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The gap between an indirect fixed restoration and the tooth is filled with a cement or luting agent.  

- **Ideal Luting Agent**  
  - Long working time.  
  - Adhere well to both tooth structure and cast alloy.  
  - Provide a good seal.  
  - Non-irritating, non-toxic to both pulp and surrounding supporting structure.  
  - Have adequate physical properties.  
  - Being compressible to thin layers i.e. have low viscosity; low solubility.  
  - Exhibit good working and setting characteristics.  
  - Easily to be removed after setting.  
  - Fluoride release.  

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**Cements**  

- The gap between an indirect fixed restoration and the tooth is filled with a cement or luting agent.  

- Zinc phosphate cement  

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In many cases, combinations of these mechanisms are at work.  

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Resin cements have tensile strengths in the range of 30 to 40 MPa, which is approximately five times that of zinc phosphate cement. The tensile strength of such bonds can sometimes exceed the cohesive strength of enamel. This allows the use of less extensive tooth preparation for restorations such as ceramic veneers and resin-bonded fixed partial dentures.

Molecular adhesion involves physical forces (bipolar, Van der Waals) and chemical bonds (ionic, covalent) between the molecules of two different substances. Resin cements and coupling agents will exhibit strong, durable molecular adhesion to tooth structure, base metals, and ceramics. Noble metal alloys are not well suited for direct molecular bonding. Thin layer of silane can be bonded to a gold alloy with special equipment (Silicoater, Kulzer; Rocatec, 3M ESPE) to serve as a coupling agent by bonding chemically to resin cements.
Cement selection

1. Zinc phosphate,
2. zinc silicophosphate,
3. polycarboxylate (zinc polyacrylate),
4. glass-ionomer,
5. resin-modified glass-ionomer,
6. composite resin cements.

Cements based on zinc oxide and eugenol are not indicated for permanent cementation.

Zinc Phosphate Cement (1878)

Advantages:
- Long clinical track record (used clinically for over 50 years).
- Specimens of cement retrieved from old castings (>40 yrs) show high chemical stability.
- Adequate strength (80-110 MPa c.s, 5-7 MPa t.s).
- Reasonable working time (1 minute to 3 min).
- Excess material can be easily removed.

Disadvantages:
- Water-sensitive during setting; microleakage; high solubility especially in acid environment (0.05 to 3.3% in d.w, 20 to 30 times higher in acids).
- Pulp irritation: Low initial pH (1-2 after mixing, below 4 to 1 h, 6-7 after 24 h); (use of varnishes?).
- Lack of antimicrobial action
- Britteness,
- Lack of adhesion.

Zinc Phosphate Cement (1878)

It is a two-bottle system composed:
- Liquid: Phosphoric acid
- Powder: Mixture of zinc oxide and magnesium oxide

The working time can be prolonged by mixing the material on chilled glass slabs.

Since zinc phosphate cement produces an exothermic reaction, mixing a small amount of the powder to the liquid and adding the remaining powder in small increments prolongs working time.

Advantages:

- High compressive strength (152 MPa) and a moderate tensile strength (9.3 MPa).
- Excessive film thickness 88 µm at the occlusal surface under an actual casting.
- An acidic pH that may be harmful to the pulp.
Preparing the casting:
- The casting should be cleaned by sandblasting with 50 μm alumina or by steam, followed by ultrasonic or organic cleaning.
- Next the operatory site is isolated with cotton rolls.
- The cement should be mixed to a luting consistency.
- A thin coat of cement should be applied on the internal surface of the casting.
- The tooth surface is dried and the prosthesis is inserted with a firm load. A static load will lead to incomplete seating. Excessive force may lead to fracture.
- Next the margins of the retainers are examined to verify the fit of the prosthesis.
- Excess cement should be removed with an explorer. Floss can be used to remove the excess cement in the inter-proximal surface.
- Occlusion should be checked with Mylar shim stock or articulating paper.
- The patient should be advised to avoid biting for the first 24 hours.

Preparation of the Restoration and Tooth Surface for Final Cementation

Cementation with Zinc Phosphate cement

The patient should be advised to avoid biting for the first 24 hours.
Zinc Phosphate Cement (1878)

Powder: zinc oxide and magnesium oxide
Liquid: poly acrylic acid

Zinc Polycarboxylate Cement
Zinc Polycarboxylate Cement

- Zinc polycarboxylate cement was the first cement to bond to tooth structure.
- Its adhesive properties produce a bond to enamel and a weaker bond to dentin by a chelation reaction between the carboxyl groups of the cement and calcium in the tooth.

Disadvantages

- It is thixotropic in nature. Hence, it may be too thick and will not flow satisfactorily.
- Short (2.5min) working time as compared to that of Zn/Po cement (5min) makes it difficult to lute long-span bridges.
- Residual cement is more difficult to remove.
- Not as strong as Zn/Po.
- Shows plastic deformation, so unsuited to high load areas.

Manipulation

- The cement should be mixed on the surface that does not absorb liquid; hence, a glass slab is preferred to treated paper pads.
- The liquid should not be dispensed prior to mixing because it tends lose water.
- The powder is rapidly incorporated in bulk as two increments into the liquid in large quantities within 30 seconds using a glass slab and stainless steel spatula.
- Cooling the slab increases the setting time.
- Should not be disturbed in rubbery stage as will pull from margins.

