



Choosing and Using Dental Cements

Two key factors affecting the long-term success of indirect dental restorations are choosing the optimum dental cement for a specific clinical situation, and using it correctly. To help guide your choices, this white paper provides an overview of the various types of dental cement, their properties, the procedures they're best suited for, and important usage considerations.

CEMENTING, LUTING, AND BONDING

Although the terms "cement," "lute," and "bond" actually have different meanings, dentists often use them interchangeably. It's important to understand the differences:

- *Luting* refers to the placement of a material between a restoration and tooth that uses micromechanical retention to hold the two surfaces together.
- *Bonding* refers to a chemical and/or physical interaction that occurs to both the restoration and the tooth.
- *Cement* is a generic term for a joining material that provides adhesion and/or micromechanical retention between two surfaces, typically the prosthesis and the tooth.^{2,3}

The term "dental cement" is generally used to describe any material that provides the link between restorative material and the tooth preparation or implant abutment.

ESSENTIAL FUNCTIONS OF DENTAL CEMENTS

Any dental cement – whatever its specific mode of action – must perform the job of holding an indirect restoration in place for an indefinite period of time and filling the gap at the tooth-restoration interface.

For a trouble-free procedure and the long-term success of the restoration, the cement used must meet these basic mechanical, biological, and handling requirements:^{3,4}

- It must not harm the tooth or surrounding tissues
- It must allow sufficient working time to place the restoration
- It must offer viscosity and film thickness low enough to allow complete seating of the restoration
- It must quickly form a hard mass strong enough to resist functional forces and thermal effects
- It must not dissolve or wash out, maintaining a sealed, intact restoration

Adhesive and Conventional Non-Adhesive Cementation

Dental cementation may be divided into two categories: adhesive and conventional.

Adhesive cements, including the categories of adhesive resin cement and self-adhesive resin cement, rely on both micromechanical retention and chemical bonding.

Conventional cements, also known as non-adhesive cements, principally rely on micromechanical retention provided by a luting agent, including cements that incorporate zinc phosphate, zinc polycarboxylate, glass ionomer, and resin-modified glass ionomer.

Table 1 gives an overview of the main properties of each type of cement. We'll discuss these properties in more detail, along with considerations for successful usage.

TABLE 1. COMPARISON OF DENTAL CEMENT PROPERTIES^{1,6}

| | Setting | Compressive Strength (MPa) | Tensile Strength (MPa) | Ease of Cleanup | Fluoride Release |
|---|------------|----------------------------|------------------------|---|------------------|
| Conventional, Non-Adhesive Cements | | | | | |
| Zinc Phosphate | SC | 96 – 133 | 3.1 – 4.5 | Easy | No |
| Zinc Polycarboxylate | SC | 57 – 99 | 3.6 – 6.3 | Moderate | No |
| Glass Ionomer | SC | 93 – 226 | 4.2 – 5.3 | Easy/moderate | Yes |
| Resin-Modified Glass Ionomer | SC, LC, DC | 85 – 126 | 13 – 24 | Easy/moderate | Yes |
| Adhesive Cements | | | | | |
| Adhesive Resin | SC, LC, DC | 180 – 265 | 34 – 37 | Difficult | No |
| Self-Adhesive Resin | SC, LC, DC | 52 – 224 | 37 – 41 | Easy to difficult, depending on formulation | No |

SC = self cure, LC = light cure, DC = dual cure



Using Non-Adhesive Cements

Zinc Phosphate Cement is widely used for luting cast dowel (post) and cores, metal, metal-ceramic, and porcelain restorations. It is supplied as a separate powder and liquid that should be gradually mixed for 60 to 90 seconds using a cool, dry glass slab to avoid early setting. Once the correct mix consistency has been reached, the restoration must be seated within 3 to 5 minutes using firm, steady pressure maintained for several minutes until the initial set has occurred.¹⁰ High solubility requires well-fitting margins to ensure minimal exposure to oral fluids, and caution is recommended for use with patients who have acid reflux problems or a very acidic diet.

