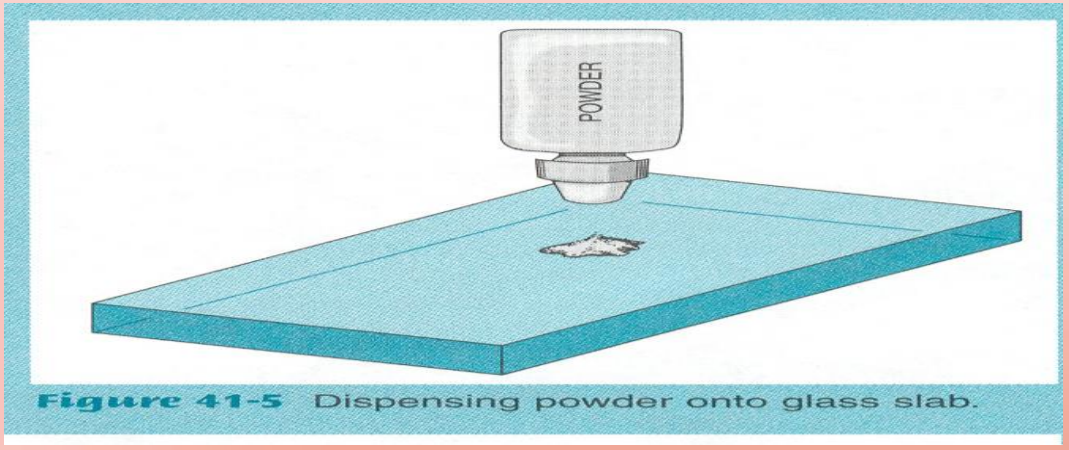


Figure 41-5 Dispensing powder onto glass slab.

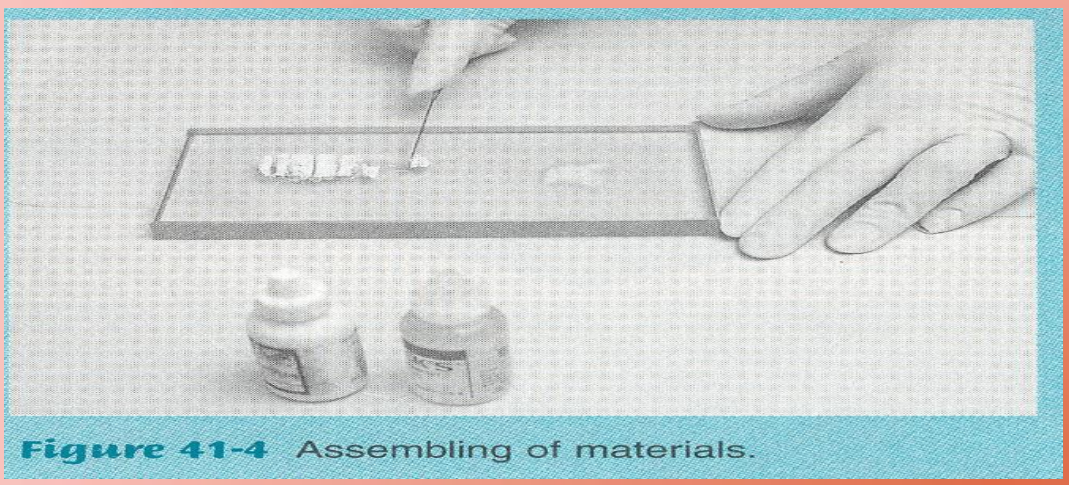


Figure 41-4 Assembling of materials.

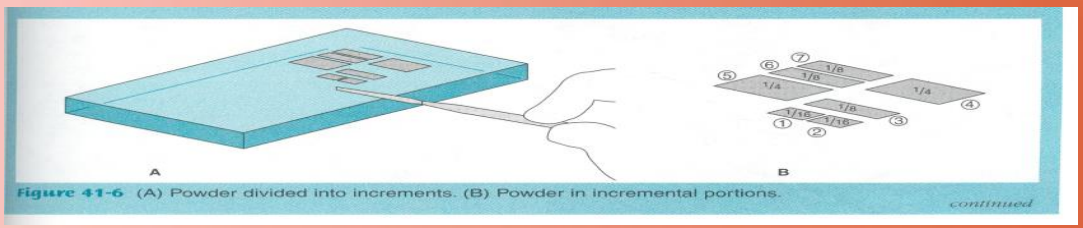


Figure 41-6 (A) Powder divided into increments. (B) Powder in incremental portions.

continued

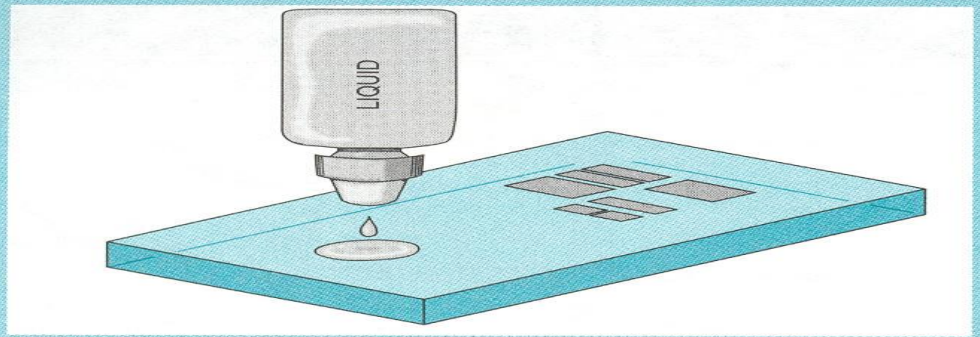


Figure 41-7 Dispensing the liquid.

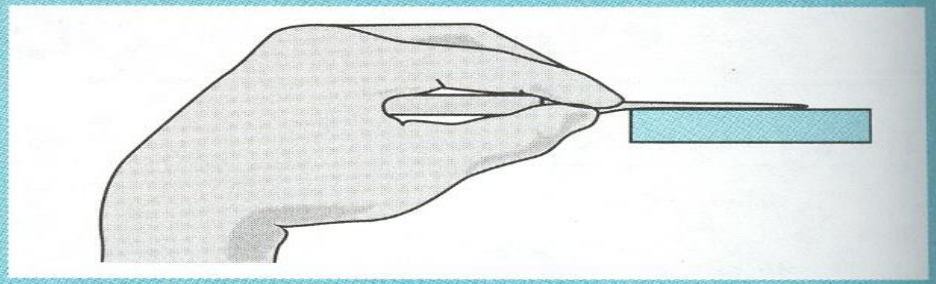


Figure 41-8 Spatula blade flat against glass slab.

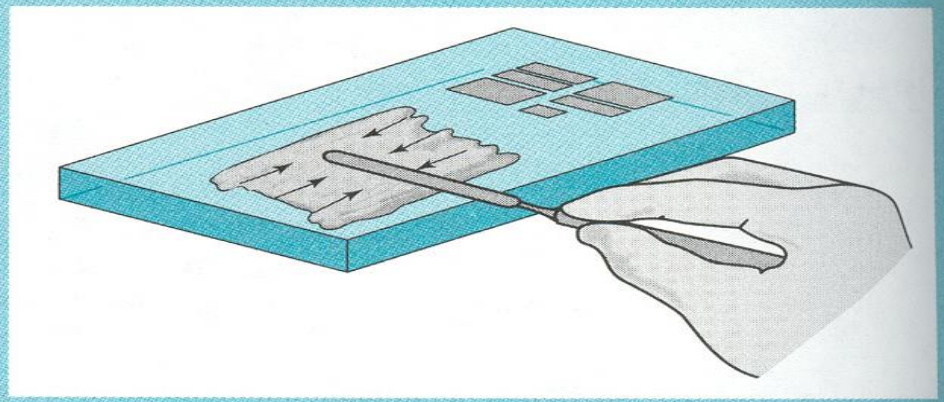


Figure 41-9 Spatulate mix over large area of glass slab.

Frozen Slab Technique

When this liquid is exposed to a humid atmosphere, it will absorb water. Whereas exposure to dry air tends to result in a loss of water which will alter the property of cement.

- Practical way to increase the working time and reduce the setting time of zinc phosphate cement.
- 50% increased powder/liquid ratio.
- Mixing in a frozen glass slab at 21^0 C.

SETTING REACTION

Exothermic reaction

Powder & liquid mixed

↓

Phosphoric acid attacks the surface

↓

Release of zinc ions & reaction of Al with phosphoric acid

↓

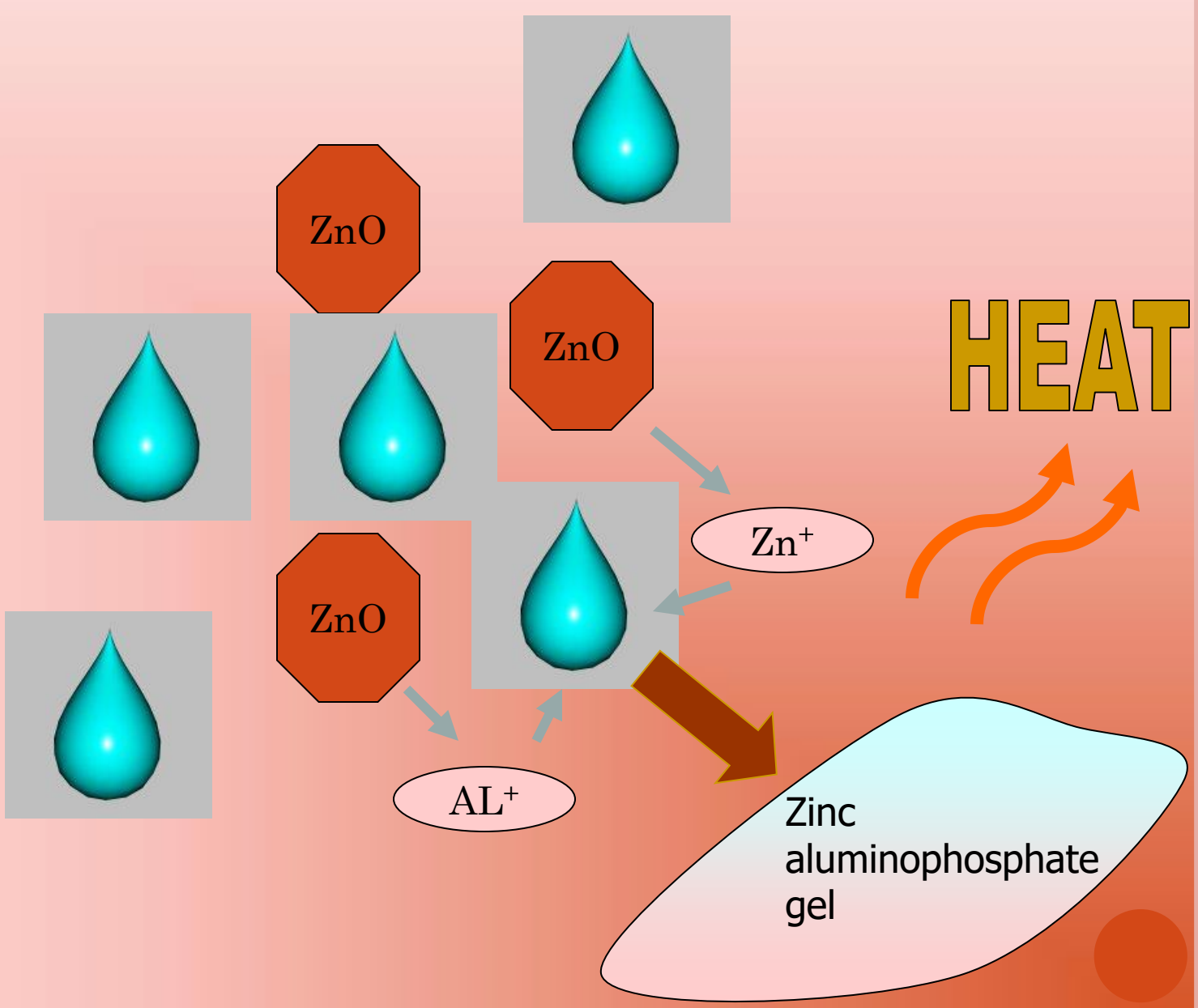
Al & Zn ions react with phosphoric acid

↓

Zinc alumino phosphate gel

↓

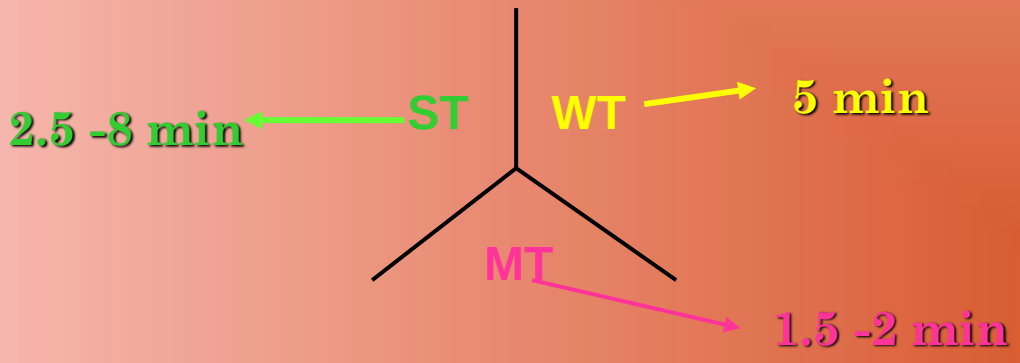
and surrounds with un reacted particle


ZnO
ZnO
ZnO
HEAT
Zn+
AL+
Zinc
aluminophosphate
gel

PROPERTIES

- Compressive strength -104 Mpa
- Tensile strength -55 Mpa
- Modulus of elasticity – 13.7Gpa (stiff & resistance to deformity)
- Retention is mechanical
- At insertion PH at 2 min – 2

  at 24 hrs – 5.5



Advantages

- Most popular for cast restorations
- Adequate strength
- Reasonable working time
- Excess material can be easily removed
- Manipulation less critical than other cements.
- Effective when multiple castings are to be cemented.

Disadvantages

- Pulp irritation
- Lack of antibacterial action
- Brittleness
- Lack of adhesion
- Solubility in acid fluids
- Decrease in compressive strength

Variations in Zinc Phosphate Cement

Fluoridated cement:

- Small % of stannous fluoride.
- Lower strength & higher solubility than zinc phosphate.
- Fluoride release continues over long period & uptake and reduces enamel solubility ,increases hardness therby reduce the incidence of enamel decalcification under orthodontic bands.
- Used in orthodontic band cementation.

Copper/Silver cement:

- Consists of proportion of red or black cuprous oxide or copper salts or silver salts to zinc oxide powder.
- Used in past due to germicidal action.
- Were discontinued due to staining of teeth.

SILICOPHOSPHATE CEMENT :

-Combination of zinc phosphate & silicate cement.

-Contains small amounts of mercury compounds.

Composition:

-Silicate glass & minor amount of zinc oxide,13-25% fluoride

-Liquid contains 50% phosphoric acid,45% water,4-9% zinc, 2% Al.

Uses:

Used for cementation orthodontic bands & restoring non vital teeth

Advantages :

- Better toughness than zinc phosphate.
- Fluoride release & degree of translucency.
- Lower solubility & better bonding.

Disadvantages :

- Less satisfactory mixing & rheological properties leading to higher film thickness
- Greater potential for pulp irritation.

ZINC POLYCARBOXYLATE CEMENT

Zinc Polycarboxylate Cement

- It is the 1st adhesive material developed in dentistry.

- Advantages over the traditional $ZnPO_4$

  - Compatibility with pulpal tissue

  - Adhesion to tooth structure.

POWDER

Zinc oxide	Main ingredient
Stannous oxide	Replaces magnesium oxide
Silica, Alumina or Bismuth	Filler
Stannous fluoride	4.5% improves the manipulation, characteristics, strength
Sodium fluoride	1% Anticariogenic property

LIQUID

Aqueous solution of Polyacrylic acid	Co-polymer of acrylic acid
Other carboxylic acid (itaconic acid)	-stabilizes the liquid

MANIPULATION

- Mixed at a P/L of 1.5 :1
- The correct consistency is found in a mix that is viscous.
- Dispensing of the liquid should be done immediately.
- The mixed cement should be used only till appears glossy on the surface.
- Polyacrylate cements should be mixed within 30-60 sec.
- The strength of the mixed cement is not compromised by this technique.

Setting Reaction

Surface dissolution of particles by acid

⇓

Release of Zn, Mg ,Sn ions

⇓

Bind to polymer chain by OH group

⇓

Reacts with carboxylic group

⇓

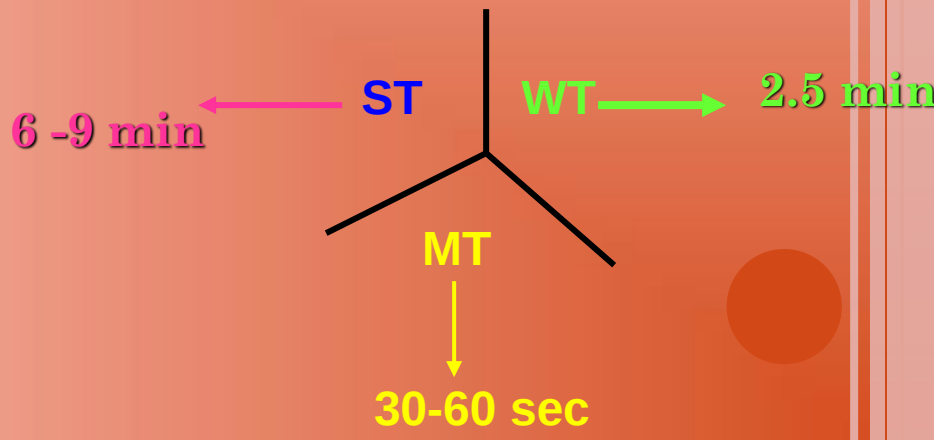
Cross linking of polymer chain

⇓

Amorphous gel particle with unreacted particle dispersed

PROPERTIES

- Compressive strength – 55 -67 Mpa
- Tensile strength –slightly higher than $ZnPO_4$
- Modulus of elasticity -2.4 – 4.4 Gpa -less stiffer & less brittle than $ZnPo_4$
- Low soluble in oral fluids than $ZnPO_4$
- Excellent biocompatibility with pulp



Advantages :

- Low level of irritation
- Good adhesion to tooth substances & alloys.
- Good strength, solubility & film thickness compare to zinc phosphate.

Disadvantage

- Need for accurate proportion, more critical manipulation
- Lower compressive strength & greater visco-elasticity than zinc phosphate.
- Short working time & need clean surface to use adhesion potential (technique sensitive).


T
Cavex
Zinc Oxide
Eugenol
cement
T
Cavex
Zinc Oxide
Eugenol cement
CAVEX

ZOE


Bosworth ZMent

Zinc Oxide Eugenol

- Extensively used in dentistry since 1890's .
- Least irritant of all the dental materials.
- Poor strength when compared to zinc phosphate.
- It has sedative effect on exposed dentin.