Glass Ionomer Cements

- Glass ionomer cements were introduced as hybrids of silicate cements and polycarboxylate cements to produce a cement with characteristics of silicate cements (translucency and fluoride release) and polycarboxylate cements (chemically bond to tooth structure with a good seal).

Powder: fluoro alumino silicate glass
Liquid: polyacrylic acid
Itaconic acid
Water

Advantages

- Higher tensile strength (8-12 MPa) compared to zinc phosphate cement, but significantly lower compressive strength (55-85 MPa).
- Bio-compatible to the pulp, rapid rise of the cement PH toward neutrality.
- Lack of post operative sensitivity. (excellent for sensitive teeth)
- Film thickness comparable to those of zinc phosphate cements
- Solubility in distilled water 0.1% to 0.6%.

Glass Ionomer Cements
**Glass Ionomer Cements**

*(Advantages)*
- Low solubility in the oral cavity
- Good working time
- Intermediate mechanical properties
- Excellent translucency
- It releases fluoride (anticariogenic effect).

**Disadvantages**
- The bond to tooth structure is significantly reduced when the tooth is excessively dried, which also contributes to post-cementation thermal sensitivity.
- Residual cement is more difficult to remove.

**Cementation with Glass Ionomer**
- Clean tooth and isolate. Do not use compressed air. If tooth is dry, moisten with a wet cotton roll.
- Excessive air drying of the preparation may cause post-cementation sensitivity.
- Seat casting, then clean up excess cement after it hardens.
- If patient has sensitivity, delay final cementation for 2-3 weeks.

**Hybrid Ionomer Cements**
- Resin modified polyalkenoate cement (Mixture of resin and glass ionomer powder)
- Combines the strength and insolubility of resin with the fluoride release of glass ionomer.
- Manufacturers recommend their use for all-metal or ceramo-metal crowns and bridges, but not for posts (risk of expansion induced root fracture).
- Not recommended for all-ceramic restorations, because delayed cement expansion can result in ceramic fracture.
Hybrid Ionomer Cementation

- Working time can be lengthened by using refrigerated liquid, mixing on cold slab or decreasing powder-liquid ratio. Higher temperature shortens working time.
- Use microetching to prepare internal metal surfaces for increased bonding.
- Remove excess cement before final set.
- Use desensitizing liquid to reduce possible sensitivity without dramatically affecting bond to tooth.

Adhesive Resins

Advantages:
- High strength,
- Low oral solubility.
- High micromechanical bonding to prepared enamel, dentin, alloys and ceramic surfaces.

Disadvantages:
- The need for meticulous and critical technique,
- More difficult sealing and higher film thickness than traditional cements,
- Possible leakage and pulp sensitivity,
- Difficulty in removal excess cement.
Primary purpose of luting cement: to seal tooth-restoration interfacial space

Choice of luting agent

Type of restoration: conventional casting or adhesive restoration
Clinical decision making for dental cements

Materials: Zinc phosphate is zinc phosphate cements for crown cementation.

Advantages:
- Easy to use
- Long clinical history
- High quality
- Low setting time
- Easy to use
- Resin

Disadvantages:
- Sensitive to mouth
- Low tensile strength
- Weakens material during setting

Analysis/Decision:
Comparing the properties of the two cements reveals they are both beneficial in achieving best long-term results. The decision lies in the personal preference of the dentist and their experience with the products. The choice is influenced by:

- Cost
- Ease of use
- Initial color
- Resin

Zinc phosphate

Glass ionomer

Advantages:
- Good wear
- Biocompatible
- Adhesive strength
- Less sensitivity

Disadvantages:
- No fluoride release

Analysis/Decision:
Both cements have a good wear, but only the glass ionomers release fluoride after placement. Fluoride is generally accepted to reduce wear and wear to it in individuals such as the patient. For the wearer, the glass ionomer was selected. Consideration to materials allows consideration without the disadvantages experienced with glass ionomer cements. The dentist was selected for the restorative choice.

The patient is asked to exercise all oral functions and awareness should be created regarding the initial discomfort.

Sudden impact forces should be avoided in the restored area, e.g. biting on a nut or metallic object.

Maintenance:
- Oral hygiene procedures with special attention to use of floss, inter-dental brushes in the concerned area.
- Desensitizing tooth paste or mouth wash can be used if there is sensitivity.
- The patient is advised to report immediately if there is pain.
- Regular recall visits for review.

Clinical decision making for dental cements

Materials: Glass ionomers vs. zinc phosphate cements for crown cementation.

Advantages:
- Good wear
- Affordable cost
- Adhesive strength
- Less sensitivity

Disadvantages:
- No fluoride release

Analysis/Decision:
Both cements have a good wear, but only the glass ionomers release fluoride after placement. Fluoride is generally accepted to reduce wear and wear to it in individuals such as the patient. For the wearer, the glass ionomer was selected. Consideration to materials allows consideration without the disadvantages experienced with glass ionomer cements. The dentist was selected for the restorative choice.

Post-cementation appointment (within a week to 10 days)

Periodic recall – patients with cast restoration are recalled at least every six months. Patients with extensive fixed prosthesis combined with advanced periodontal disease needs more frequent recall appointments.

Follow-up Care

Post-cementation appointment (within a week to 10 days)

Periodic recall – patients with cast restoration are recalled at least every six months. Patients with extensive fixed prosthesis combined with advanced periodontal disease needs more frequent recall appointments.