KEY CONSIDERATIONS

- Correct mix is essential for correct seating and strength⁹
- Brittle and stiff: high compressive strength, low tensile strength
- Highly soluble in newer restorations and acid environments⁷
- Not recommended for deep preparations or when pulpal irritation is a concern
- Consider using cavity varnish or calcium hydroxide, especially if less than 1 mm of dentin remains^{6, 8, 11}

Zinc Polycarboxylate Cement is an acid-base reaction cement that provides luting action similar to zinc phosphate, along with a weak chemical adhesive bond.^{12, 13} This cement is more viscous than zinc phosphate, although vibrating the restoration while seating can compensate for this. Additional liquid should never be used since this will decrease compressive strength.⁶ Relatively low compressive and tensile strength and a tendency to exhibit plastic deformation may limit the use of zinc polycarboxylate primarily to long-term temporary cementation of single unit restorations or short-span fixed partial denture cementation.

KEY CONSIDERATIONS

- Low compressive and tensile strength
- Cured material may exhibit significant plastic deformation under dynamic loading¹
- Good biocompatibility with dental pulp, minimizing sensitivity¹⁴
- Typically used as a provisional cement

Using Non-Adhesive Cements (continued)

Glass-Ionomer Cement is a hybrid material combining the adherence properties of polycarboxylate with the long-term fluoride release of aluminosilicate.¹⁵ Physical properties vary widely depending on the powder/liquid ratio, so the manufacturer's mixing instructions should be followed carefully.¹⁶ Although glass ionomer cements are self-adhesive, pretreatment with a weak polyalkenoic or phosphoric acid conditioner improves bonding and sealing efficacy.¹⁷⁻²⁰ A cotton pledget should be used to blot the dentin surface to avoid excessive drying. With a low resistance to acid, this cement may not be appropriate for patients who have gastric reflux problems or who will undergo bleaching.^{22, 23}

KEY CONSIDERATIONS

- Low bond strength, moderate compressive strength, low tensile strength
- Excessive drying reduces bond strength and contributes to sensitivity¹²
- Exposure to water/saliva contamination while setting can increase solubility and decrease ultimate hardness²¹
- Fluoride release may help mitigate recurrent caries

Resin-Modified Glass Ionomer Cements are designed to overcome the two main weaknesses of conventional glass ionomer cement – sensitivity to early moisture contamination and high solubility²⁴ – offering improved adhesion to tooth structure, higher compressive and tensile strength, and low solubility to ensure the long-term integrity of restorative margins. These cements, like conventional glass-ionomer cements, provide the added benefit of releasing fluoride. Resin-modified glass ionomer cements cure through two mechanisms: an acid-base reaction that is initiated when the powder and liquid are mixed and a polymerization process that can be triggered either by light or through a sufficient presence of free radicals.²⁶

KEY CONSIDERATIONS

- Moderate bond strength, good compressive and tensile strength
- Low solubility for improved long-term marginal integrity
- Can be self cured, light cured or dual cured
- Less post-op sensitivity compared to glass ionomer or zinc phosphate²⁵
- Fluoride release may help mitigate recurrent caries

Using Adhesive Cements

Adhesive resin cements are based on methacrylates modified from composite resin and set through polymerization rather than an acid-base reaction. They are an excellent choice when there are concerns about retention or for esthetic restorations made from glass-ceramic or composite resin. However, adhesive resin cements require isolation from moisture and other contaminants, and may not be appropriate when access or isolation is difficult or for restorations with subgingival finish lines.¹

These cements require application of a separate dental bonding agent. Many practitioners are reluctant to use the “total-etch” technique required with many bonding agents, which requires multiple steps and may increase post-op sensitivity. “Self-etch” bonding agents eliminate the need for separate etching and priming steps, although light curing of the bonding agent may be recommended before seating the restoration to improve bond strength and minimize post-operative sensitivity.^{29, 30}

Light cure, self cure and dual cure options are available.³¹ Self cured and dual cured resin cements can be used for most applications including metal, zirconia, and glass-ceramic restorations. Light cured cements should only be used for porcelain veneers and glass-ceramic restorations that allow light transmission.