POWDER

ZnO	Principal Ingredient
White rosin	Brittleness of set cement
Zn acetate	Accelerator strength – up to 1%
MgO	Modifier
Zn stearate	Plasticizer

LIQUID

Eugenol	Reacts with ZnO
Olive Oil	Plasticizer (85% Eugenol)
Water	Initiator
Acetic acid/alcohol	To accelerate setting – about 1%

CLASSIFICATION (ADA SP. NO 30)

Type I	Used for Temporary cementation (Tempbond / Neogenol / Freegenol)
Type II	Used for Long Term cementation of fixed prosthesis(Kalzinol)
Type III	Temporary Filling/ Thermal insulating base (IRM)
Type IV	Intermediate Restorations and Cavityliners(Dycal)

MANIPULATION:

Temporary cements (Type I) & Liners (Type IV)
(two paste systems)

- Dispense equal lengths and Continue mixing until a uniform color is achieved.

Long term Zinc oxide Eugenol Cements (Type – II)
(powder & liquid system)

- Incorporate the powder into the liquid all once and mix for 30 sec with a metal spatula

- Coat the patient's lips and adjacent teeth with petroleum gel before application of the cement. Oil of orange is a solvent useful in removing set cement.

ZINC OXIDE EUGENOL

SETTING REACTION

zinc dioxide hydrolysis

↓

zinc hydroxide eugenol

↓

zinc eugenol

Chemistry of Setting :

$ZnO + H_2O \longrightarrow Zn(OH)_2$

Zn hydroxide

$Zn(OH)_2 + 2HE \longrightarrow ZnE_2 + 2H_2O$

Base Acid Zn – eugenolate salt

Advantages:

- Minimal pulp reaction.
- Good sealing properties
- Strength adequate for lining material &luting single restoration & retainers, with good retention form.

Disadvantages:

- Hydrolytic breakdown under exposure to oral fluids
- Inflammatory reaction in soft tissue
- Potential allergic response
- Minimal mechanical properties for luting
- May soften & discolor

USES

Primary application

- Temporary restoration
- Intermediate restoration
- Temporary luting
- Thermal insulating base
- Pulp capping agent

Secondary application

- As root canal sealants and in RC restorations
- Periodontal dressings

MODIFICATIONS OF ZOE :

- Resin Reinforced Zinc Oxide Eugenol Cement
- EBA and other Chelate Cements

RESIN REINFORCED ZINC OXIDE EUGENOL CEMENT

POWDER

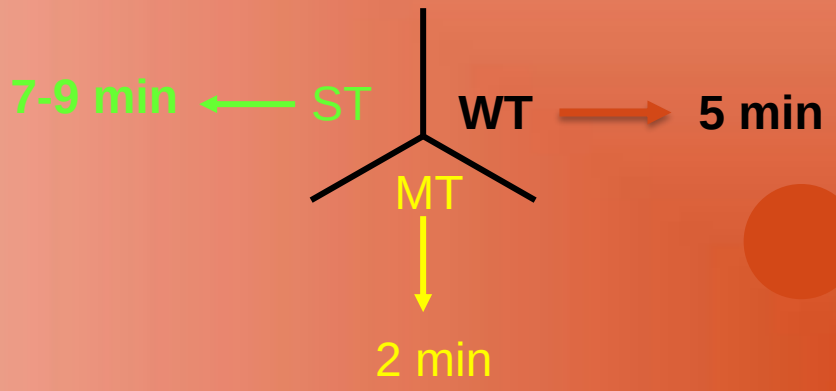
Zinc powder	80.0%
Poly methyl-methacrylate	– 20.0%(bond to other components)
Zinc stearate Zinc acetate	traces (accelerator)
Thymol & hydroxyquinoline	– traces (antimicrobial agent)

LIQUID

Eugenol	85%
Olive oil –	15% -(as plasticizer ,masks irritating effect of eugenol).

PROPERTIES:

- Film thickness - 25-75 um
- Compressive strength - 35-55 MPa
- Tensile Strength - 4 MPa
- Modulus of elasticity - 2-3000 MPa
- Water immersion reduces the mechanical properties due to loss of eugenol.
- Mechanical retention of crowns of ZOE cement is less than Zinc phosphate cements.
- An 83.5% success rate was noted for polymer reinforced cement after 7 years.



EBA AND OTHER CHELATE CEMENTS

POWDER

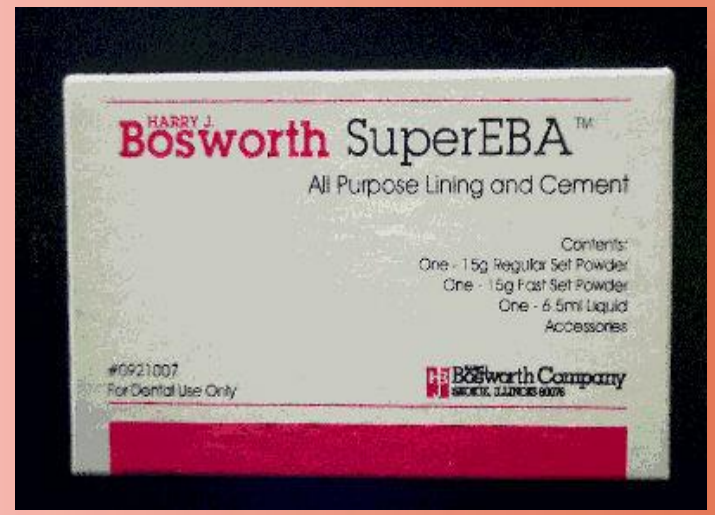
ZnO	Main ingredient
Aluminium oxide/other mineral fillers	**20-30%**
Poly methyl methacrylate	**Polymeric reinforcing agent**
Barium sulphate	**radiopacity**

LIQUID

O- ethoxy benzoic acid	**50-60%**
Eugenol	**Remaining part**

PROPERTIES

- Working time and setting time – 7-13 min.
- Film thickness – 40-70 um
- Tensile strength – 6-7 MPa
- Modulus of elasticity – 5000 MPa
- Shows visco -elastic properties with very low strength and large plastic deformation at slow rates of deformation at mouth temperatures (37 C)
- This is why EBA cement retention values for orthodontic bands, although superior to those of other zinc oxide eugenol type materials, are considerably less than those of zinc phosphate cement.
- Exposing EBA cements to moisture results in greater oral dissolution than with other cements.



ADVANTAGES

- Easy manipulation
- Long working time
- Good flow characteristics & strength characteristics
- Minimal irritation to the pulp
- Best suited to luting of restorations with good fit retention where there is no under stress and for cavity bases.

DISADVANTAGES

- More critical proportioning
- Hydrolytic breakdown in oral fluids
- Liability to plastic deformation
- Less retention than zinc phosphate cements

Applications

- Luting agent
- Cavity bases

NON- EUGENOL CEMENT (CAVIT)

- A premixed non eugenol paste used for temporary restorations & cavity bases.

- Contains – Zinc oxide
  Zinc sulphate
  Calcium sulphate
  Glycol acetate
  Poly vinyl acetate
  Triethanolamine
  Red pigments

- Setting reaction initiated by saliva & water.
- Better sealing into cavity walls due to hydroscopic properties.
- Minimum thickness of atleast 3 to 3.5 mm required.
- It is not satisfactory material for cementation.
- When inserted into dry cavity it creates negative pressure, causing aspiration of odontoblast leading to pain.
- PH same as ZOE.
- The solubility of the set ZOE cement is highest among the cements.

GI filling material

Definition

Glass-ionomer is the generic name of a group of materials that use silicate glass powder and aqueous solution of polyacrylic acid"

-Kenneth J Anusavice.

Other names

- Glass ionomer-term coined by **wilson & kent**
  glass-alumino silicate glass particles
  ionomer-poly carboxylic acid.

- ISO terminology- **poly alkenoate cement**.

- Since its extensive usage to replace the dentin ,has given different names
  Dentin substitute
  Man made dentin
  Artificial dentin

- Introduced into u.s as **ASPA-Alumino silicate polyacrylate**

Glass Ionomer Cement

- Relatively “Kind” to pulp.
- Fluoride releasing property.
- Chemical adhesion to the tooth structure

POWDER

Calcium flouroaluminosilicate glass	(SiO_2 - ,$Al2O_{3,}$- $AlF_{3,}$- $CaF_{2,}$ - Na_3AlF_6 - $AlPO_4$)
ZnO, Lanthanum, Strontium, Barium	opacity.

LIQUID

Polyacrylic acid	40-50%
Tartaric acid	improves the handling characteristics is working time
Itaconic acid	the active liquid
Maleic acid	the viscosity
Tricarboxylic acid	the tendency for gelation

ACCORDING TO APPLICATION BY SMITH/WRIGHT 1994

- Type I – For luting
- Type II - Restoration
- Type III - Liner and bases
- Type IV - Pit & Fissure sealants
- Type V - Orthodontic cement
- Type VI - Core build up

TYPE I

TYPE II

- Type VII - Pink GIC

TYPE VII

- Type VIII - Auto Cured Resin Reinforced Glass Ionomer Cement for Anterior Restorations

- Type IX - Auto cured resin Reinforced Glass Ionomer Cement for posterior Restorations

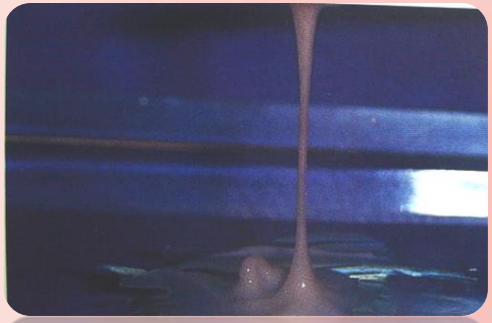
TYPE IX

NEWER CLASSIFICATION:

- **Traditional glass ionomer**
  - **a. Type I --- Luting cement**
  - **b. Type II --- Restorative cements**
  - **c. Type III --- Liners&Bases**
- **Metal modified Glass Ionomer**
  - **a. Miracle mix**
  - **b. Cermet cement**
- **Light cure Glass Ionomer**
  - **HEMA added to liquid**
- **Hybrid Glass Ionomer/resin modified Glass Ionomer**
  - **a. Composite resin in which fillers substituted with glass ionomer particles**
  - **b. Precured glasses blended into composites**

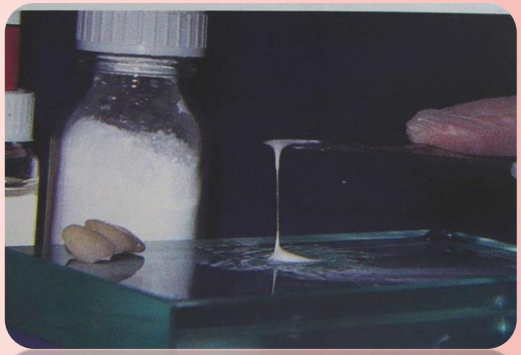
MANIPULATION:

CORRECT CONSISTENCY FOR HAND MIXED



Type I : Luting : string up to 3-4cm from slab

Type II : String 1cm + gloss



Type III :

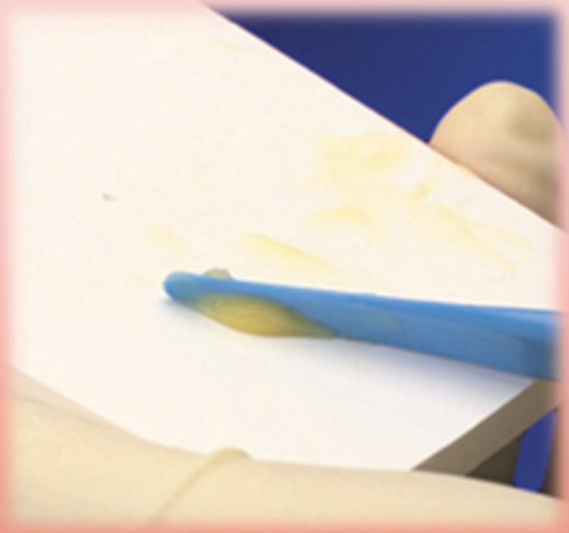
for lining amalgam :

1.5:1 P/L ratio : 3-4cm string

For base for composite :

3:1 P/L ratio : 1-1.5cm string

PREPARATION OF THE MATERIAL



mixing time is 30-60 sec.

- The cement must be used immediately because the working time after mixing is about 2 mins.

- At room temperature (23°C), an extension of the working time can be achieved by mixing on a **cold slab**, but a reduction in compression strength and the modulus and elasticity is observed.

- The cement should not be used once a "**skin**" forms on the surface or when the viscosity noticeably increases.

- **Sensitive** to contact with **water during setting**.

- The field must be **isolated completely**

SETTING REACTION:

Powder and liquid mixed

Acid leaches Na,Ca,Al,Fl ions

Polyacrylic acids cross linked by Ca ions

Cross linking replace by Al ions in 24 hrs

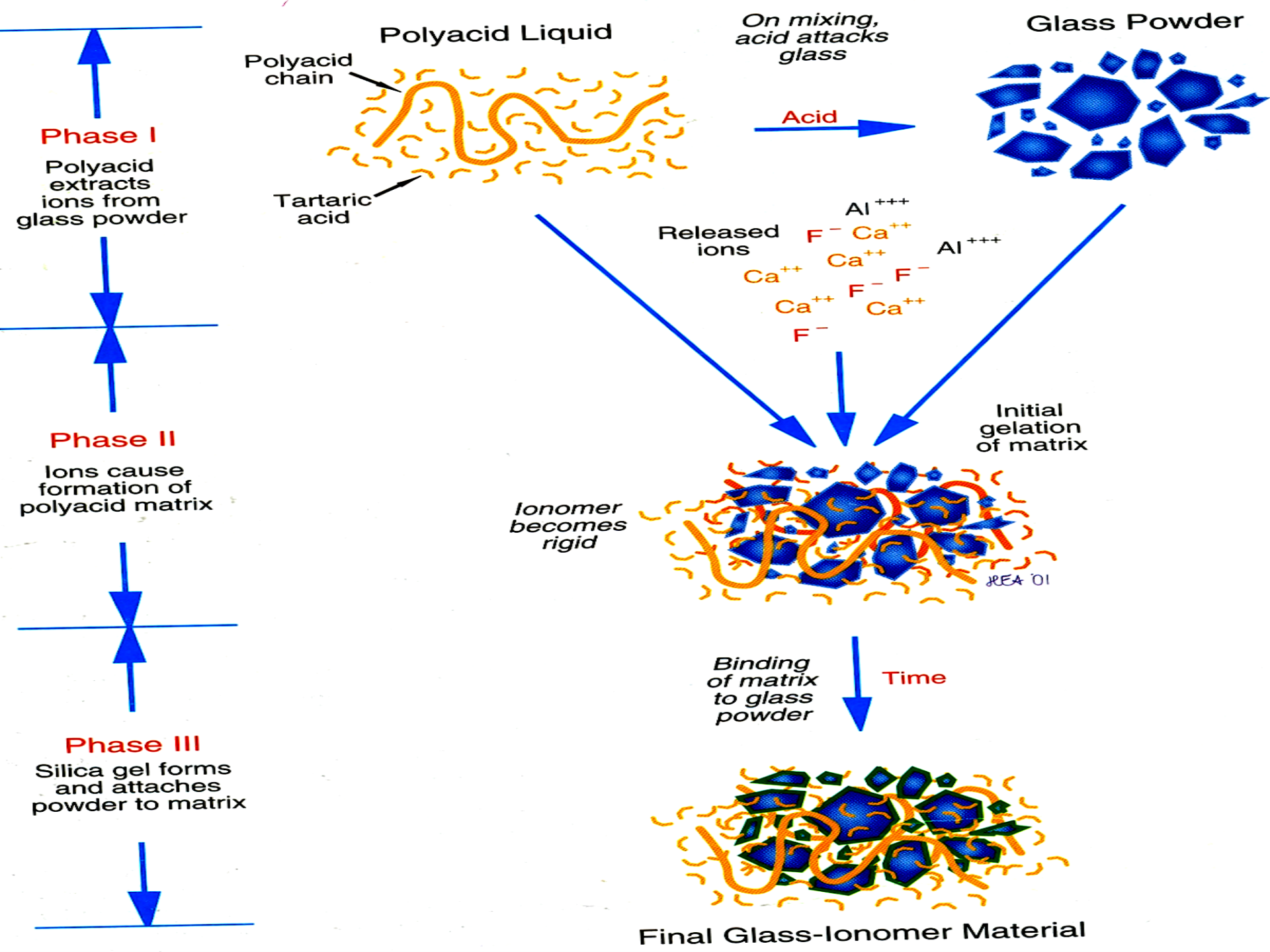
Sodium & Fl ions do not participate in cross linking

Sodium ions are replaced by OH ions in carboxylic & Fl ions dispersed uniformly on set cement.

Hydration of cross linked phase

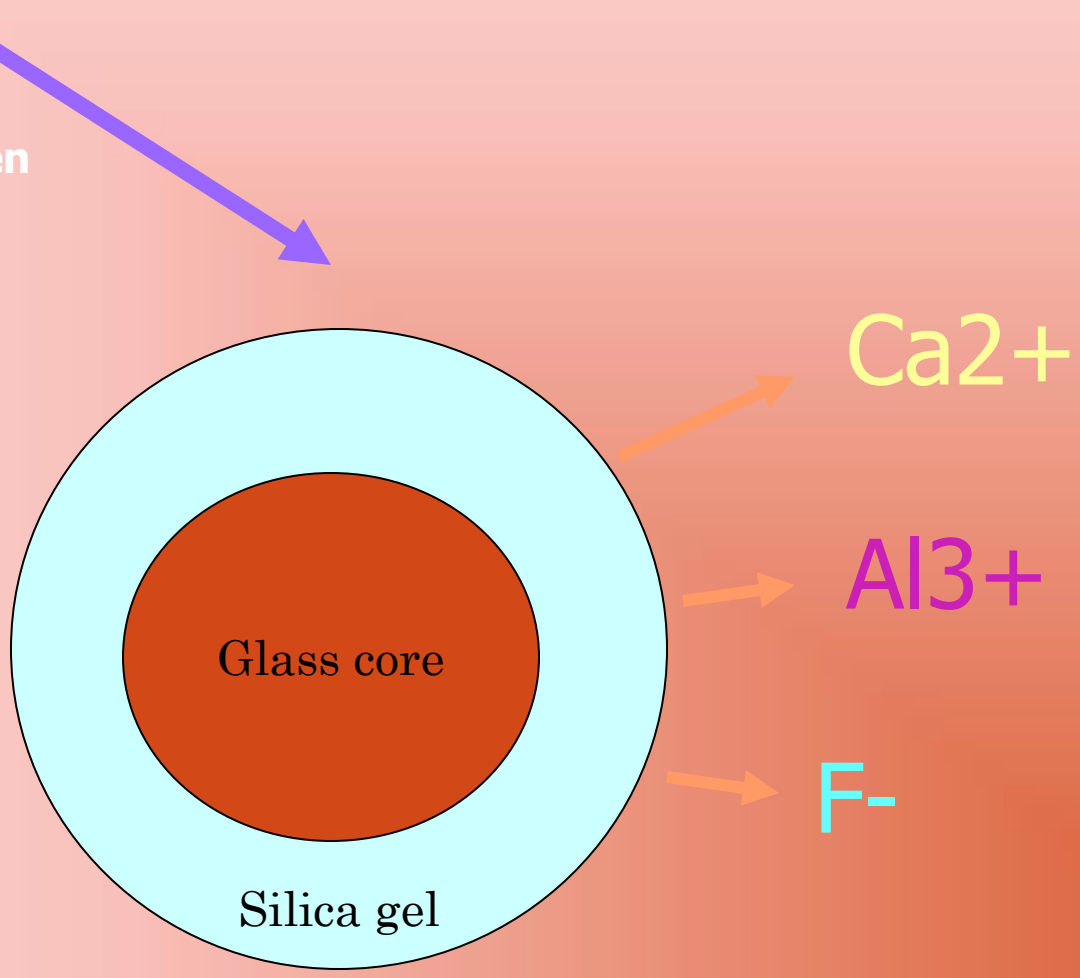
Maturation of silica gel

Agglomeration of the unreacted powder particles surrounded by a silica gel in a **amorphous matrix** of hydrated calcium and aluminum polysalts.


