Cementation Simplification with.

......a Bioactive Cement
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What do you cement with?

Weigh the benefit of a bioactive cement vs. a bonding agent & adhesive cement. Evaluate the preparation design & moisture control.
Cementation
Adhesion
Adhesion
Restoration Placement?

- Cemented
  - Margin placement
  - Moisture Tolerant
  - Retention Required
  - Materials
    - RMGI
    - Ceramic

- Bonded
  - Margin placement
  - Moisture Control
  - Technique Sensitive
  - Materials
    - Self Adhesives
    - Bonding agent (TE or SE) & luting resin
Cementation Material Options

- Glass Ionomers / RMGIs
- SE Resins
- Aluminate Calcium / Calcium Silicate
- Bonding Agents w/Resins
Traditional Cementation Options

**Glass Ionomers**
- Acidic pH
- Moisture Tolerant
- Fluoride Release
- Degrades over time
- Low bond strength
- Biocompatibility-Fair
- Bioactivity-None
- Sealing Quality-Ok

**Resin Modified Glass Ionomers**
- Acidic pH
- Insoluble
- Moisture Tolerant
- Fluoride Release
- Stronger Than Traditional GIs
- Degrades over time
- Improved bond strength
- Biocompatibility Ok
- Bioactivity-None
- Sealing Quality-Ok
- Ceramic Primer on Restorations
TRADITIONAL GLASS IONOMER
CEMENTATION OPTIONS
CERAMIC PRIMER

- Feldspathic
- Leucite
- Lithium Disilicate
- Lithium Silicate
- Zirconia
Resin Modified Glass Ionomer Cements

- Use Ceramic Primer prior to try-in
- Clean with ethanol after try-in
- Keep tooth slightly moist and place RMGI cement as it will chemically cure to the tooth and the Ceramic Primer
- Still want to always have good prep design
Resin Modified Glass Ionomer Cement and a Ceramic Primer

- Lab sandblasts @ 30psi w/ 50 micron aluminum-oxide particles
- G-Multi Primer (MDP) prior to tryin
- Ultrasonic clean with ethanol
- Place FujiCEM2 RMGI cement in restoration
Cementation
Bonded Adhesion

Increasing strength demands
Resin Cement Options

Self Adhesive Resin
- Acidic/Neutral pH
- Not moisture tolerant
- Low-moderate initial bond strengths
- Decreased bond strength over time
- Water sorption
- Biocompatibility-Ok
- Bioactivity-None
- Sealing Quality-Ok

Bonding Agent w/ Resin
- Acidic/Neutral pH
- Not moisture tolerant
- Best initial bond strengths but can decreases w/time
- Decreased bond strength over time
- Water sorption
- Biocompatibility-Ok
- Bioactivity-None
- Sealing Quality-Good but technique sensitive
SE Resin Cements

Self-Adhesive Resin Cements Without a Primer or Bonding Agent have less:

- Wettability
- Which Results in Less Contact to the Tooth
- Which May Result in a Less Durable Bond
- Acid Neutralization
- Prolonged Gel State
- Convenience
All Ceramic Crown Microleakage

Bonded Resin Cement

SE Auto Resins

After simulated aging through cyclic loading (1.2 million) and dye penetration test to detect Microleakage. LSU Dental School. IADR 2006, Abstract #2090.
1 Hour Shear Bond Strength to Dentin
24 Hour Shear Bond Strength to Dentin
24 Hour Shear Bond Strength to Zirconia Ceramic
Results: Groups with primer had significantly higher shear bond strength (SBS) than the non-primed groups by factors of 16-25X for the dentin subgroups and 6-10X for enamel subgroups. With dentin bonding, the U with SEP samples were significantly higher than the enamel subgroup with the same treatment. Dentin bonding with “U with CSEP” was significantly higher than “SC with CSEP”.

Conclusions: Use of a self-etch primer on the tooth structure, in addition to the self-adhesive resin cements, significantly increases the SBS of the “all-in-one” resin cements used in this study.
Conventional methods applied to the bonding of silica-based ceramics are not successful. You cannot acid etch and silanate the intaglio surface of metal oxide ceramics as you can with lithium disilicate (e.max) or other glass ceramic restorations.