KEY CONSIDERATIONS

- High bond, compressive, and tensile strength
- Multiple shade options offer superior esthetics
- Isolation from moisture and contaminants required
- Bonding agent required using “total-etch” or “self-etch” technique
- Ensure selected cement meets ISO standard for film thickness ($\leq 50 \mu\text{m}$)²⁸

Dentsply Sirona Restorative Offerings: Adhesive Resin

Calibra Ceram Cementation System



- Wide tack cure window and extended gel phase for easy cleanup
- High retentive bond strength
- Shade Stable™ technology
- Five esthetic shades
- Automix syringe
- Excellent radiopacity
- Self cure, light cure or dual cure
- Ideal for glass-ceramics, lithium disilicates and any preparation where strength and esthetics are needed

- Primer and bonding agent in a single bottle
- Total-etch, self-etch, or selective-etch
- Low film thickness
- High bond strength
- Minimal post-op sensitivity



- Wide tack cure window and extended gel phase for easy cleanup
- Five esthetic shades
- Improved matching try-in pastes
- Shade Stable™ technology
- Light cure
- Low film thickness

Cements

Self-adhesive resin cements are the latest innovation, providing the ease of use associated with glass ionomer and resin-modified glass ionomer cements, but with higher strength, improved esthetics, and dual-curing. These cements contain acrylic or diacrylate monomers plus specific adhesive monomers that are sufficiently acidic to enable self-adhesion without the need for a separate adhesive bonding agent.³²

Because these cements are resin-based, they can be used for cementation of glass-ceramics, such as lithium silicates, where glass ionomer and resin-modified glass ionomer cements are not recommended. As with adhesive resin cements, isolation from moisture and other contaminants is essential to ensure a reliable bond. Self-adhesive resin cements are most effective when bonding to dentin.

KEY CONSIDERATIONS

- No need for a separate adhesive bonding agent
- High bond, compressive and tensile strength
- Multiple shade options offer superior esthetics
- Isolation from moisture and contaminants required
- Dual cure

Dentsply Sirona Restorative Offerings: Self-Adhesive Resin Cement

- Wide tack cure window and extended gel phase for easy cleanup
- Wide range of indications, from metal crowns and PFMs to all-zirconia and all-ceramic
- Five esthetic shades
- Shade Stable™ technology
- Automix syringe
- Low film thickness
- Self cure or dual cure
- Excellent radiopacity
- Contains fluoride
- Ideal for routine, retentive restorations



Making the Right Choice

When choosing a dental cement, the most important factors to consider are the restorative material and whether the preparation is retentive or non-retentive (based on preparation taper and height). Tables 2 and 3 show cement recommendations for retentive and non-retentive preparations based on the crown material or substrate.

All-ceramic restorations require additional considerations based on the specific material used, including silica-based and non-silica-based ceramics.^{5, 33, 34} Table 4 lists appropriate cements for ceramic substrates along with clinical tips for successful cementation.^{35, 36} When choosing between an adhesive or non-adhesive cement, clinicians must evaluate the taper and crown height of the tooth preparation. For short preparations or teeth with taper greater than 20 degrees, an adhesive resin cement can help maximize crown retention.^{5, 27}