Phase I
Polyacid extracts ions from glass powder
Phase II
Ions cause formation of polyacid matrix
Phase III
Silica gel forms and attaches powder to matrix
Polyacid Liquid
Polyacid chain
Tartaric acid
On mixing, acid attacks glass
Acid
Glass Powder
Released ions
Al+++
F− Ca++
Ca++
Ca++
F−
F−
Ca++
Ca++
F−
Al+++
Initial gelation of matrix
Ionomer becomes rigid
JREA '01
Binding of matrix to glass powder
Time
Final Glass-Ionomer Material

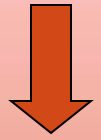
Dissolution

Polyacid liquid



Gelation

Polyacid liquid



Ca2+

Al3+

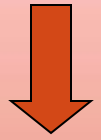
F-

-COOH

Cross-linked polyacid

Hardening

Polyacid liquid



Al3+  -COOH 

Cross-linked polyacid

FACTORS AFFECTING RATE OF SETTING

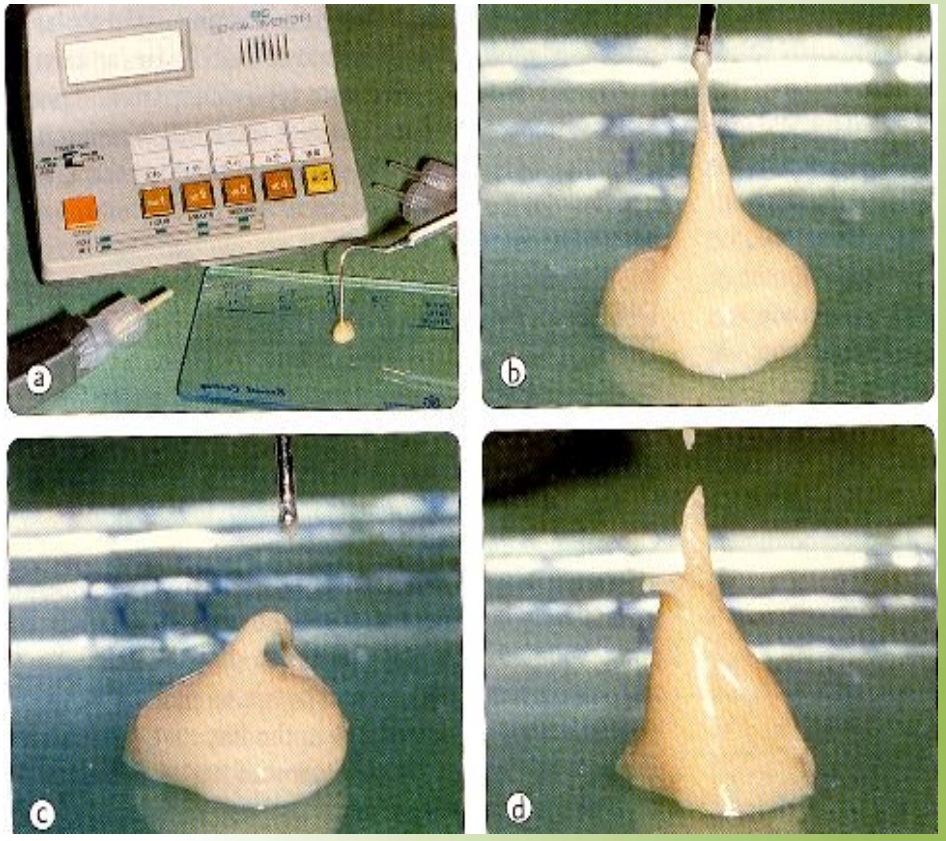
- Glass composition : increase in Al/Si ratio – faster set
- Particle size : finer – faster set
- Tartaric acid – increases working time and shortens setting time
- Relative proportion of constituents – Powder : Liquid
- Temperature of mixing – increase – faster set

Among these factors within the province of the clinician are

Temperature of mixing

Powder : Liquid

Loss of gloss/ slump test



GIC ⟶ 60 – 90 sec

Resin-modified GIC ⟶ 3 – 3.5 min

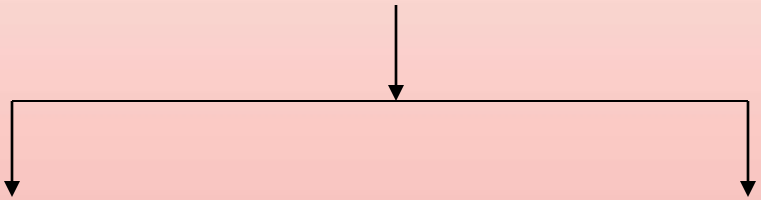
- **Water** acts as the reaction medium initially then slowly hydrates the cross linked matrix, thereby yielding a stable gel structure that is *stronger* and *less susceptible to moisture.*

- If the freshly mixed cements are exposed to ambient air without any protective covering the surface will craze and crack as a result of **desiccation.**

- Any contamination by water that occurs at this stage can cause **dissolution** of the matrix forming cations and anions to the surrounding areas.

- Therefore conventional glass ionomer cement **must be protected** against desiccation and water changes in the structure during placement and for a few hrs after placement if possible.

USES :



Conservative

- Luting & bonding
- Restorative
- Lining & base
- Minimal intervention

Endodontics

- Root canal sealing

  -Orthograde root canal sealing

  -Root-end filling material

- Repair of perforations and root resorption defects
- Treatment of vertically fractured teeth
- Coronal seal

Advantages

- Adhesive property
- No retention features are required
- Esthetic restorative material
- Liberates fluoride that is anti cariogenic
- Biocompatible
- Low oral solubility
- Easy to manipulate
- Easily available
- Permanent restorative material

Disadvantages

- WHITE AND CRAZED SURFACE
- DEBOND READILY
- HIGHLY TECHNIQUE SENSITIVE
- POOR STRENGTH

GLASS IONOMER CEMENT

MODIFICATIONS:

- Metal Reinforced glass Ionomer cement

- Resin-modified glass Ionomer Cement

METAL REINFORCED GLASS IONOMER CEMENT

Rationale :

- Cannot withstand high stress concentration
- Promote crack propagation.

GICs can be reinforced by physically incorporating silver alloy powder with glass powder.

referred as Silver Alloy Admix / Miracle Mix.

Application :

- Alternative to amalgam & composite in posterior teeth
- Core build up.

It can be also reinforced by fusing glass powder to silver particles through sintering.

referred as cerment .

PROPERTIES :

- The strength of both types of metal modified cements are not greatly improved over that of conventional cement.
- Toughness is more than compared to conventional GIC.
- Have anticariogenic capability due to leaching of fluoride

  -But less fluoride is released from the cermet cement because a portion of the glass particle is metal coated .

  -For admix cement the metal filler particles may not bond well to the cement matrix, thus the filler cement interfaces become additional surface areas for fluoride reaching.
- Brittle in nature
- Metal fillers made the material radiopaque and grayish in color.
- Exhibit frequent fracture when used for class II restoration
- Hardens rapidly, so they can be finished in a relatively short time.

RESIN MODIFIED GLASS IONOMER CEMENTS

RESIN MODIFIED GLASS IONOMER CEMENT/ HYBRID IONOMER CEMENT

- **Rationale – Moisture sensitive & low early strength.**

These products could be

- **Dual cure – light / chemical & acid base reaction.**
- **Tri cure - light , chemical & acid base reaction.**

POWDER

Ion-leachable fluoral unisilicate glass particles	radio opaque
micro encapsulated catalyst system and initiators	light curing and chemical curing.

LIQUID

Methacrylate (HEMA)	polymerization
Polyacrylic acid	modified with pendant methacrylate , hydroxyethyl methacrylate (HEMA) monomers and tartaric acid

Relative properties of a glass ionomer and a resin-modified GI cements:

Property	GIC	RMGIC
Working time	2 min	3 min 45 sec
Setting time	4 min	20 sec
Compressive strength	202 MPa	242 Mpa
Tensile strength	16 Mpa	37 Mpa

Resin Modified Glass Ionomer:

Advantages

- Increased wear and fracture toughness
- Some fluoride release
- Comand cure
- Increased esthetics

Disadvantages

- Not as strong as composite or amalgam
- Less fluoride release than glass ionomer

Indication:

- Permanent cementation of crowns and bridges to tooth structure
- Core build ups
- Cementation of posts
- Bonding of orthodontic appliances
- Liners
- Fissure sealants
- Bases
- Restorations
- Retrograde root filling material.
- Most products are not recommended for cementations of all ceramic inlays, onlays because of their water sorption, which leads to expansion, which can cause cracking of the ceramic restoration.

Auto Cured Resin Reinforced Glass Ionomer Cement for Anterior Restorations

Fuji VIII

New glass ionomer cement with improved physical and aesthetic properties that makes it the material of choice for class III, V and root surface restorations.

Advantages

- Reliable Bond Strength
- Long-lasting bond due to GC Fuji VIII GP strong chemical bonding
- Good Translucency without Light-Curing
- GC Fuji VIII GP has been developed to provide the best translucency and a perfect match with Vita shades
- Special formula with specific resins to provide better aesthetics, making it ideal for anterior restorations

- Excellent Physical Properties
- Good diametric tensile strength (30 Mpa)
- High flexural strength (52 Mpa)
- Reaches 90% of its mechanical properties within just 10 min.
- Working time: 1'30"
- Net setting time: 2'10"

Plus all the Advantages of a GIC

- ✓ **Fluoride release**
- ✓ **Radiopacity**
- ✓ **Easy to use, no isolation needed**
- ✓ **Excellent biocompatibility**

Interim Therapeutic Restorations(ART)

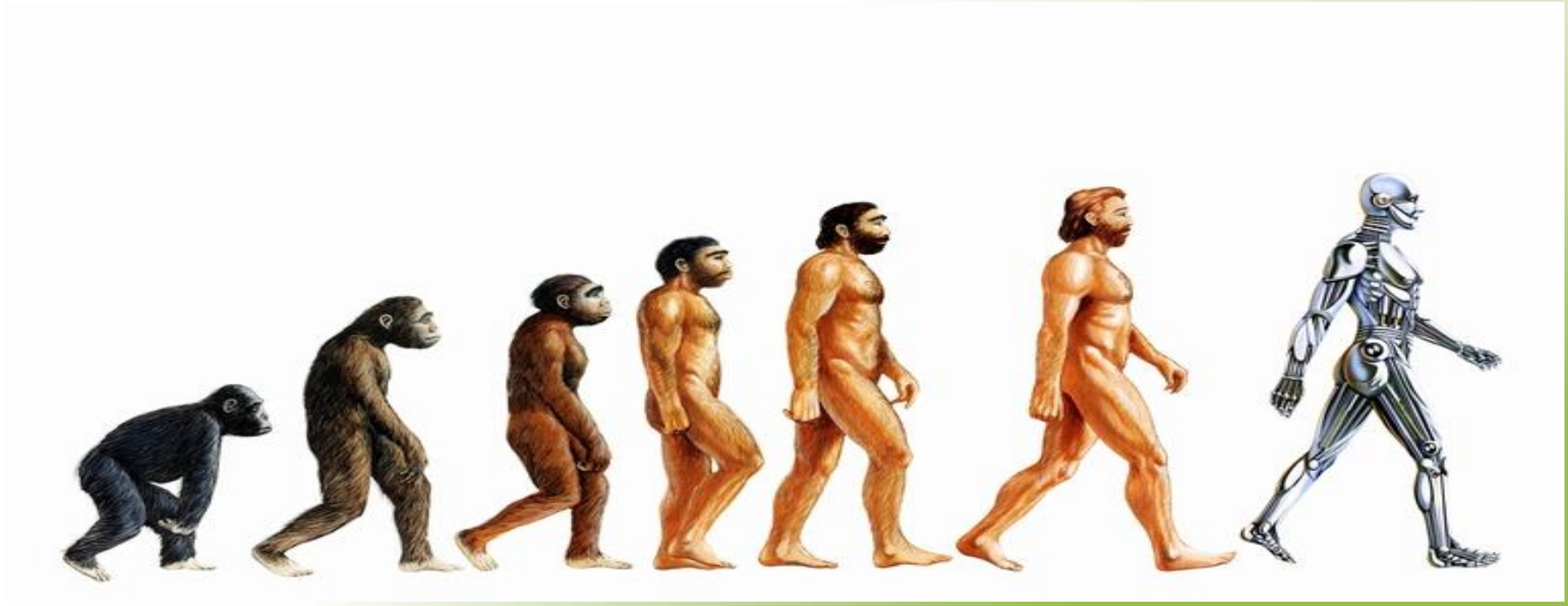
Removing carious tissues using hand instruments only:

- Less traumatic
- No need for electricity
- Conservation of tooth structure
- Low cost

Glass Ionomer:

- Bonds to tooth
- Releases fluoride

COMMON IN PEDIATRIC PATIENTS



Recent advances in Glass ionomer cement

Self hardening GIC

Low viscosity / flowable GIC

Condensable GIC / High Viscosity GIC

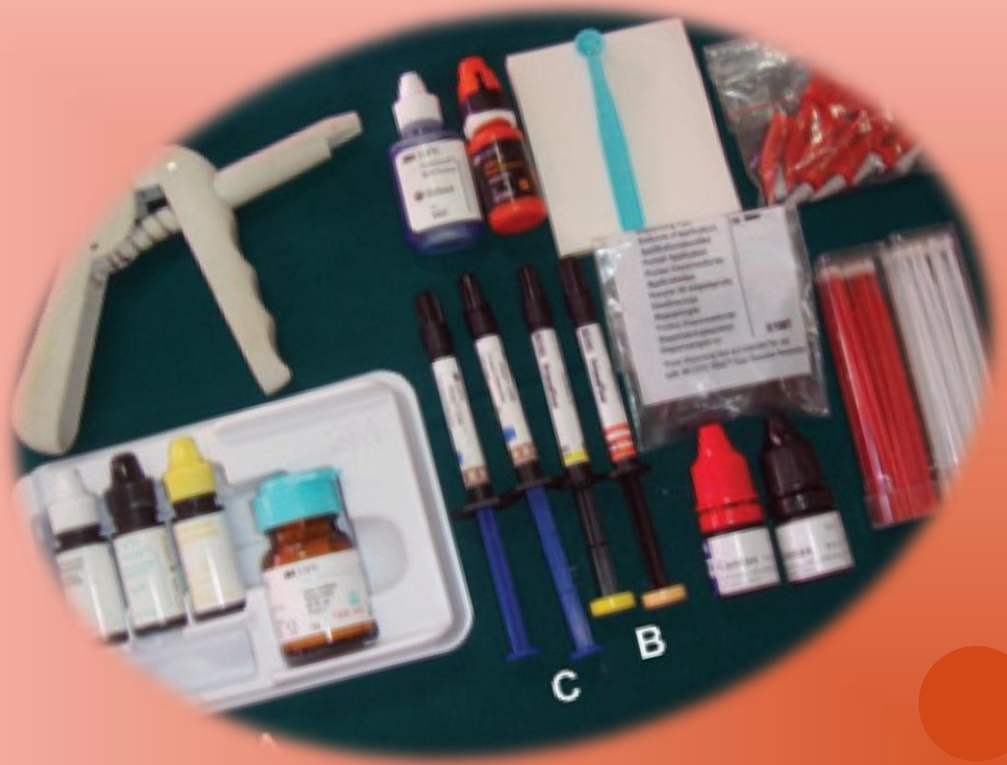
New fluoride releasing GIC

- Fluoride charged GIC
- Low pH 'SMART' MATERIALS

- Bioactive glass
- Fibre-reinforced GIC
- Giomer
- Hainomer
- Amalgomer
- Equia

- Chlorhexidine impregnated GIC
- Proline containing GIC
- CPP-ACP containing GIC
- Zirconia cotaining GIC
- Nano Bio ceramic modified GIC
- Calcium Aluminate GIC(ceramic)

COMPOMERS



COMPOMERS

Rationale –

Fluoride releasing capability of GIC & durability of composite led to introduction of compomer.

Also known as Polyacid Modified Composite

COMPOSITION:

Powder:

Strontium aluminum fluorosilicate glass, sodium fluoride,& self and light cure initiators

Liquid:

Polymerizable methacrylate/ carboxylic acid monomer, diacrylate monomer, water .

It may be available in powder liquid form or two paste system.

SETTING REACTION

- Self & light cure polymerization
- In contact with oral fluids acid-base reaction may occurs.
- Carboxylic contribute to adhesive capability.
- Mechanical bonding.

MANIPULATION:

- Isolation :Dry the tooth to be cemented but do not desiccate.
- Mixing :Mix the powder rapidly for 30 sec. Place the mixed cement in the crown only & then seat the crown.
- Cementation:A gel state is reached after 1 min , at which time the excess cement is removed & with floss & and a scaler.
- Curing :Light cure the exposed margins to stabilize the restoration
- Final setting :Setting occurs 3 min after start of mix once set compomer cement is very hard.

PROPERTIES

- High value of retention, bond strength, flexural strength, & fracture toughness.