HF acid does not sufficiently alter the surfaces of metal oxide ceramics, and conventional silane coupling agents cannot provide chemical bonds to these materials because of the lack of silica.
Zirconia Cases

Should be delivered from the lab having been sandblasted with aluminum-oxide particles. Research shows small particles (30 µm) @ low pressure (35 psi) to enhance resin bonds while minimizing surface damage.*
Alternative methods for bonding to metal alloys and metal-oxide ceramics include tribochemical silica coating and other silica-coating methods. These methods embed silica particles into the metal alloy/metal-oxide ceramic surfaces. Silane coupling and bonding agents used for conventional feldspatic porcelain can then be used to bond to the silica-modified surfaces. (ex.Rocatec Silicoating 3M/ESPE)
Prior to Try-in

- The internal surfaces should be coated with a ceramic/metal primer that contains adhesive monomers that chemically bond to metal oxides.*
- MDP has been shown to offer the most consistent bonds to zirconia
Silanes

Universal Adhesives (w/MDP)

Silane Primers

Organo-Phosphate Monomer (MDP)

Silane Primer + MDP

Universal Adhesives (w/MDP)
Developed by Kuraray 1983

- Acidic Monomer Activates Silanes & Chemically Bonds to Metal Oxide Ceramics (Zirconia & Alumina).
- (Key Ingredient to make a Silane Universal)
- Hydrophilic & Hydrophobic
- **Very Durable Dentin Bond**
  (Creates An Insoluble, calcium Salt with Dentin)
- Is The Most Copied Monomer In Dentistry
- The Most Researched Monomer In Dentistry
- 20 + Years Of Research On Metal Oxide Ceramics (Zirconia & Alumina)
- Strongest & Most Durable Bond to Metal Oxide (Zirconia & Alumina) Ceramics
THE “NO-WATER” SILANE w/ MDP

INSTANT ACTIVATION

LESS DEGRADATION
(More Stable 2 Year Shelf-Life)

BONDS WITH OR WITHOUT HF
ACID ETCHING
Zirconia Cleaning

• Try-in contaminates the surface more than if a ceramic primer is not present.
• Salvia contains phosphates so they compete for the same receptor sites as the ceramic primers

**Composition (wt%):**
- Zirconium oxide 10 - 15
- Water 65 - 80
- Polyethylene glycol 8 - 10
- Sodium hydroxide ≤ 1 (pH = 13 - 13.5)
- Pigments, additives 4 - 5
REVIEW: Ceramic Try-in

• Make sure it is sand blasted properly from lab
• Use a Ceramic Primer prior to try-in (unless using Calcium Aluminate Cement)
• Ultrasonic with ethanol after try-in
• No additional MDP Ceramic Primer needs to be used.
  Or
• Sandblast after try-in and use a MDP Ceramic Primer then follow cementation protocols
Zirconia Adjustments
(Ultradent & Clinician’s Choice)
Adhesive Functional Monomers

- MDP
- Modified Phosphates
- Penta-P
- GPDM
Lithium Disilicate & Silicate, Leucite and Feldspathic restorations

IS AN ADHESIVE CEMENTATION SYSTEM THAT IS EASY-TO-USE, EFFICIENT AND HIGHLY EFFECTIVE
“Tooth-colored resin restorations have an average replacement time of 5.7 years due to secondary caries precipitated by bond failure.”

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3148178/
Factors that compromise bond durability in restorative dentistry

We challenged that current dentin adhesive designs that incorporate increasing concentrations of hydrophilic monomers are going in the wrong direction.

- Water sorption
- Polymer swelling
- Decline in mechanical properties
- Leaching of hydrolyzed resin components
Bond Degredation


Resin-dentin bonds are not as durable as was previously thought. Microtensile bond strengths often fall 30% to 40% in 6 to 12 months.
Intact hybrid layers created by a simplified etch-and-rinse adhesive in caries-affected primary dentin partially disappeared after 6 months of intraoral function.
Factors that compromise bond durability in restorative dentistry

Demineralizing dentin is like opening the Pandora’s box, releasing endogenous enzymes (Matrix Metalloproteinases - MMPs) that were trapped within the mineralized dentin matrix.