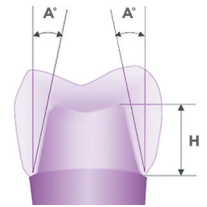


TABLE 2. RETENTIVE PREPARATIONS: RECOMMENDED CEMENTS

| Type | Glass Ionomer | Resin-Modified Glass Ionomer | Traditional Adhesive Resin | Self-Adhesive Resin |
|---------------------------------------|---------------|------------------------------|----------------------------|---------------------|
| Materials | | | | |
| All Gold/PFM | Yes | Yes | Yes | Yes |
| All Zirconia/Reinforced Core | Yes | Yes | Yes | Yes |
| High Strength Glass Ceramics > 250MPa | No | No | Yes | Acceptable |
| Low Strength Glass Ceramics < 250MPa | No | No | Yes | No |
| Composite | No | No | Yes | Yes |
| Indications | | | | |
| Endodontic Posts | Yes | Yes | Yes | Yes |
| Veneers | No | No | Yes | No |
| Crown | Yes | Yes | Yes | Yes |
| Maryland Bridge | No | No | Yes | No |
| Inlay/Onlay | No | No | Yes | Acceptable |

A preparation is defined as retentive when it has adequate axial height ($\geq 4\text{mm}$) and taper ($\leq 20^\circ$).⁶

TABLE 3. NON-RETENTIVE PREPARATIONS: RECOMMENDED CEMENTS

| Type | Glass Ionomer | Resin-Modified Glass Ionomer | Traditional Adhesive Resin | Self-Adhesive Resin |
|--|---------------|------------------------------|----------------------------|---------------------|
| Materials | | | | |
| All Gold/PFM | Acceptable | Acceptable | Yes | Yes |
| All Zirconia/Reinforced Core | Acceptable | Acceptable | Yes | Yes |
| High Strength Glass Ceramics > 250 MPa | No | No | Yes | No |
| Low Strength Glass Ceramics < 250 MPa | No | No | Yes | No |
| Composite | No | No | Yes | No |
| Indications | | | | |
| Endodontic Posts | Acceptable | Acceptable | Yes | Yes |
| Veneers | No | No | Yes | No |
| Crown | Acceptable | Acceptable | Yes | Acceptable |
| Maryland Bridge | No | No | Yes | No |
| Inlay/Onlay | No | No | Yes | No |

A preparation is defined as non-retentive when it has insufficient axial height (< 4mm) and taper (> 20°).⁶

TABLE 4. ALL-CERAMIC RESTORATIONS: RECOMMENDED DENTAL CEMENTS AND CLINICAL TIPS^{35, 36}

| Substrate | Recommended Cement | Clinical Tips |
|---|---------------------|---|
| Feldspathic Porcelain | Adhesive resin | Etch with hydrofluoric acid |
| Leucite-Reinforced Ceramic | Self-adhesive resin | Use a silane coupling agent or appropriate ceramic primer |
| Lithium Disilicate Ceramic | Adhesive resin | Etch with hydrofluoric acid |
| Zirconia-Reinforced Lithium Silicate | Self-adhesive resin | Use a silane coupling agent or appropriate ceramic primer when bonding adhesively |
| | Non-adhesive cement | Use non-adhesive cement only for retentive preparations and with sufficient occlusal clearance and material thickness |
| Aluminum Oxide and Zirconia-Based Ceramics | Non-adhesive cement | Use conventional non-adhesive cement if retention is good; otherwise use a resin cement |
| | Adhesive resin | Abrade the intaglio with aluminum oxide and a ceramic primer |
| | Self-adhesive resin | No silane, no hydrofluoric acid |
| | | To clean the intaglio surface of the crown, consider ultrasonic cleaning in alcohol or acetone |

Refer to manufacturer's direction for use.

New Cements for Better Restorations

In use since the late 1800s, zinc phosphate cement is still commercially available and has its place in the armamentarium. However, it has largely been replaced by glass ionomers, resin-modified glass ionomers, and resin cements that deliver greater strength, ease of use, and more natural esthetics.

In recent years, resin cements – especially self-adhesive resin cements – have become increasingly popular for use in a wide variety of clinical applications. Although self-adhesive resin cements significantly improve ease of use, adhesive resin cements with a bonding agent should still be considered for applications where maximum bond strength is required.

While every type of dental cement has its appropriate uses, the most important factor in the success of any cementation procedure is to fully understand and strictly adhere to the manufacturer's instructions for use.

For more information and to use our interactive cement selection tool, visit www.CalibraCement.com.



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