- Low solubility & F release

DIRECT COMPARISON OF CONVENTIONAL GIC, RMGIC AND COMPOMER

CHARACTERISTIC	CONVENTIONAL GIC	RESIN MODIFIED GIC	POLYACID MODIFIED COMPOSITE RESIN(compomer)
Handling properties/ preparation of the material	Powder-liquid systems, aqueous based; hand-mixed versions or precapsulated systems	Powder – liquid Systems, Water-monomer based; hand-mixed or Precapsulated systems	One component material, no water and no mixing
Working time	1-2 minutes	Several minutes (setting initiated by light curing)	(light Cured)
Setting mechanism	Acid – base reaction (4-8 minutes), second phase within the next 24 hours	Light curing (40 seconds); radical Polymerisation and acid –base reaction	Light curing only (40 seconds); Incremental technique

Moisture sensitivity initial placement	High, especially during first setting Stage (protective covering required)	Moderate to low	None
Final finish	Fair	Good	Excellent
Adhesion to tooth Structure	Self adhesive; chemical bond to enamel and dentin	Self adhesive; Primer needed for Certain products	
Strength	High compressive strength; low flexural strength	High compressive Strength; medium flexural strength	
Wear resistance	Low ; highly Viscous cements- Moderate to acceptable	Poor	

APPLICATION

- Cementation of cast alloys &bridges, metal ceramic crowns, cast gold inlays & onlays.
- Restoration in **low stress bearing areas**.
- Alternatives to GIC in class III & V

CONTRAINDICATION

- Cement Should not be used as core or filling material.
- Cementation of all ceramic crowns, inlays, onlays & veneers is contraindicated.

To summarize the differences between the three types of materials:

- ***Fluoride Release and Rechargability***

  GICs>RMGICs>PAMCRs
- ***Wear Resistance***

  PAMCRs>GICs>RMGICs
- ***Strength***

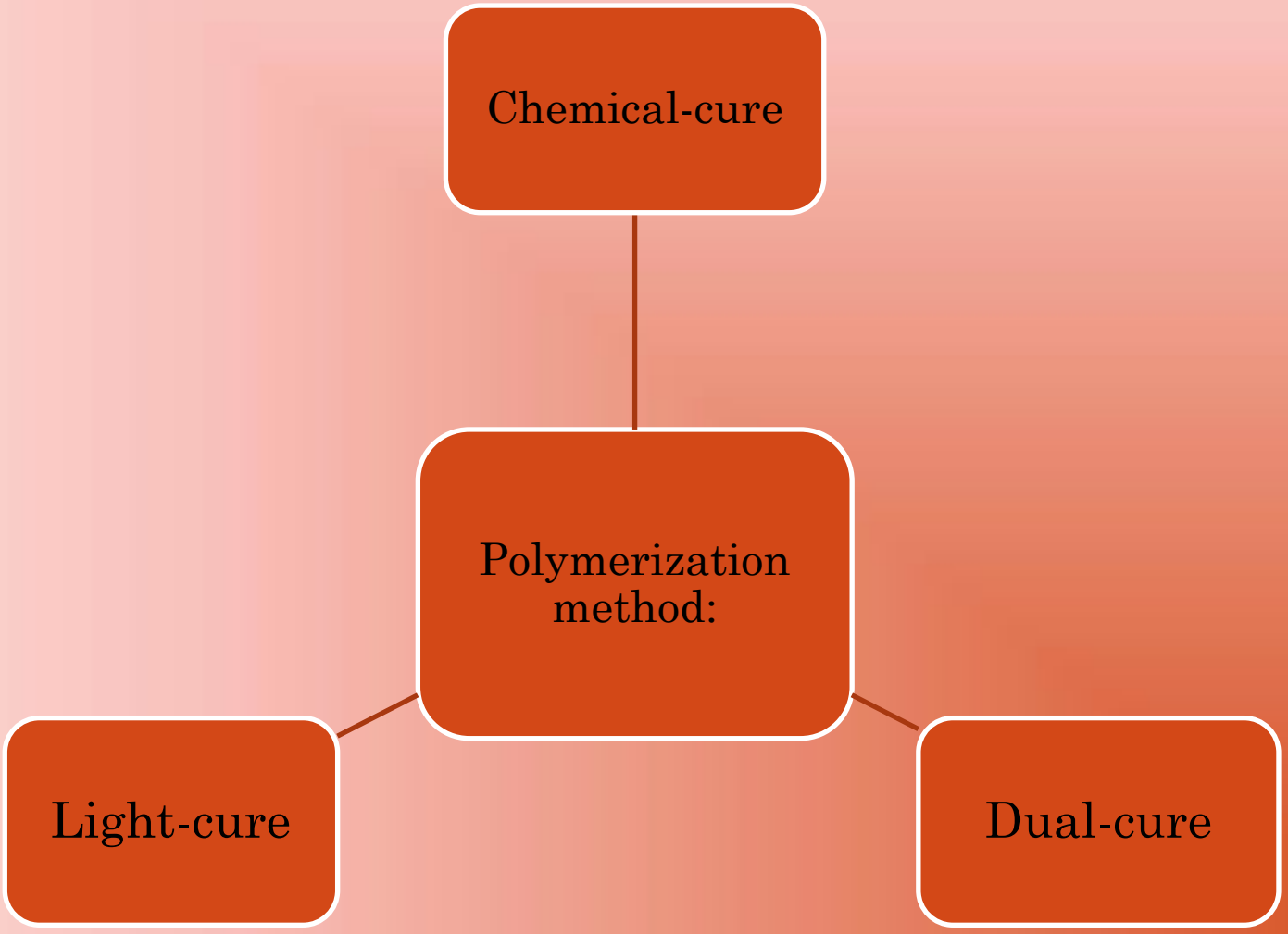
  PAMCRs>RMGICs>GICs
- ***Ease of Handling***

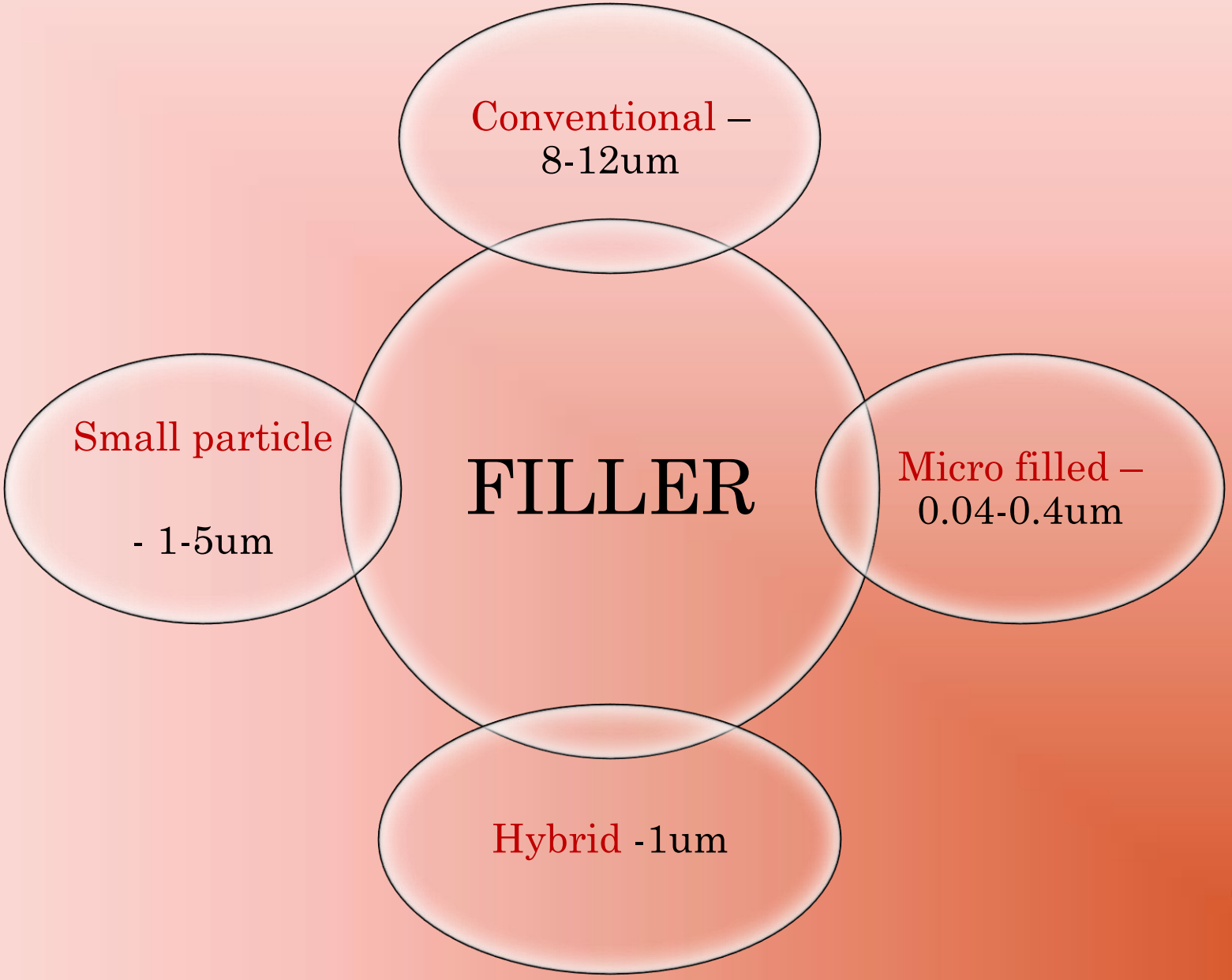
  PAMCRs>RMGICs>GICs
- ***Polishability and Esthetics***

  PAMCRs>RMGICs>GICs

Resin cements

Classification
According to ANSI/ADA no 27




Conventional –
8-12um
Small particle
- 1-5um
FILLER
Micro filled –
0.04-0.4um
Hybrid -1um

COMPOSITION:

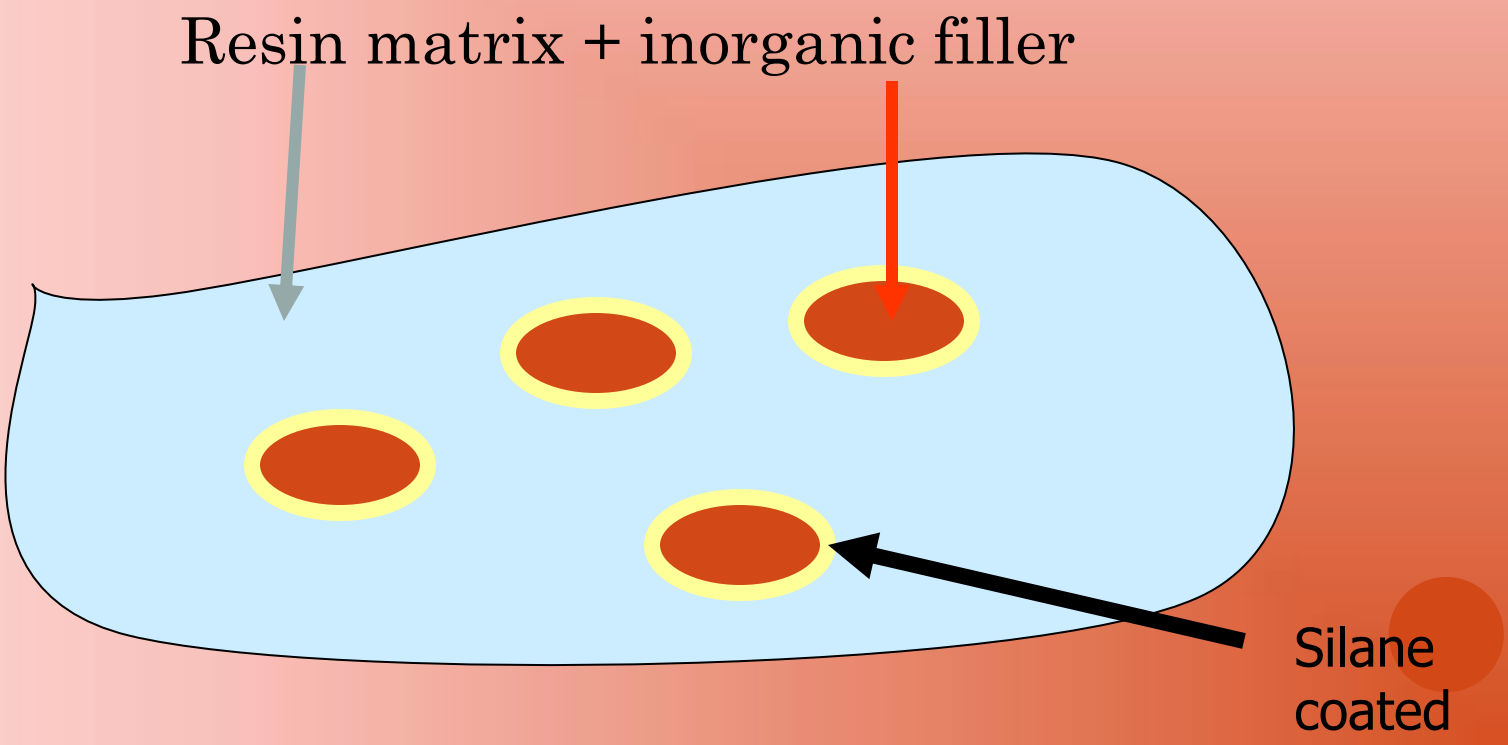
POLYMER

Organic matrix	Major constituents (BISGMA)
Inorganic fillers	Major constituents (Silica)
Coupling agent	Organosilanes
Activator or initiator	Light/t-amine activator

Inhibitor	Hydroquinone
Colour pigments	

Composite resin cement-chemistry

Composite :



CHEMISTRY OF REACTION

- Polymerization is achieved by the conventional peroxide amine system or light activation.
- A few systems utilize both mechanism ,referred to as "Dual cure" materials.
- Light cured cements are normally used for cementation of restorations.

PROPERTIES

- Setting time – 2-4 mins
- Film thickness - < 25 um
- Compressive strength 70-172 MPa
- Solubility for disintegration in H_2O – **0.00- 0.01% weight**
- Pulp response – Moderate

BIOLOGICAL PROPERTIES :

- They are irritating to the **pulp.**
- Thus pulp protection via CaOH base is important for indirect restoration in a cavity that involves **dentin.**
- If the bonding area involves only **enamel**, the irritating properties of the monomer's are not of consequence.

PREPARATIONS:

- Powder / liquid

  Chemical, light, or dual cure

- 2 paste system [base / catalyst]

  Chemical, light, or dual cure

- Single paste

  Light cure

TECHNIQUE AND MANIPULATION

CHEMICALLY CURED CEMENTS:

- The **perioxide initiator** is contained in one component and the **amine activator** in the other.
- The two components are combine by mixing on a treated paper pad for 20-30 seconds.

Diagram showing incremental placement of resin composite

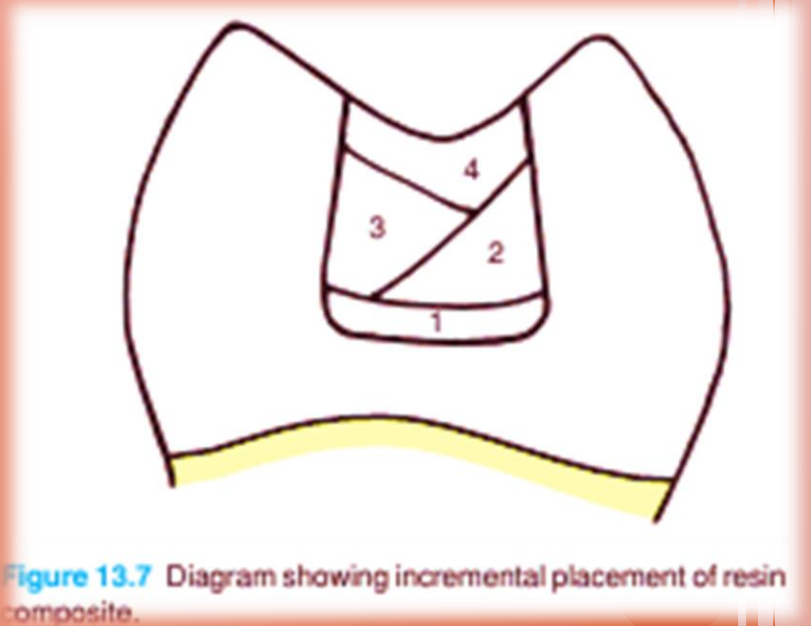


Figure 13.7 Diagram showing incremental placement of resin composite.

- **LIGHT CURED CEMENTS** are single component systems just as are the light-cured filling resins.

- They are widely **used** for cementation of porcelain and castable glass restorations and for direct bonding of ceramic orthodontic brackets.

- The **time of exposure** to the light that is needed for polymerization of the resin cement depends upon the light transmitted through the ceramic restoration or bracket and the layer of polymeric cement.

- The **time of exposure** to the light should be less than 40 seconds.

- The **DUAL-CURE CEMENTS** are two-component systems and require mixing just as for the chemically activated systems.

- The chemical activation is **very slow**, which provides extended working time until the cement is exposed to the curing light, at which point cement solidifies **rapidly**.

- It then continues to **gain strength** over an extended time period owing to the **chemically activated polymerization**.

INDICATIONS

- From Class III to Class IV cavities except high stress bearing areas like extensive Class II and extended Class I's ,Class V cavities in which control of saliva can be achieved.
- In restoration of developmental defects like enamel hypoplasia, dens in dente microdontia, malpositioned teeth
- Non carious lesions like cervical abrasions, erosions.
- Treatment of fracture incisal edge
- Splinting of luxated teeth.
- It is a choice in cementation of resin bonded bridges.
- These are widely employed for intermediate prosthesis.
- It is also involves in direct attachment of orthodontic brackets.
- Used to attach either resin or ceramic veneers to the surface of anterior teeth again using the acid etch technique.

Uses

- Closing diastema (less than 1mm)
- Veneering of discoloured teeth.
- Veneering of metallic restorations
- Core buildings
- Composite Inlays
- Repair of old composite restorations

Contraindications

- Deep subgingival preparations.
  - Lack of peripheral enamel.
  - Poor moisture control.
  - Load-bearing cusps.
- High stress bearing areas like ext class I ,class V cusp heights and ridges

RelyX Unicem Self-Adhesive Universal Resin Cement

APPLICATION -RELYX

- Strong, versatile and easy to use
- uniquely combines the advantages of both conventional luting cements (ease of use) and resin cements (strength and esthetics).
- Designed for nearly all cementation applications.
- Specially formulated to be self-adherent and moisture tolerant, eliminating the need for separate etching, priming and bonding steps to save time and greatly reduce the potential for patient sensitivity.

- Convenient Aplicap unidose capsule provides easy and reproducible mixing with direct delivery into the restoration.
- Excess cement is easy to remove after seating the restoration.
- High performance cement offers excellent adhesions.
- High physical strengths and low linear expansion.

APPLICATION -RELYX

- Superior marginal integrity.
- Available in five shades: A1, A2 Universal, A3 Opaque, Translucent and White Opaque.
- Resin cements are virtually insoluble and the fracture toughness is higher than that for other cements.
- From biological stand point they are irritating to pulp
- Some of them bond to dentin and all can form a strong attachment to enamel by the acid etch technique.