In the presence of water (such as that derived from water sorption or from adhesives, MMPs (2,8 & 9) can breakdown collagen fibrils that are not protected by intrafibrillar minerals.
Courtesy Pacific University (Dr Marc Geissberger)
InstroN

- Ultra Tester (Ultradent)
- Ultra Jig (Ultadent)
Shear Bond Test Results - 2012

Maximum/Minimum Shear Bond Strength per Bonding Material

- Optibond Solo P: 50.8, 3.4
- Optibond XTR: 55.1, 4
- Peak LC: 50.7, 1.6
- Peak SE: 47.8, 1
- Prelude self-etch: 47.1, 2.5
- Scotchbond universal: 47, 4.9
Zirconia Try-in Questions???

• The lab should have sandblasted the restoration at 30-50psi w/ 50 micron aluminum oxide.

• After try-in:
  • Ivoclean and silanate?
  • Ultrasonic with ethanol after try-in or steam clean then silanate?
  • Sand blast then ultrasonic and ethanol?
  • Zirconia silanate prior to try-in
    (Ultrasonic with ethanol after try-in)
  Sandblast after try-in and use a MDP based cement
What substrate are we treating?

Tooth Preparation

3x Tubule Density Equals Higher Fluid & Increased Difficulty for Bonding 30% Decrease in Bond Strengths with most bonding systems.**
What substrate are we treating?

3x Tubule Density Equals Higher Fluid & Increased Difficulty for Bonding 30% Decrease in Bond Strengths with most bonding systems.**
Full coverage ceramics and Zirconia
Blatz MB et al. JPD 2003
Al-Amleh B et al. J Oral Rehabil 2010
Wolfart M et al. Dent Mater 2007

- Prime the ceramic before trying in the mouth
- Do not use phosphoric acid to clean zirconia unless it has been primed
- Ethanol, acetone, and phosphoric acid can be used to clean ceramics after priming
- Phosphoric acid will react with the Zr surface – depoling ZrO sites for MDP to react
- Try-in contaminates Zr surface – saliva contains phospholipids
- Apply primer and wait several minutes for optimum chemical bond
## Zirconia Ceramic Conditioning

<table>
<thead>
<tr>
<th>Zr Treated with</th>
<th>Clean</th>
<th>Treat</th>
<th>SBS, MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Clean</td>
<td>Z-Prime</td>
<td>31.5 (8.4)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Saliva</td>
<td>Water</td>
<td>Z-Prime</td>
<td>20.6 (7.1)&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Saliva</td>
<td>Ethanol</td>
<td>Z-Prime</td>
<td>20.3 (4.2)&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>Saliva</td>
<td>Ivoclean</td>
<td>Z-Prime</td>
<td>32.0 (6.2)&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>Saliva</td>
<td>Sandblast</td>
<td>Z-Prime</td>
<td>30.3 (6.7)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Z-Prime/Saliva</strong></td>
<td>Ethanol</td>
<td>None</td>
<td>28.8 (7.7)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
MDP-containing material bonds to Zirconia

Summary of Bond Strength Testing

• Primers producing excellent bond to IPS e.max all contained silane, although some silane-containing products were less effective.

• Primers producing excellent bond to zirconia and metal materials all contained MDP, although some MDP-containing products were less effective.

• Application of effective restoration primers increased bond strength to all tested substrates. Priming of zirconia was especially necessary to create a long-lasting bond when using resin cement.
1. Prepare Restoration Surface
   Sand Blaster 30um @35psi
2. Ceramic Primer (MDP)
   Etch Dentin 10-15 secs
4. Apply Adhesive. Apply into
   preparation X secs. Thin
   with air X secs. Light Cure.
5. Seat Restoration. Load
   cement into restoration. Seat
   & remove Most excess.(Air
   inhibiting liquid) Light cure.
Bonded Adhesion
Bonded Adhesion
- Alkaline pH 8.5
- Moisture Tolerant
- Self Sealing
- Apatite Formation
- Insoluble/No Degredation
- Stronger with time
- Semi / Translucent
- Biocompatibility-Excellent
- Bioactivity-Apatite formation
- No silane, conditioning, bonding

Cement Selection

Ceramir® Crown & Bridge**
Ceramir Crown & Bridge is indicated for permanent cementation of:

