BONDing 007th Generation & Beyond

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Accredited, American Academy of Cosmetic Dentistry
Fellow, International Academy for Dental Facial Esthetics
Former Faculty, UCLA Center For Esthetic Dentistry
"Tooth-colored resin restorations have an average replacement time of 5.7 years due to secondary caries precipitated by bond failure."

What do we use to adhere our materials to the tooth?

- Substrate determines the type of technique to be implemented
- How large of a defect?
- Isolation is a critical factor
- C-factor stress
- Avoid complications
- Understand principals of adhesion to tooth structure and materials
When possible we need to shift away from a surgical approach of disease management, to early intervention. Save enamel.

**Minimally Invasive Dentistry**

(it will also help the bite)

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**How do you diagnose?**

How will you prepare and treat a condition?
A New standard of Care?
Crystal Structure Diagnostics

The Canary System Detects Cracks & Cavities not Visible on X-rays
- Around & beneath intact margins of fillings & crowns
- Under sealants (including opaque sealants)
- On proximal surfaces
- On smooth surfaces, pits & grooves
- Around orthodontic brackets

Measures tooth structure breakdown, allows for early treatment
+ Restore conservatively
+ Remineralize back to health
+ Seal with confidence

Research claims validated by 60+ papers
- 15+ case reports & 2 FDA CFR 21 clinical trials
Delegated Scanning & Whitening Assistant

Interproximal Caries Detection

Bitewing radiograph did not detect caries.
What are the Most Common Placement Problems with Composite Restorations??

- Time/Labor Intensive
- Layering
- Material Adaptation
- Polymerization Shrinkage
- Volumetric Shrinkage
- Sensitivity
- Micro leakage
- Others??

How are you restoring these different preparations?
Problem

TECHNIQUE AND VARYING TOOTH SUBSTRATES

Enamel & Variable Dentin Bonding

What substrate are we treating?

: Composite Preparation

Class I or II

3x Tubule Density Equals Higher Fluid & Increased Difficulty for Bonding
%30 Degrease in Bond Strengths with most bonding systems.
The Bonding Agents

<table>
<thead>
<tr>
<th># of components</th>
<th>Total etch</th>
<th>Self etch</th>
<th>Universals</th>
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<tbody>
<tr>
<td>Etchant</td>
<td>3</td>
<td>2</td>
<td></td>
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<tr>
<td>Primer</td>
<td>4th</td>
<td>5th</td>
<td>6th</td>
</tr>
<tr>
<td>Adhesive</td>
<td>7th</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Generation</td>
<td></td>
<td>OR</td>
<td></td>
</tr>
</tbody>
</table>

Annual failure rate (%)

- 3-step ETCH/RINSE
- 2-step ETCH/RINSE
- 2-step SELF-ETCH
- "mild" 2-step SELF-ETCH
- 1-step SELF-ETCH
- GLASS-IONOMER

Biomat
Leuven Research Cluster
### Ranking of Adhesives

<table>
<thead>
<tr>
<th>Adhesive</th>
<th>Mean</th>
<th>SE**</th>
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<tbody>
<tr>
<td>Optbond FL</td>
<td>48.2</td>
<td>3.1</td>
</tr>
<tr>
<td>Clearfil SE Bond</td>
<td>41.0</td>
<td>1.0</td>
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<tr>
<td>XPDON**D</td>
<td>39.3</td>
<td>4.1</td>
</tr>
<tr>
<td>Optbond Solo Plus</td>
<td>39.2</td>
<td>5.6</td>
</tr>
<tr>
<td>Clearfil Protect Bond</td>
<td>39.2</td>
<td>2.7</td>
</tr>
<tr>
<td>G-Bond</td>
<td>30.8</td>
<td>4.0</td>
</tr>
<tr>
<td>Optbond Solo Plus Self-etch</td>
<td>37.4</td>
<td>1.5</td>
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<tr>
<td>Hybrid Bond</td>
<td>37.3</td>
<td>0.3</td>
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<tr>
<td>Scotchbond 1</td>
<td>35.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Adper Scotchbond 1 XT</td>
<td>35.7</td>
<td>2.4</td>
</tr>
<tr>
<td>Clearfil S* Bond</td>
<td>34.8</td>
<td>3.4</td>
</tr>
<tr>
<td>Prime&amp;Bond NT</td>
<td>32.3</td>
<td>2.9</td>
</tr>
<tr>
<td>One-Step</td>
<td>32.1</td>
<td>2.4</td>
</tr>
<tr>
<td>Adper Scotchbond Multi-purpose</td>
<td>31.3</td>
<td>2.9</td>
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<tr>
<td>Fluoro Bond Shake One</td>
<td>29.2</td>
<td>4.0</td>
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<td>Clearfil Liner Bond 2V</td>
<td>28.6</td>
<td>8.7</td>
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<td>Syntra Single Component</td>
<td>29.1</td>
<td>7.2</td>
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<tr>
<td>Prompt L-Pop</td>
<td>25.8</td>
<td>4.4</td>
</tr>
<tr>
<td>Tyrian SPE/One-step Plus</td>
<td>25.8</td>
<td>2.3</td>
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<tr>
<td>ArcheSE</td>
<td>25.5</td>
<td>6.3</td>
</tr>
<tr>
<td>Adper Prompt L-Pop</td>
<td>25.2</td>
<td>3.5</td>
</tr>
<tr>
<td>One-up Bond F</td>
<td>24.9</td>
<td>2.1</td>
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<tr>
<td>Xeno Ill</td>
<td>23.8</td>
<td>2.2</td>
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<tr>
<td>iBond</td>
<td>23.6</td>
<td>2.9</td>
</tr>
<tr>
<td>Etch &amp; Prime 3.0</td>
<td>17.8</td>
<td>1.4</td>
</tr>
</tbody>
</table>