CALCIUM HYDROXIDE

Calcium Hydroxide

INTRODUCTION

- It has multipurpose use though not used as permanent restorative material
- Ca(OH)2 is a white odorless powder
- Mixed with water or saline to a form a paste.
- It is strongly alkaline with a PH of 12.5
- It is classified as an astringent in Pharmacology.

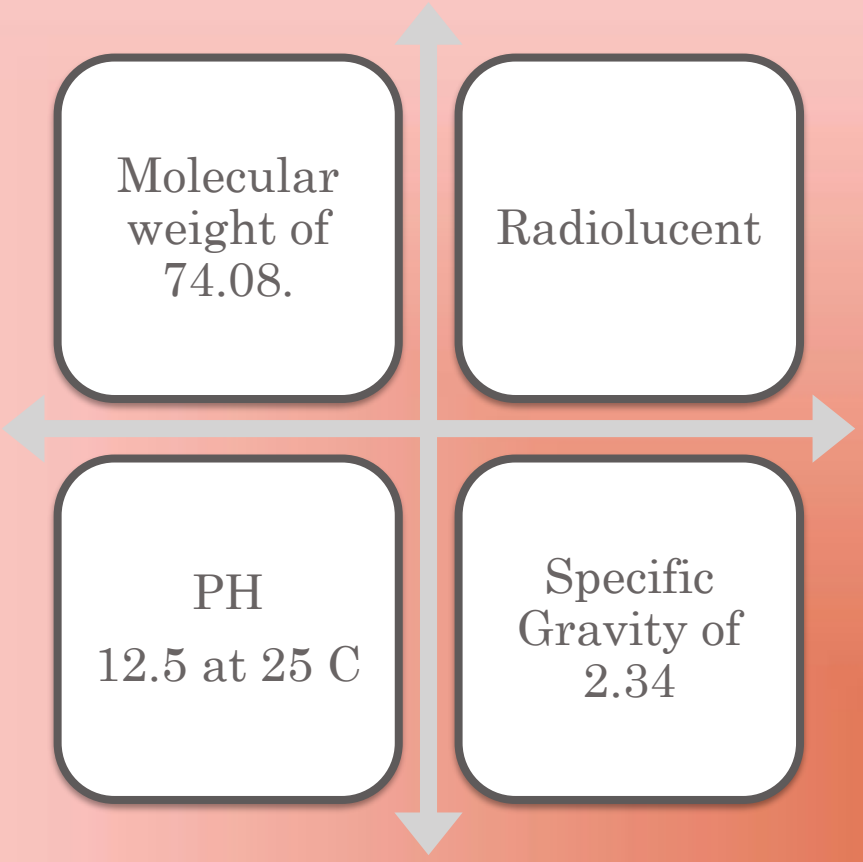
HISTORY

- In 1936 **Hermann** introduced Ca(OH)2 to promote healing in many clinical situations

- The introduction of this material in the US was by **Teuscher and Zander** in 1938.

- Successful pulpal healing using Ca(OH)2 is first identified during 1934 & 1941.

CHARACTERISTICS OF CA(OH)2



Very slightly soluble in water, soluble in glycerin syrup and acids.

MECHANISM OF ACTION

- High alkaline PH(11-13) Causes neutralization of acids produced by microorganisms.
- Antibacterial effect due to high PH.
- Seals the dentinal tubules offering dentin protection.
- Induces reparative dentin below existing dentin.
- Biocompatibility & calcific barrier enabling to maintain pulp vitality.
- Ca(OH)2 maintains a local state of alkaline by that is necessary for bone/dentin formation .

On Vital dentin

- Considerably reduces the permeability of exposed dentin for penetration of bacterial components towards the pulp.

- This may be due to

-Coagulation of proteins in dentinal tubules

- Due to secondary dentin formation

- It has an antibacterial effect

On Carious Dentin

Ca(OH)2 has a strong antibacterial effect on the contaminated soft carious dentin.

ON EXPOSED PULP

Low grade irritation due to coagulative necrosis caused by Ca(OH)2 leading to hard tissue differentiation in the pulp to calcific barrier formation.

DIFFERENT FORMS OF CA(OH)2 AVAILABLE

DRY POWDER

- Dry powder of Ca(OH)2 medicinal grade.
- Free from impurities
- Mixing with water or ortho-ethoxy benzoic acid is avoided as the reaction is too fast for convenient clinical use.

LIQUIDS

- They are supplied in bottles. Resinous solution of Ca(OH)2 are used as liners.
- The combination or resin film with alkaline Ca(OH)2 provides a protective film having better physical integrity as well as chemical neutralizing capacity for acids.

NON – SETTING PASTES

- They are supplied in Jar's or injectable single paste system.
- In these materials, calcium hydroxide is not reacting with other ingredients of the paste.
- The other ingredients are only carriers and the availability of free Ca and OH ions from the preparation will be more.

SETTING PASTE:

Chemically Activated Ca(OH)2 paste system

BASE

1) Calcium hydroxide – 51%
2) Zinc oxide -9.23%
3) Zinc Stearate – 0.29%
4) Ethylene Toluene Sulphonamide -39.48%

CATALYST

1) Titanium oxide – 45.1%
2) Calcium Tungstate -15.2%
3) Barium sulphate – 4%
4) Glycol salicylate – 35.7%

Visible light activated Ca(OH)2 – Single paste system.

1) CaOH
2) $BaSO_4$
3) UDMA Resin
4) Camphorquinous

SLOW SETTING CA(OH)2 PASTES.

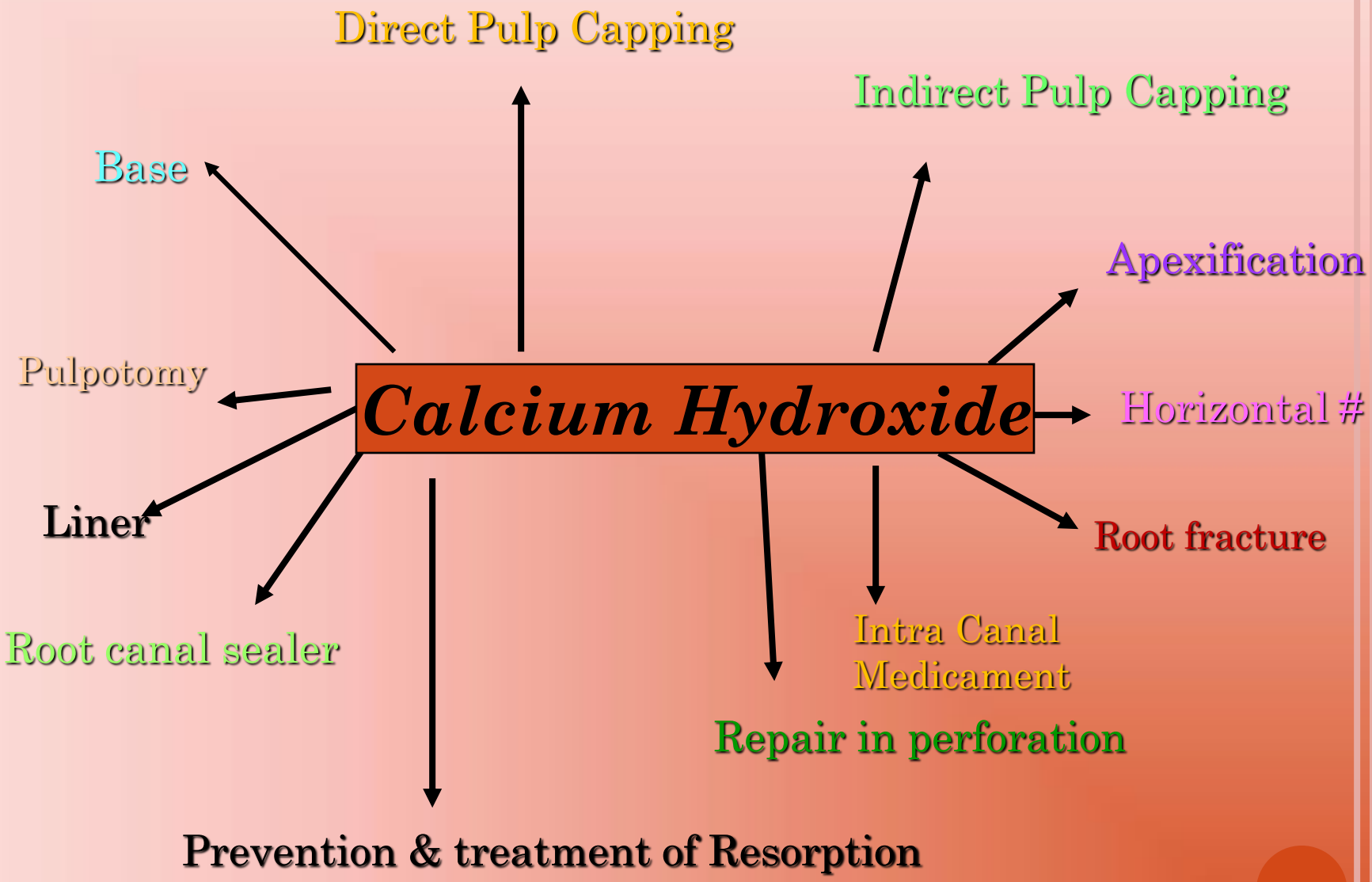
Root Canal Sealer materials :

1. Ca(OH)2 can be used as a sealer to coat the Would of the pulp space and form a hermetic seal Ex – Calcibiotic
2. Root Canal Sealer paste (CRCS Paste)

VEHICLES

- When CaOH2 powder is mixed with a suitable vehicle a paste is formed.
- The vehicles play a major role in the over all process because it determines the velocity of ionic dissociation causing the paste to re-establish and restore at various rates by the peri apical tissues within the root canal

Types of Vehicles are used

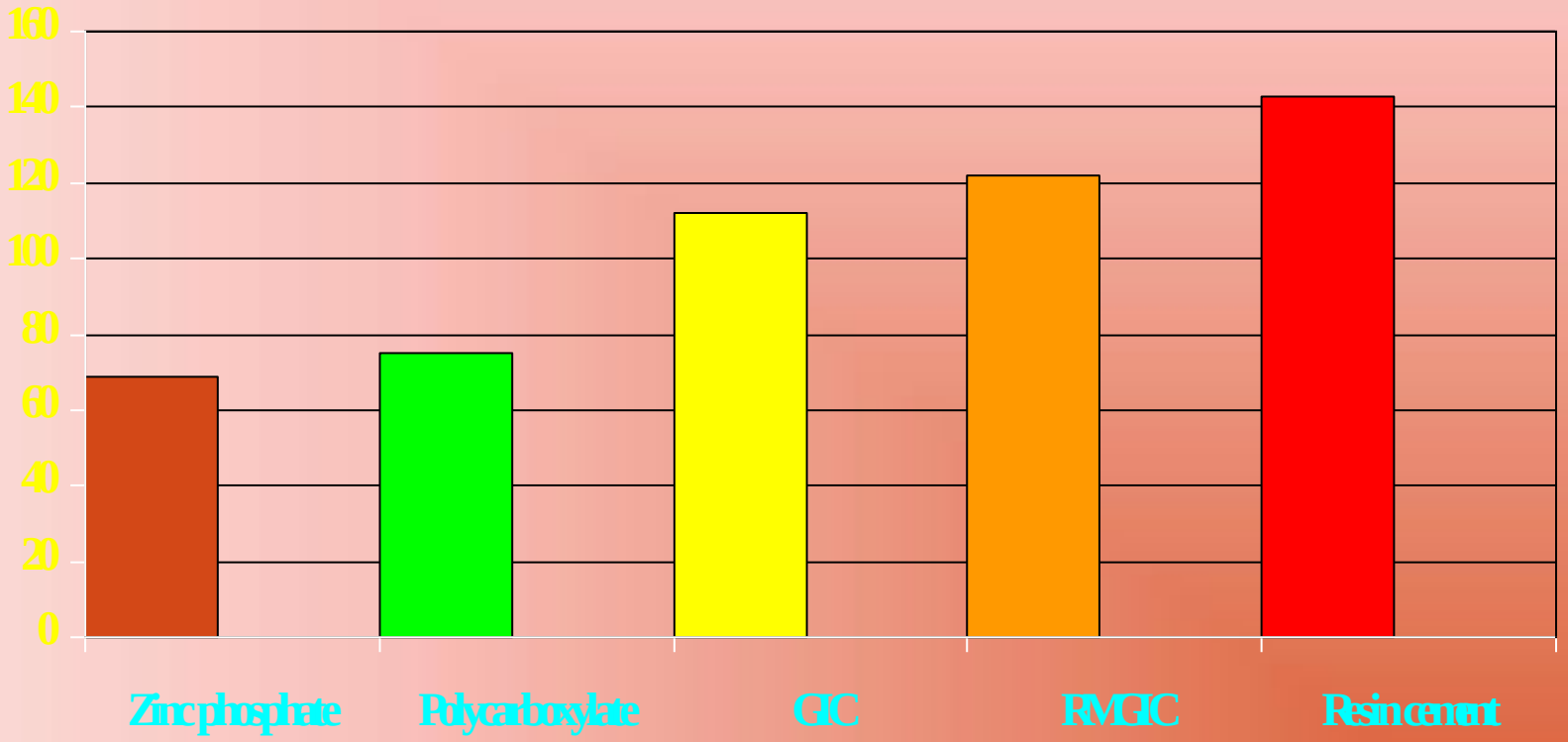

Direct Pulp Capping
Indirect Pulp Capping
Base
Apexification
Pulpotomy
Calcium Hydroxide
Horizontal #
Liner
Root fracture
Root canal sealer
Intra Canal Medicament
Repair in perforation
Prevention & treatment of Resorption

Adverse Effects:

- Increased brittleness of dentin.
- Ankylosis
- Internal resorption
- Pulp calcification

Comparable properties of cements

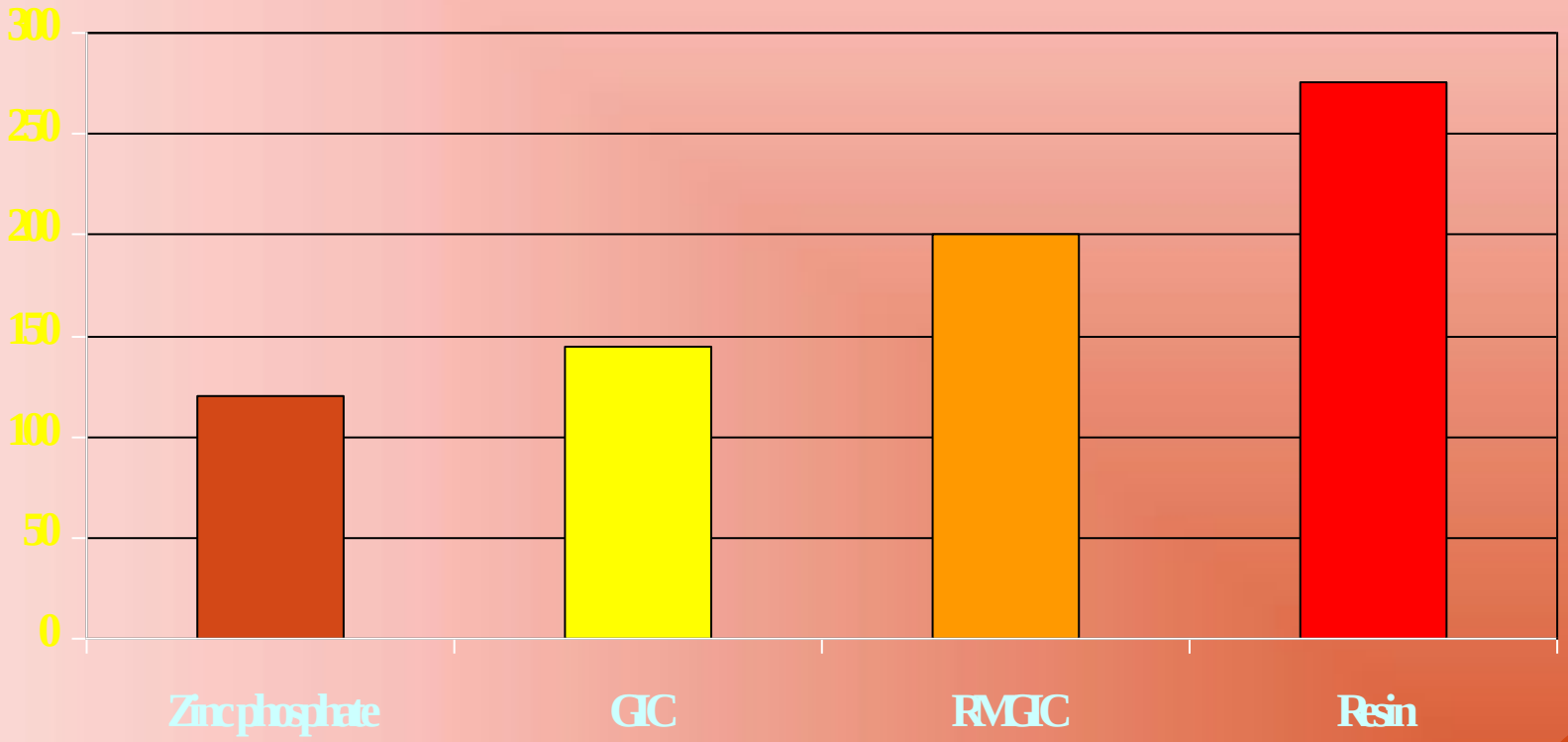
Compressive strength [MPa]