- Porcelain fused to metal crowns and bridges
- Metal (gold, etc.) crowns and bridges
- Gold inlays and onlays
- Cast or prefabricated metal posts
- Strengthened core all-zirconia or all-alumina ceramic crowns and bridges
- Lithium Disilicate (eMax)
- Stainless steel crowns
- Ortho bands and appliances
Bioactivity by Doxa

A reactive bioactive system that contributes to hydroxyapatite mineralization of hard tissue through ion release and alkaline pH.**
Cement Selection

Cementation Technique

Mix for 8-10 seconds
3-4 restorations
## Ceramir C&B Comparison to other cement classes

<table>
<thead>
<tr>
<th>Material Class</th>
<th>Ceramir Crown &amp; Bridge</th>
<th>GI/RMGI</th>
<th>RESINS</th>
<th>SELF ADHESIVE RESIN</th>
<th>ZINC PHOSPHATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydroxyapatite Formation/Self-seal</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
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<tr>
<td>Biocompatibility</td>
<td>EXCELLENT</td>
<td>fair/OK</td>
<td>OK</td>
<td>OK</td>
<td>good</td>
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<tr>
<td>pH</td>
<td>BASIC</td>
<td>acidic</td>
<td>acidic/neutral</td>
<td>acidic/neutral</td>
<td>acidic</td>
</tr>
<tr>
<td>Post-op Sensitivity</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Stability Over Time</td>
<td>STABLE</td>
<td>degrades</td>
<td>degrades</td>
<td>degrades</td>
<td>degrades</td>
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<tr>
<td>Integration Mechanism</td>
<td>NANOSTRUCTURAL INTEGRATION</td>
<td>micromechanical retention, chemical bonding/adhesion</td>
<td>adhesion/micromechanical retention</td>
<td>adhesion/micromechanical retention</td>
<td>micromechanical retention</td>
</tr>
</tbody>
</table>
Lithium Disillicate (eMax)

- Cleaning w/phosphate scavengers is not necessary
- Silane is contraindicated
- Tooth etching or conditioning is not necessary
- Bonding agent is not needed
Crown Retention

Results Zirconia crowns (Kg/F)

<table>
<thead>
<tr>
<th>Material</th>
<th>Result (Zirconia crowns) Kg/F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramir Crown &amp; Bridge</td>
<td>32.1 ± 6.3</td>
</tr>
<tr>
<td>RelyX Unicem (3M)</td>
<td>27.8 ± 11.3</td>
</tr>
<tr>
<td>Dyract Cem (Dentsply)</td>
<td>12.2 ± 3.1</td>
</tr>
<tr>
<td>Rely X Luting (3M)</td>
<td>10.9 ± 6.5</td>
</tr>
</tbody>
</table>
A Bioactive Dental Luting Cement—Its Retentive Properties and 3-Year Clinical Findings

Steven R. Jefferies, MS, DDS, PhD; Cornelis H. Pamelier, DMD, DSc, PhD; David C. Appleby, DMD, MScD, FACP; Daniel Boston, DMD; and Jesper Lööf, PhD

ABSTRACT—A clinical validation study was conducted to determine the performance of a new bioactive dental cement. Three-year recall data yielded no loss of retention, no secondary caries, no marginal discoloration, and no subjective sensitivity. All restorations rated excellent for marginal integrity.

Keywords: dental cement, cementation, luting cement, bioactive, crowns, bridges, gold, PFM
Cementation Technique
Zirconia Restorations

- Cleaning w/ phosphate scavengers is not necessary
- Silane is contraindicated
- Tooth etching or conditioning is not necessary
- No bonding agent necessary
Technique
Cement Selection
Lithium Disillicate (eMax) removal
Missing Canine
Zirconia abutment and Empress crown
FIGURE 1. Basic experimental design for artificial gap (left) and microscopic photos of artificial gap changes over time during incubation in phosphate buffered saline (right).
Simplify Cementation

- Silane is contraindicated
- Restoration does not have to be cleaned after tryin
- Tooth etching or conditioning is not necessary
- Bonding agent is not needed

Research/Literature**

- Moisture Tolerant
- No Sensitivity
- Alkaline pH
- Apatite Forming
- Insoluble
- Stronger With Time
- Self Sealing
Thank you!

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Questions?