Zhen Chun Li and Shane N. White, 1999

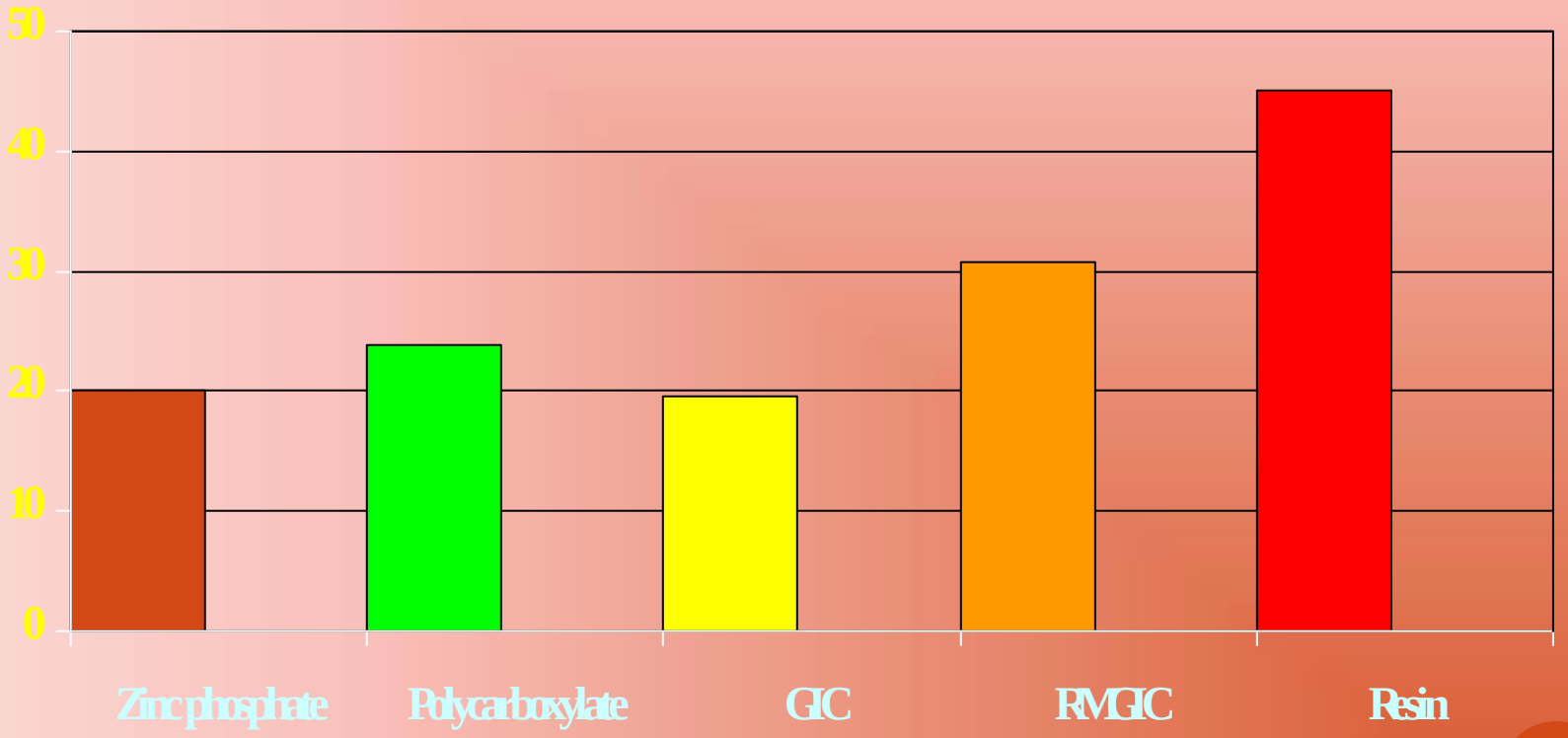
Bond strength

Separation forces [MPa]



Sule Ergin and Deniz Gemalmaz, 2002

Film thickness [mm]



Shane N. White, Zhaokun Yu, 1992

Others

Solubility

- ZOE > Polycarboxylate > Zinc phosphate~GIC > Resin cement

Irritation to pulp tissues

- Resin~Zinc phosphate > GIC > Polycarboxylate > ZOE~Calcium hydroxide

Literature review

JAMES METZ, WILLIAM BRACKETT .THE OHIO STATE UNIVERSITY PERFORMANCE OF A GLASS IONOMER LUTING CEMENT OVER 8 YEARS IN A GENERAL PRACTICE, JPD. 1994;71:13-5

- Report 1230 cast restorations luted with glass ionomer cement followed for 8 years.
- The result show no secondary caries
- 99% retention of restorations
- 4% incidence of irreversible pulpitis

William Kydd, et al. University of Washington, Seattle Marginal leakage of cast gold crowns luted with zinc phosphate cement,JPD, 1996;75:9-13

- This study demonstrated that zinc phosphate may successfully serve as a luting agent for 20 years in select clinical situations even it is soluble in intraoral fluids.

ALIREZA FARHAD AND ZAHED MOHAMMEDI ESFAHAN: CALCIUM HYDROXIDE : A REVIEW. INTERNATIONAL DENTAL JOURNAL 55, 293-301, 2005

- This review emphasized on multipurpose use of calcium hydroxide.
- Its indications include

Direct & Indirect Pulp Capping

Apexogenesis

Apexification

Treatment of root resorption, iatrogenic root perforation, root fractures ,replanted teeth, interappointment intercanal dressing.

CARLOS A.DE SOUZA COSTA,ET AL :HUMAN PULP RESPONSE TO RESIN CEMENTS USED TO BOND INLAY RESTORATION, JOURNAL OF DENTAL MATERIALS,22,2006,954-962

Variolink II associated with adhesive system excite causes more aggressive effect to pulp dentin complex than RelyX Unicem when both are used to cement inlay restoration

Indian Journal of Dental Sciences. (October 2013 Issue:4, Vol.:5

- A Comparative Study Of Retentive Strengths Of Zinc Phosphate, Resin Modified GIC And Adhesive Resin Cement With **Stainless Steel Crowns** was done.

- Study concluded that Resin cement possessed the maximum retentive strength values when compared to RMGIC and Zinc phosphate both at 1 day and 7 days interval.

CONCLUSION-CEMENTS

Zinc phosphate cement

- **Universal luting** cement.
- Good handling characteristics and a proven **longevity** in the oral cavity.

Its disadvantages include

- **pulp irritation**,
- lack of adhesiveness
- lack of anticariogenic properties.
- $ZnPO_4$ is not suitable when the mechanical retention poor or when the aesthetic demand is high.

Zinc Oxide Eugenol

- The main advantage of improved ZOE cement is their **biocompatibility.**
- The physical and mechanical properties and the handling characteristics generally inferior to those of other long term luting cements.

Zinc Polycaroxylate cement

The outstanding characteristics are their

- **kind to the pulp**
- **adhesive bond** to tooth structure.

- Disadvantages include the short WT, SF and limited capability for fluoride release.

Glass ionomer luting cements

- **GIC bond to tooth structure**
- **Release fluoride**
- **Biocompatible**
- Greater resistance to disintegration in oral cavity
- Low stiffness

Compomers

- The durability of compomer is inferior to that of resin based composites. Thus they should only be used for **low stress areas.**

Resin cements

- **Insoluble** in oral fluids
- **Higher fracture toughness**
- Cements bond to dentin and form strong attachment to enamel.
- The poor handling characterizes of some specialist resins.
- The disadvantage is **pulp irritation**

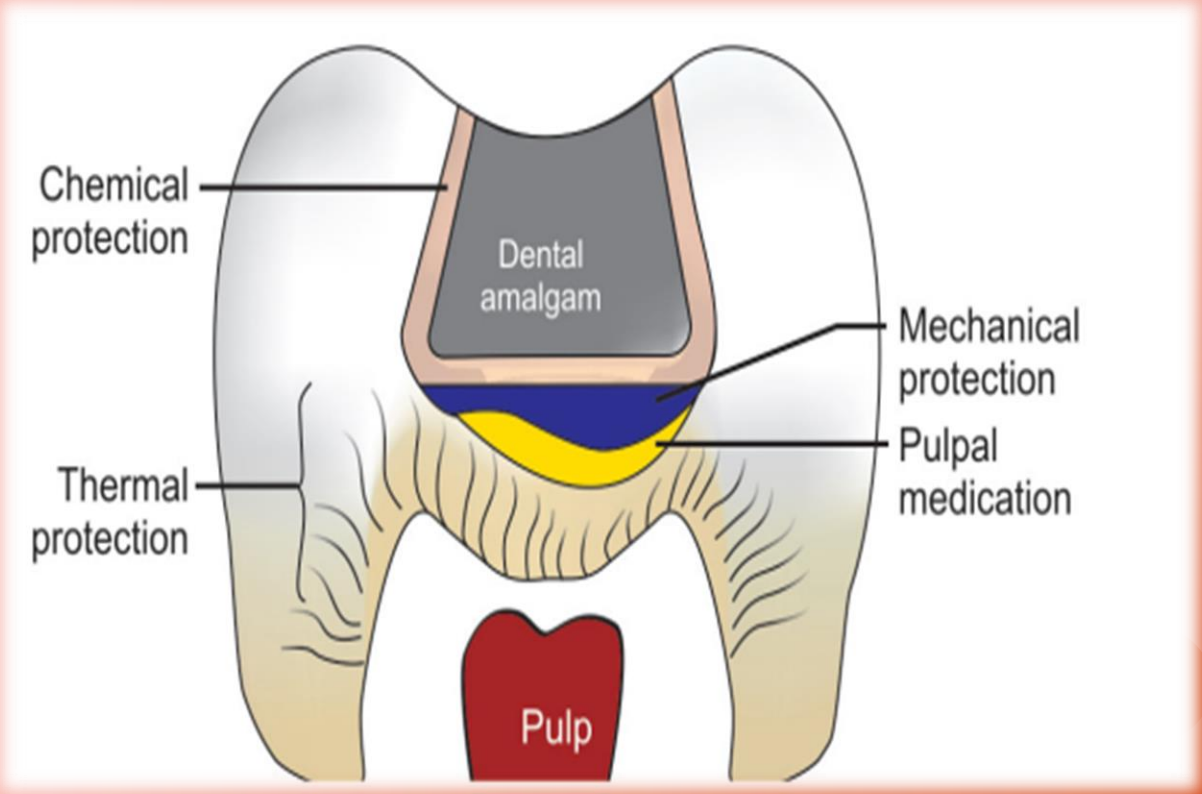
Calcium hydroxide is not a restorative material by itself many a time , but forms a part of restoration. Its fascinating **osteogenic & dentinogenic potential** have elevated its status as unique material used in dentistry.

REFERENCES OF CEMENTS

1. Kennith J Anusavice: Phillips' Science of Dental Materials 11th edition & 9th edition.
2. Theodore M. Roberson: Sturdevant's Art and Science of Operative Dentistry 4th & 5th edition.
3. Robert G. Craig and John. M: Restorative Dental Materials 11th edition & 12th edition.
4. Joyre Reese , Thomas Valege :Restorative Dental Materials :An Overview, 2nd edition
5. Richard van Noort : Introduction to Dental materials.
6. William .j. Obrein : Dental materials properties & selection .

7) Karl .F. Leinfelder , Jack .E. Lemons :Restorative dental materials .
8) James Metz, William Brackett .The Ohio State University, :**Performance of a glass ionomer luting cement over 8 years in a general practice** JPD. 1994;71:13-5
9) William Kydd, et al. University of Washington, Seattle,:**Marginal leakage of cast gold crowns luted with zinc phosphate cement,**JPD, 1996;75:9-13
10) Alireza Farhad and Zahed Mohammedi Esfahan: Calcium hydroxide : a review. International Dental Journal 55, 293-301, 2005.
11) Carlos A.De Souza Costa,et al :human pulp response to resin cements used to bond inlay restoration, journal of Dental materials,22,2006,954-962

BASES


Chemical protection
Dental amalgam
Mechanical protection
Pulpal medication
Thermal protection
Pulp

CONTENTS:

- Introduction
- Definition
- Classification
- Types
- Properties
- Requirements of bases
- Selection of a base material
- Manipulation of bases
- Uses of bases
- Review of literature
- Conclusion
- References

INTRODUCTION:

- Base is a layer of cement placed beneath a permanent restoration to encourage **recovery of the injured pulp and to protect it against numerous types of insults.**

- The type of insults depends upon the particular restorative material. It may be thermal or chemical.

- The base serves as replacement or substitute for the protective dentin, that has been destroyed by caries or cavity preparation.

DEFINITION:

Base is a layer of cement placed beneath a permanent restoration that replaces missing dentin to protect pulp from various insults.

CLASSIFICATION:

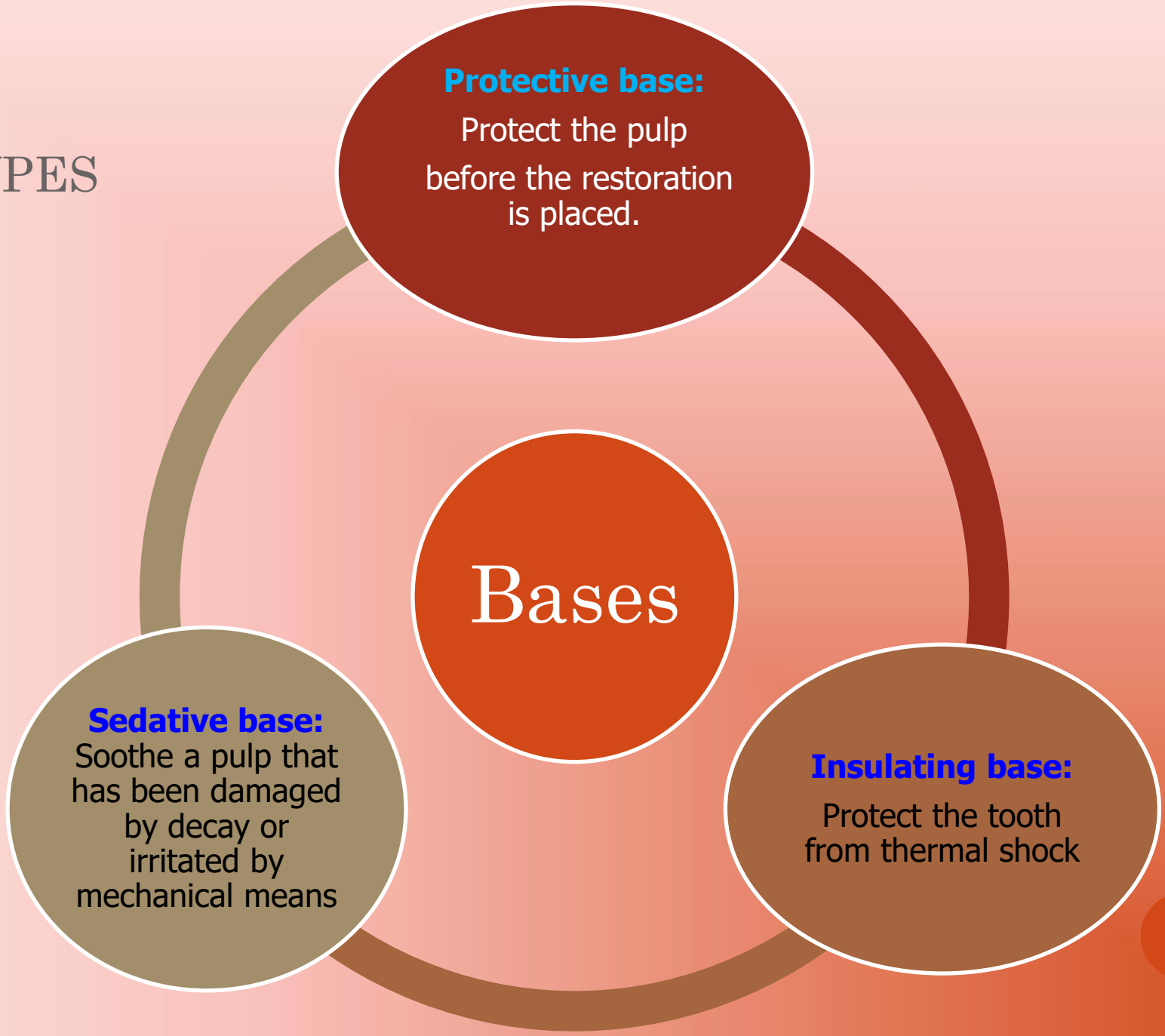
High Strength Bases

- These are used to provide thermal protection & mechanical support for the restoration.
-
- Ex: zinc phosphate, zinc polycarboxylate, glass ionomer and reinforced ZOE cements.

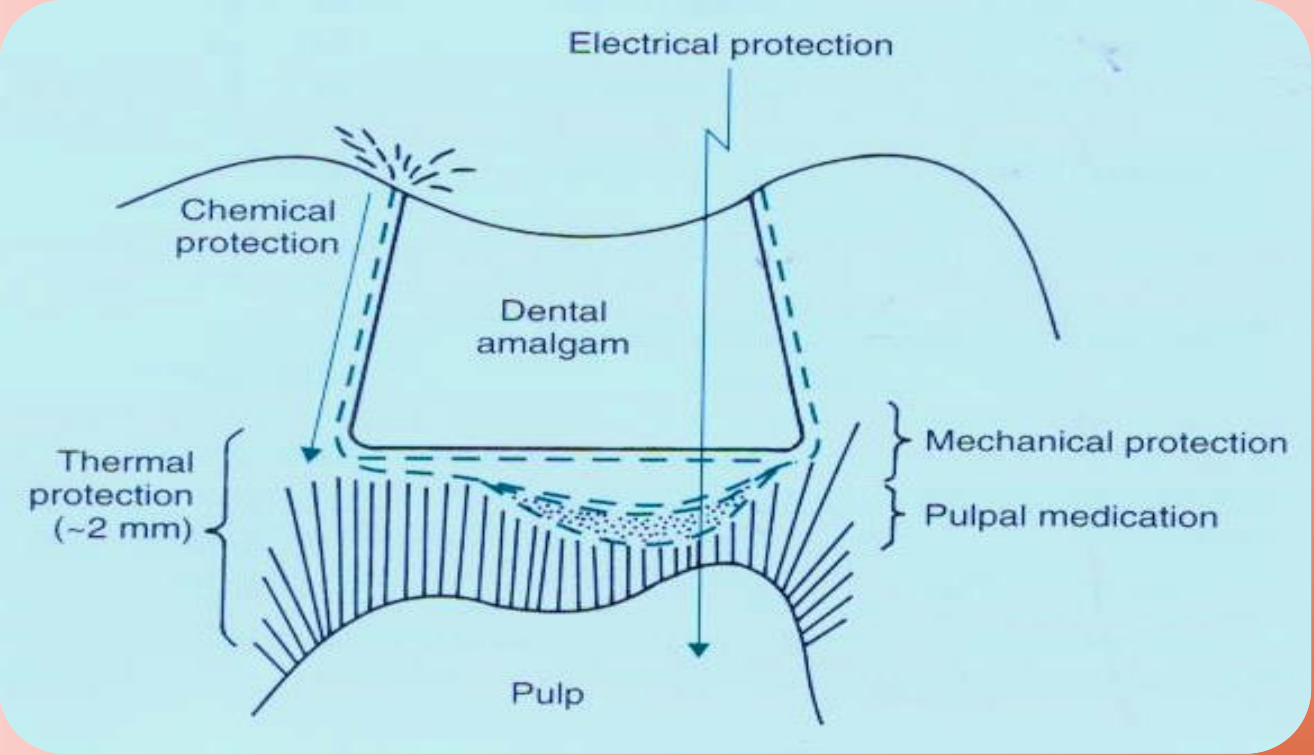
Low Strength Bases

- Have minimum strength and low rigidity. Their main function is to act as a barrier to irritating chemicals and to provide therapeutic benefit to the pulp.
-
- Ex: calcium hydroxide and zinc oxide eugenol.

TYPES


Protective base:
Protect the pulp
before the restoration
is placed.
Bases
Sedative base:
Soothe a pulp that
has been damaged
by decay or
irritated by
mechanical means
Insulating base:
Protect the tooth
from thermal shock

BASES

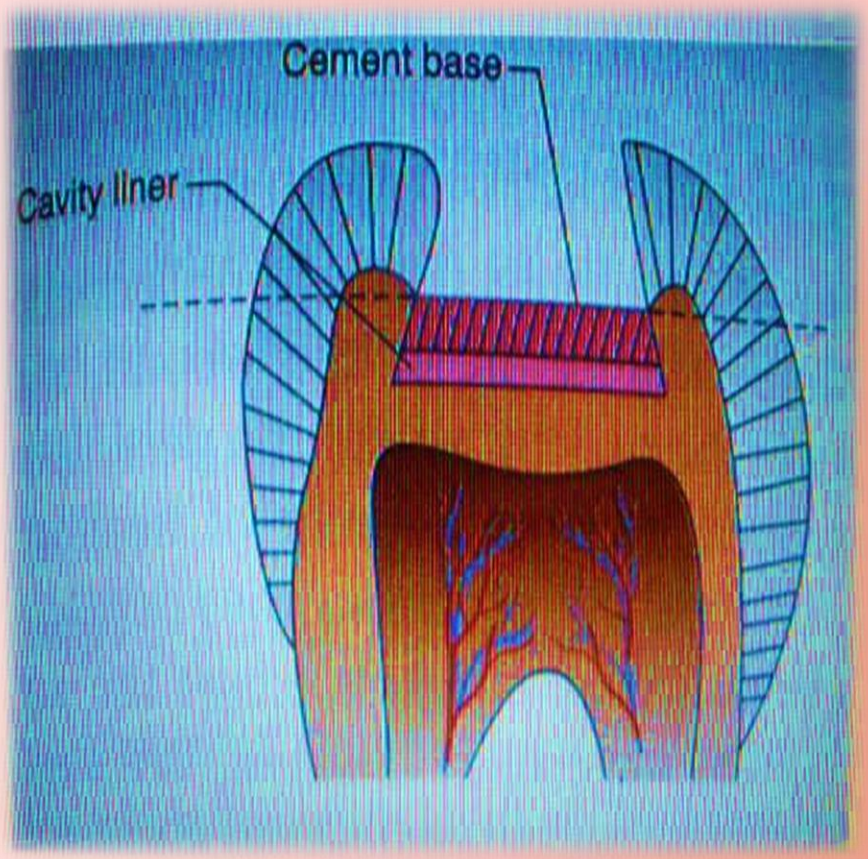


Chemical and Thermal, Mechanical Insulation

PROPERTIES OF BASES

- Well insulation ability
- Good sealing
- It acts as a thermal barrier to protect pulp from temperature changes

REQUIREMENTS OF CEMENTS BASES:



- The minimum strength requirement of a base between 0.5 and 1.2 MPa.
- Atleast **0.75mm** of thickness is required
- The base should be strong enough to resist the condensation force during the placement of restoration and Withstand fracture or distortion under masticatory stresses .
- Should contain an **obtundant** to soothe tooth, usually zinc oxide and eugenol.
- Barium is required to make it **radiopaque** so that it can be distinguished from recurrent caries.

SELECTION OF A BASE MATERIAL

The base is selected according to:

1)Design of the cavity

2) Type of permanent restorative material used.

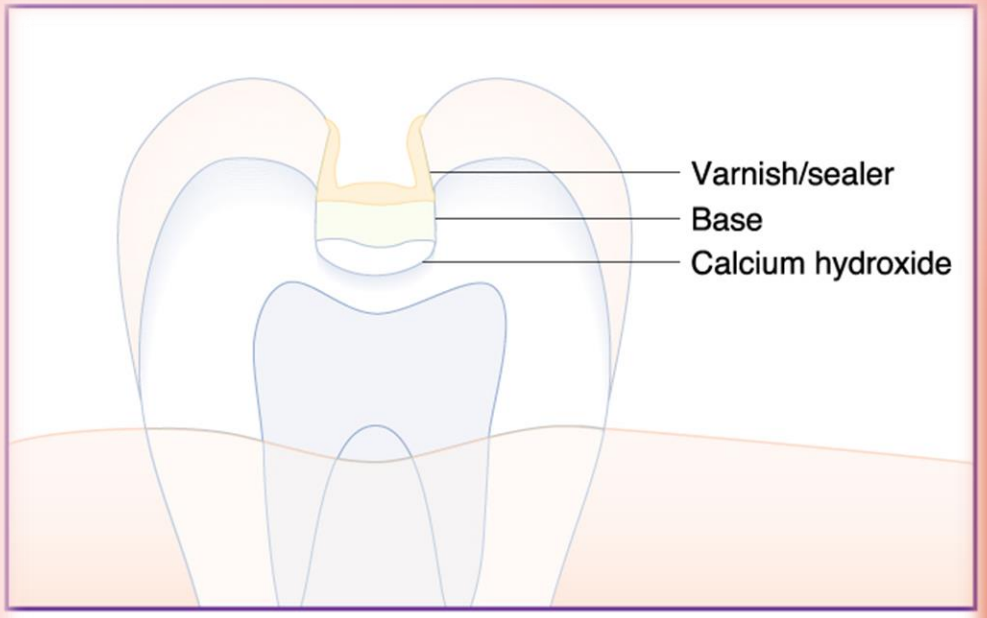
3) Proximity of the pulp to the cavity walls .

- Calcium hydroxide and zinc oxide-eugenol are most effective for this especially in **deep (**close to the pulp) cavities.
- Polycarboxylate and glass ionomer bases are also used as chemical barriers in more **moderate** cavities

- **ZOE** is best used as an insulating or sedative base.(high concentrations of eugenol can be toxic adhesions becomes difficult.)
- **Zinc Phosphate cement**. If used, a liner is placed under the cement in order to protect pulp
- **Polycarboxylate cement** is ideal to use as a protective or insulating base.

Moderately deep

Location for placement of a base.



Deep

MANIPULATION OF CEMENT BASES

- Cement bases are mixed to a thick putty and placed in the cavity to protect the pulp and provide mechanical support for the restoration
- These cement bases are placed on the floor of the cavity
- Cement bases are glass ionomers, hybrid ionomers, reinforced zinc oxide

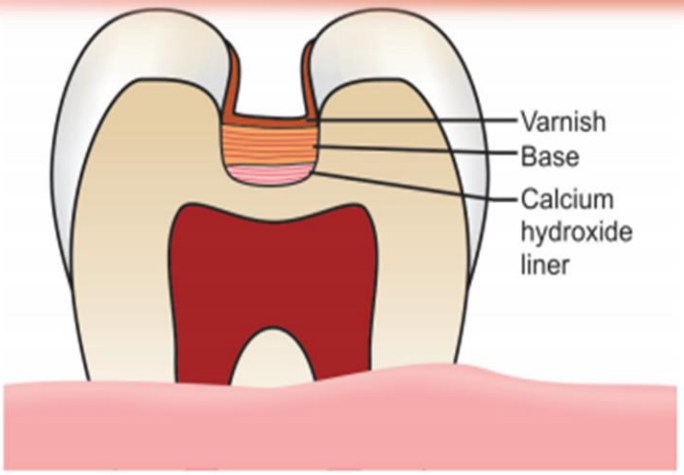


Figure 14.22: Base is applied over liner as pulp protective material in deep preparations

Uses of bases

- Pulp protective materials as thermal insulation.
- Protection as a barrier
- Therapeutic benefit to the pulp.
- Encourage recovery of injured pulp from thermal, mechanical or chemical trauma, galvanic shock and microleakage

Eg:

Calcium hydroxide - **formation of secondary dentin**

Zinc oxide eugenol - **sedative effect on the pulp.**

SUMMARY OF "MEDICAMENT, LINER / BASE, VARNISH / SEALER / DBS" PROCEDURES

(Pulpal protection = pulpal medication, dentin sealing, thermal insulation, electrical insulation, and mechanical protection.)

	Shallow Excavation (RDT >=2 mm)	**Moderately Deep (RDT = 0.5 - 2.0 mm)**	**Deep (RDT < 0.5 mm)**
Amalgam	[Medicament / Lining / Sealing] No / No / Sealer	[Medicament / Lining / Sealing] No / Vitremer / Sealer	[Medicament / Lining / Sealing] Dycal / Vitremer / Sealer
Composite	[Medicament / Lining / Sealing] No / No / DBS	[Medicament / Lining / Sealing] No / No / DBS	[Medicament / Lining / Sealing] Dycal / No / DBS
Gold Inlays, Onlays	[Medicament / Lining / Sealing] No / No / Vitremer Cement	[Medicament / Lining / Sealing] No / Vitremer / Vitremer Cement	[Medicament / Lining / Sealing] Dycal / Vitremer / Vitremer Cement
Ceramic	[Medicament / Lining / Sealing] No / No / DBS+DC Cement	[Medicament / Lining / Sealing] No / No / DBS+DC Cement	[Medicament / Lining / Sealing] Dycal / No / DBS+DC Cement

Sealer = (originally Copalite Varnish and later dentin bonding agent but now sealers only) Gluma or Hurriseal
Liner = Dycal; Liner/Base = Vitremer or Durelon
DBS = ...
Luting Cement = Vitremer Cement; Luting Composite Cement = Dual Cure Cement

REVIEW OF LITERATURE

Comparative study of heat release of various cement base materials during their setting.Panagiotouni E[1], Karanika-Kouma A.1995 Jan-Feb;38(1-2):45-50

- ZOE cements - lowest temperatures ranging from 32.8º C to 37º C,
- Zinc phosphate cements -highest temperatures ranging from 44.4 º C to 52º C.
- Zinc polycarboxylate and Glass ionomer cements developed biocompatible temperatures ranging from 38º C to 40.8 ºC, which usually do not cause deteriorations and harms to the pulp.

Znpo4 > GIC > Zn.polycarboxylate > ZOE

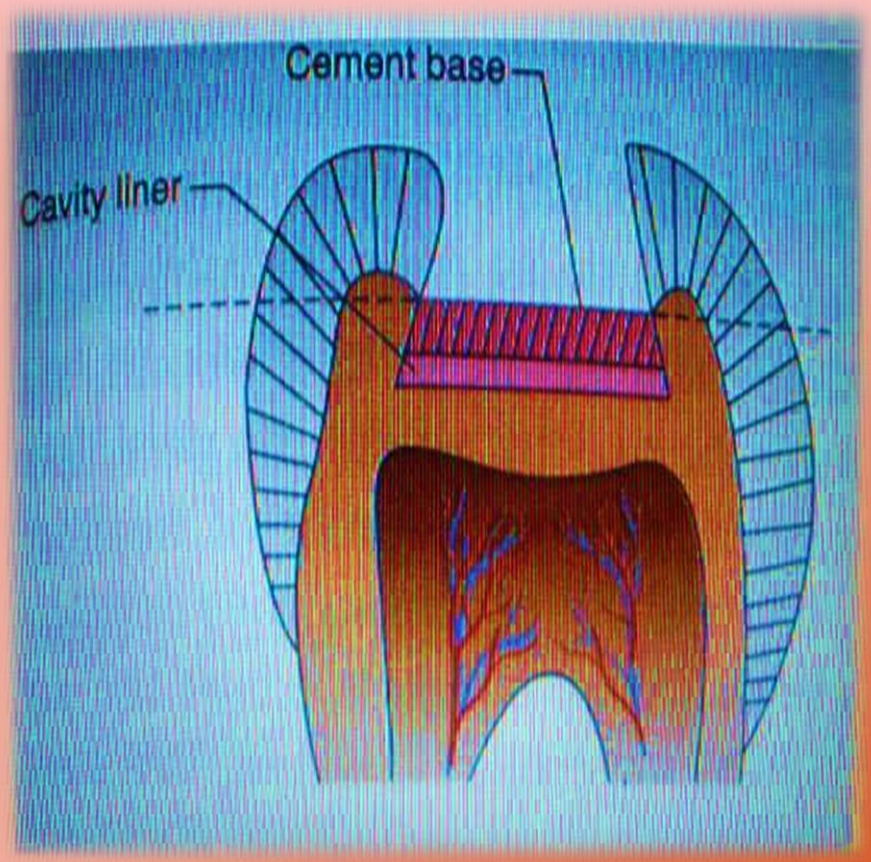
CONCLUSION

- **ZOE** is best used as an insulating or sedative base.
- **Polycarboxylate cement** is ideal to use as a protective or insulating base
- **GIC** can be used as it is biocompatible and provides chemical adhesion to the tooth structure

REFERENCES

1. Kennith J Anusavice: Phillips' Science of Dental Materials 11th edition & 9th edition.
2. Robert G. Craig and John. M: Restorative Dental Materials 11th edition & 12th edition.
3. DENTISTRY TODAY Liners, Bases, and Cements in Clinical Dentistry A Review and UpdateWritten by Randy Weiner, DMDThursday, 31 July 2003 19:00
4. Liners, Bases, and Cements: Material Selection and Clinical Applications Written by Randy Weiner, DMD Tuesday, 31 May 2005 19:00
5. Comparative study of heat release of various cement base materials during their setting. **Panagiotouni E[1], Karanika-Kouma A**.1995 Jan-Feb;38(1-2):45-50
6. Liners and bases in general dentistry. Weiner R.

CAVITY LINERS



CONTENTS

- Introduction
- Definition
- Composition
- Properties
- Requirements of liners
- Manipulation of liners
- Selection of a liners
- Uses of liners
- Review of literature
- Conclusion
- References

INTRODUCTION

- Liners are **protect the pulp from chemical irritations** and also provide a therapeutic effect to the tooth
- Liners are **calcium hydroxide, zinc oxide eugenol, and glass ionomer cement**
- Liners also called low-strength base

DEFINITION:

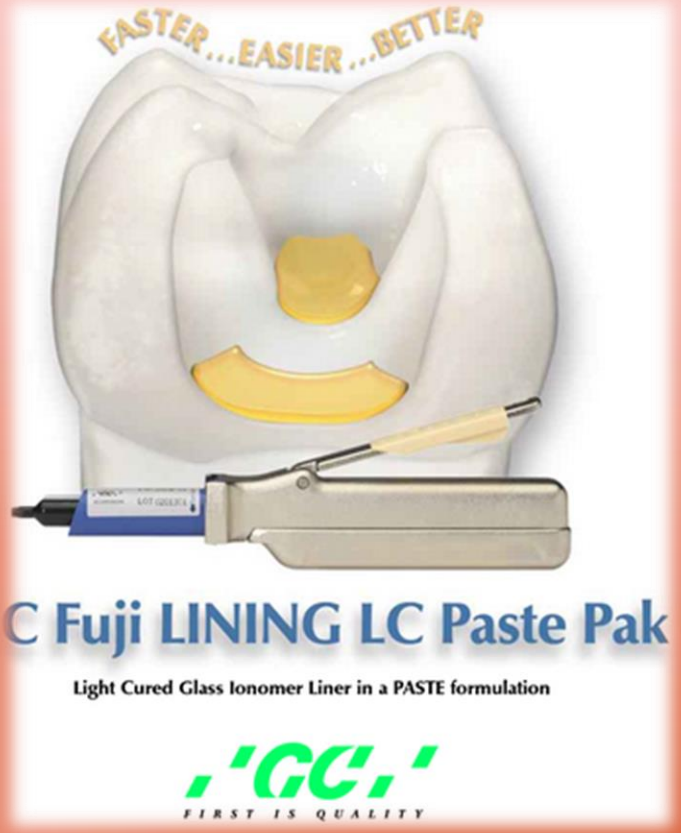
Dental liners are placed in the deepest portion of the cavity which provide a thin barrier that protects the pulpal tissue from irritation caused by physical, mechanical, chemical and biologic element.

Composition:

1. Ca(OH) / ZnO – Therapeutic agent
2. Ethyl alcohol – Solvent
3. Ethyl cellulose – Thickening agent
4. Barium sulfate – Radiopacifier
5. Fluorides – Anticariogenic

PROPERTIES:

- Acts as a thin barrier between the restoration and the remaining dentine and **protects the pulpal tissue** from irritation caused by physical, mechanical, biological, or chemical agents.
- Like cavity varnish it neither posseses mechanical properties nor provides thermal insulation.
- Should not be applied on cavity margins.



Pulpal Responses

Types of stimulus	Examples of stimulus
Physical	Thermal, electrical
Mechanical	Handpiece, traumatic occlusion
Chemical	Acid from dental materials
Biologic	Bacteria from saliva

REQUIREMENT FOR A LINER:

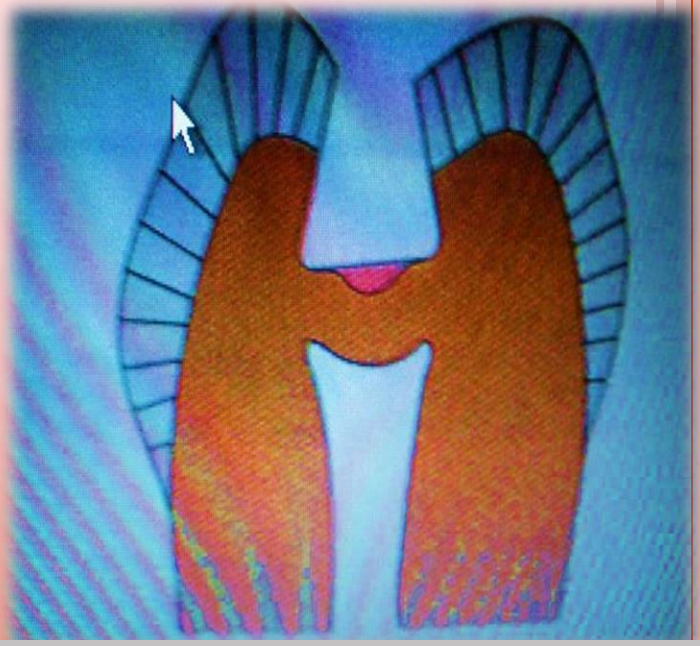
It should prevent noxious stimuli reaching the pulp

Eg:

- The liners are commonly placed under amalgams and resin composites is to prevent thermal stimulation of the pulp and acid contamination of dentine.
- On direct pulp capping treatment, place the calcium hydroxide liner and then reinforced ZOE as a temporary restoration . This aids to see whether the pulp is going to heal.

MANIPULATION:

- **Trade names: Dycal and Life**
- Mixed till homogeneous colour is obtained
- As it is fluid in consistency it readily flows or gets painted over the cavity over which the thermal insulating base or temporary restoration is provided.



Application:

1. **Two-Paste system**: Manually mixed with spatula on an oil-impermeable paper pad or clean glass slab.

2. **One-Paste/One-Step light-cured system**: Requires no mixing,already set to cure.

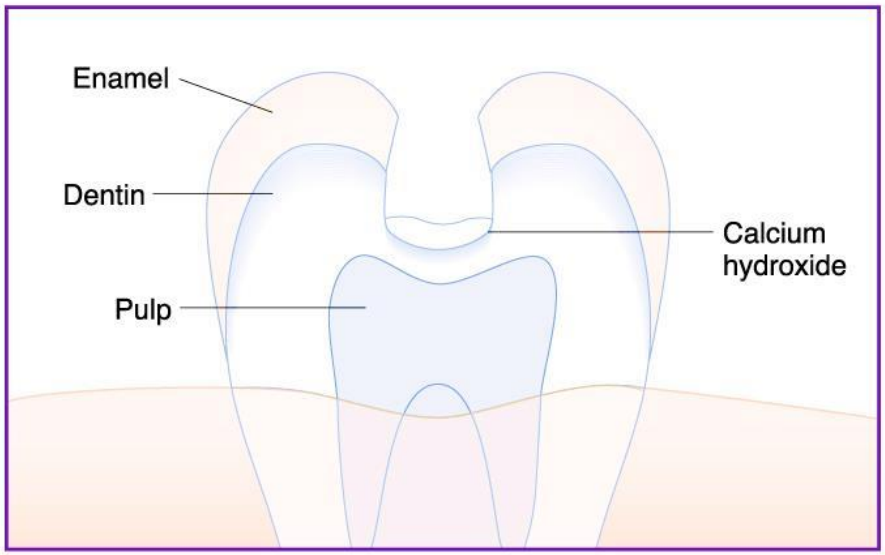
SELECTION OF A LINER:

- Preparation liners also seal freshly cut dentine but have additional functions, such as adhesion to tooth structure, fluoride release and/or antibacterial action.
- Preparation liners are applied in thin section **(<0.5 mm).**
- Following materials are most commonly used as liner
  - Calcium hydroxide
  - Flowable composites
  - Glass ionomers
  - Zinc oxide eugenol liners

CALCIUM HYDROXIDE HAS BEEN USED AS LINER IN DEEP PREPARATIONS BECAUSE OF ITS FOLLOWING FEATURES:

- It causes dentin mineralization by activating the enzyme ATPase
- It stimulates reparative dentin formation
- It forms a mechanical barrier, when applied to dentin
- Because of high pH, it neutralizes acidity of silicate and zinc phosphate cements
- Calcium hydroxide dissociates into Ca^{2+} and OH^- ions, the OH^- ions neutralize the (H^+) hydrogen ions from acids of cement
- Biocompatible in nature
- Bactericidal in nature.

Location for placement of calcium hydroxide.



Calcium Hydroxide (dycal)

Indications

- **Protects the pulp** from chemical irritation by its sealing ability.
- Stimulates the production of **reparative or secondary dentin.**
- **Compatible** with all types of restorative materials.

Limitations:

- low strength,
- High solubility .
- This limits its use over only small areas requiring pulp protection.

Flowable composites:

Advantages

- **Adaptation** to preparation walls because of their flow
- Placement ease since the materials are injected directly into the preparation
- **Esthetic**

Disadvantages

- Flowable composites -lower amount of filler.
- This reduced filler content allows more fluid consistency**, less strength and lower modulus** than fully filled composites

Glass Ionomers

- Used as a dentin liner.
- Seal dentin.
- Glass ionomers **release fluoride**, have the ability to bond and strengthen

Zinc Oxide Eugenol (ZOE)

It is used as a temporary restorative material and liner to provide a sedative base.

Contraindication:

- It can't be used with composite b/c of the oils it contains.
- It shouldn't be applied directly on a vital pulp b/c of the number of its impurities and the irritation it can cause

USES:

- As pulp capping agent due to its **sealing** ability.
- As **anticariogenic** cement because it stimulates the production of secondary or reparative dentin. Prevents post operative sensitivity or pain.
- It is **compatible** with all types of restorative materials
- **Prevents microleakage**
- Helps reduce the effect of shrinkage
- **Versatile protection** for every restoration

- Releases fluoride in the tooth (3M™ ESPE™ Vitrebond™ Plus Light Cure Glass Ionomer Liner/Base)
- Indirect pulp (not exposed but seen) cap liner is placed when there's a possibility of pulp exposure. If pulp is exposed, a pulp cap is placed directly on pulp nerve.

- Common commercial liners: Cavitec, Dycal, Hydrex, Life, Pulprotex, Temres, Timeline, Ultraband, and ZOE.

REVIEW OF LITERATURE

Effect of Liners on Microleakage in Class II Composite Restoration-Normaliza.et al 2013

Since the **GIC** has the good seal at the cervical margin,its been proved that, in clinical situation if the cavity margin is placed below the cemento enamel junction,it is advisable to line the cavity with GIC **to reduce the incidece of microleakage.**

The effect of flowable composite lining thickness on microleakge in class II composite restoration(Contemp Dent Practice 2013)

The studies shows that the ultrathin lining of **flowable composite** at the base of the cavity results in least cervical marginal microleakage with **best marginal adaptation**

CONCLUSION:

ZOE acts as a sedative base
CaoH stimulates reparative dentin formation
GIC and flowable composite reduce the incidence of microleakage

REFERENCES

1. Kennith J Anusavice: Phillips' Science of Dental Materials 11th edition & 9th edition.
2. Robert G. Craig and John. M: Restorative Dental Materials 11th edition & 12th edition.
3. DENTISTRY TODAY Liners, Bases, and Cements in Clinical Dentistry A Review and UpdateWritten by Randy Weiner, DMDThursday, 31 July 2003 19:00
4. Liners, Bases, and Cements: Material Selection and Clinical Applications Written by Randy Weiner, DMD Tuesday, 31 May 2005 19:00
5. Liners and bases in general dentistry. Weiner R.
6. **Effect of Liners on Microleakage in Class II Composite Restoration-Normaliza.et al 2013**
7. **The effect of flowable composite lining thickness on microleakge in class II composite restoration(Contemp Dent Practice 2013)**

VARNISH

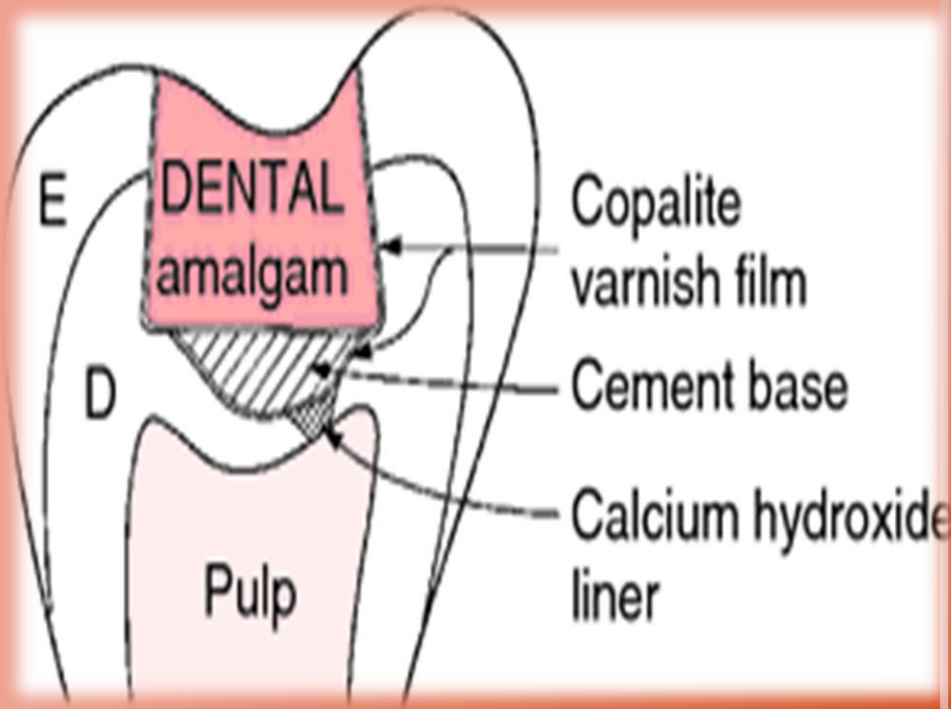

Copalite®
INTERMEDIARY
VARNISH
AND
DENTINAL TUBULI
SEAL
ONE-HALF OUNCE NET
Copalite®
INTERMEDIARY
VARNISH
AND

CONTENTS

- Introduction
- Definition
- Composition
- Properties
- Requirements of a varnish
- Manipulation of varnish
- Uses of varnish
- Indication and contraindication of varnish
- Storage and shelf life
- Trade names
- Review of literature
- Conclusion
- References

INTRODUCTION :

- A gum(cavity varnish) substance placed in prepared teeth to seal dentinal tubules to protect acids, saliva and debris from the pulp
- It is a volatile solvent



DEFINITION:

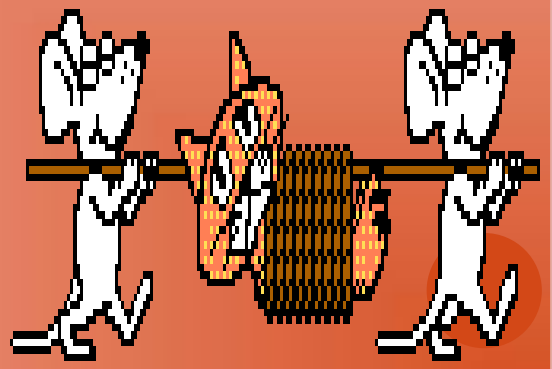
It is a natural gum like copal resin or synthetic resin dissolved in organic solvents such as ether, chloroform or alcohol . Varnishes are used for coating the freshly out tooth structure of the prepared cavity.

COMPOSITION

Natural gum	Copal and nitrated cellulose
Solvents	ether, acetone benzene, ether acetate, ethyl alcohol, chloroform, amylacetate and medicaments such as chlorobutanol, thymol and eugenol are also added.
Flouride	Any fluoride supplements

Properties:

1. It is not a physical or mechanical insulator, provides chemical barrier.
2. Thickness: 2-40mm
3. Always applied in 3 layers to be more effective



REQUIREMENTS OF A VARNISH

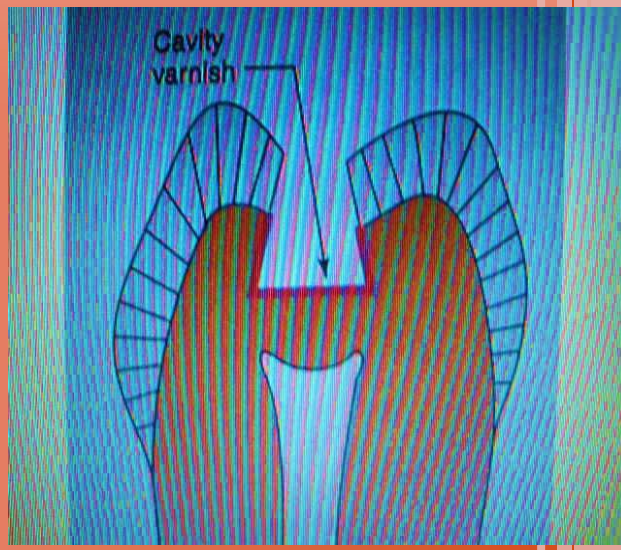
1) It should seal the dentinal tubules and prevent penetration of chemicals into the pulp.

2) It should act as a thermal protection against the loss of constituents from the surface of a filling material.

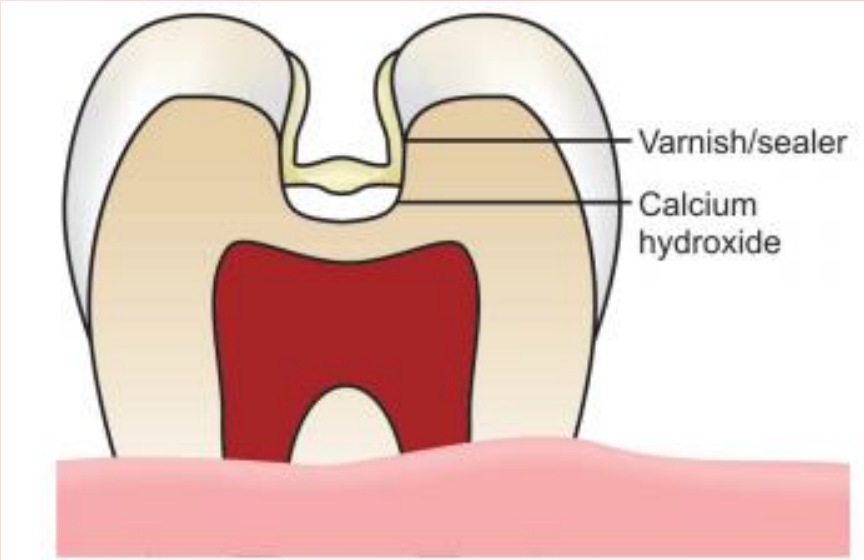
- under amalgam restorations - prevent microleakage
- under zinc phosphate cement -prevent penetration of acid to the pulp
- If cavity liners are medicated based -varnish is placed after or on top of these materials

MANIPULATION:

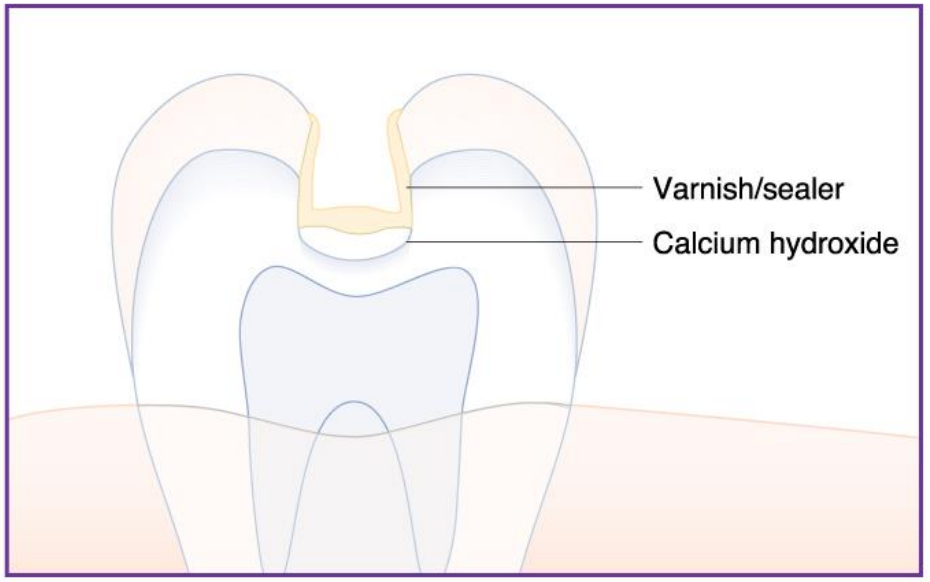
- On a patient, Cavity varnish is applied with the help of small cotton pellet with the help of wire or R.C Reamer or a brush applicator.
- Thin layers of varnish are applied on the floor, walls including cavosurface margins.
- Gentle stream of air can be used to remove the excess
- Apply a second coat and the bottle should be tightly capped after use to minimize loss of solvent.



Placement of cavity varnish



Varnish is applied on prepared tooth surface



Uses:

- Prevents **Microleakage**
- Prevents penetration of acids from ZnP cement i.e prevents chemical penetration.
- Prevents penetration of corrosion products from amalgam therefore prevents discoloration of tooth.
- Decreases post operative sensitivity and pain.
- It may be used as a surface coating over certain restorations to protect them from dehydration or from contact with oral fluids until they harden.

eg. silicate and GI cements

- **Protect & seal dental tubules and serves as insulatiton**

INDICATIONS AND CONTRAINDICATIONS

Indications for use of varnish

- To seal the dentinal tubules
- To act as barrier to protect the tooth from chemical irritants from cements
- To reduce microleakage around restorations.

Contraindications

Contraindicated under composite resin and glass ionomer restorations.

It is not used under Polycarboxylate cement and CaoH/ZOE

STORAGE AND SHELF-LIFE

- Store at temperatures not exceeding 75°F **(24°C),** ensuring that the cap is securely in place. When stored under such conditions, the material has a shelf-life of 3 years.

- A slight haze may develop in the material during storage; this is normal and acceptable and does not indicate that the shelf-life has elapsed.

TRADE NAMES OF VARNISH

Caulk, Cavaseal, Chembar, Copalite, Handliner, Hydroxyline, Repelac, & Varnall

Sci-Pharm Universal Cavity Varnish:

- Lack of irritating effect on pulp
- Compatible
- Excellent ability to sealdentinal tubules
- Protection against secondary decays in case of marginal leakage.
- It does not interfere with curing
- Resistant to the oral environment
- It does not require refrigeration

REVIEW OF LITERATURE

Dentin adhesive superior to copal varnish in preventing microleakage in primary teeth Michael C. Royse, DMD Norman W. Ott, DMD Gregory P. Mathieu-Pediatric Dent(1996)

This study evaluated only **ProBond dental adhesive agent** as a means of reducing microleakage in primary teeth and the copal cavity varnish group displayed microleakage approaching the pulpal chamber.

To evaluate the biocompatibility of glass ionomer cements (GICs) with and without chlorhexidine (CHX) as well as coated with varnish or not using *in vitro* cytotoxicity test. Eur J Dent 2013;7:89-93

Fuji IX coated with varnish was found to be the most **biocompatible** one among others.

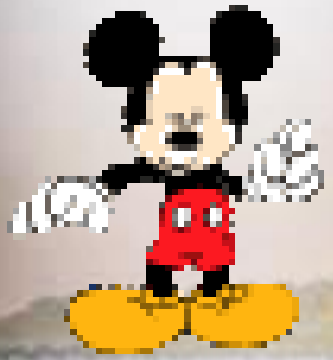
CHX significantly **reduced the cell viability**, due to the leakage of CHX and the other components of the GICs to the cell culture medium, so it is highly recommended to use varnish not only to reduce the water loss from the GICs, but also to reduce the cytotoxicity of the GICs.

CONCLUSIONS

Varnish- prevents microleakage
ability to seal dentinal tubules
serves as insulation

REFERENCES

1. Kennith J Anusavice: Phillips' Science of Dental Materials 11th edition & 9th edition.
2. Robert G. Craig and John. M: Restorative Dental Materials 11th edition & 12th edition.
3. DENTISTRY TODAY Liners, Bases, and Cements in Clinical Dentistry A Review and Update Written by Randy Weiner, DMDThursday, 31 July 2003 19:00
4. Liners, Bases, and Cements: Material Selection and Clinical Applications Written by Randy Weiner, DMD Tuesday, 31 May 2005 19:00
5. SCI PHARM- universal cavity varnish a review
6. Dentin adhesive superior to copal varnish in preventing microleakage in primary teeth Michael C. Royse, DMD Norman W. Ott, DMD Gregory P. Mathieu(1996) Pediatric Dent
7. **To evaluate the biocompatibility of glass ionomer cements (GICs) with and without chlorhexidine (CHX) as well as coated with varnish or not using *in vitro* cytotoxicity test. Eur J Dent 2013;7:89-93**



Thank you