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### Bond Strength

![Graph showing bond strength for different adhesives](image-url)

**Note:** The graph compares bond strength in dentin and enamel for various adhesives. The data is from Ultradent Internal Testing.
New Universal Adhesives (Part II): Faster, Easier, Better?

Gordon's Clinical Bottom Line: A significant problem with dentin bonds in the past has been the deterioration of the bond to dentin over time. Clinicians have often been dismayed to see how easily ceramics, initially bonded to dentin with high bonds, could be removed after a period of service. As a result, the main advantage clinicians have come to desire from dentin bonds has been dentin bond durability. The past, dentin has had to use several bonds of bonding agents when bonding to metal, glass, or zirconia. New "universal" bonds claim to bond to all substrates with fewer components. This CR scientific report may change your opinion as you see CR results supporting manufacturers' claims of retention of dentin bond over time as well as agents that bond to tooth structure, metal, and ceramics without using several bottles of material.

Historically, decay in dentin bond strength over time has been obvious to clinicians and is well documented in the scientific literature. Current CR research on new universal adhesives shows that these bond strengths are being maintained over six months of water storage. Those results confirm manufacturers' claims of improved chemistry to enhance dentin bond durability and represent an improvement over previously available adhesives. Part I of this report was published in March 2012.

This second report on universal adhesives includes:
1) Data on the six-month longevity of enamel and dentin bonds produced by universal bonding agents
2) The ability of bonding agents to bond to zirconia, ceramics, and metal alloys
3) CR suggestions and conclusions

Bond to Dentin and Enamel

The following graphs show that bond strengths after 24 hours and six months of water storage. Each technique was used on cut dentin and enamel. Data compare new formulations and previously available formulations (controls). The influence of a glutaraldehyde/HEMA desensitization/distillation solution (MicroPrime G & B by Danville) was also evaluated.

Bonding to Enamel/Dentin

Total-Etching

Drawbacks:
- MMP activity from acid etching
- Bond strength to dentin
- Technique
- Sensitivity
Bonding to Enamel/Dentin

**Self-Etching**

*Drawbacks:
- Need to selective etch enamel
- MMP activity from acidic monomers pH x<2
- Bond strength
- Technique
- Sensitivity

Handpiece Lubricants & Bur Choice can induce bond problems
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.

Factors that compromise bond durability in restorative dentistry

- Hydrophilic dentin bonding (1956 - )
- Critical Reviews in Oral Biology & Medicine
- A Critical Review of the Durability of Adhesion to Tooth Tissue: Methods and Results

"The major shortcoming of contemporary adhesive restoratives is their limited durability in vivo."
Factors that compromise bond durability in restorative dentistry

**Hydrophilic dentin bonding (1956 - )**

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

**RESEARCH REPORTS**


- Instability of hybrid layers - problem may be more severe than we realize

**Chlorhexidine Arrests Subclinical Degradation of Dentin Hybrid Layers in vivo**

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

Hydrophilic dentin bonding (1956 - )

RESEARCH REPORTS
D.H. Posner,1** F.R. Tan,2 C. Yin2
M. Nahrendroh2, J. Brand,1 R.M. Corrigan1, and S. No2

Collagen Degradation by Host-derived Enzymes during Aging

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

Potential ways to extend bond longevity

-MMP inhibition with chlorhexidine

Potential ways to extend bond longevity

1. MMP inhibitors

More useful for etch-&-rinse adhesives as CHX can be applied to acid-etched dentin
Potential ways to extend bond longevity

MMP inhibition with chlorhexidine


Chlorhexidine prevented degradation of hybrid layers created by Prime&Bond NT after 12 months of intraoral function.

MMP Activity in the Hybrid Layer Detected with in situ Zymography


J DENT RES published online 21 February 2012
What is the best adhesive?

Can you get good results?

— Courtesy Pacific University (Dr Marc Guisberger)
• Courtesy Pacific University (Dr Marc Guisberger)

InstroN

- Ultra Tester (Ultradent)
- Ultra Jig (Ultradent)
Average Shear Bond Strength to Dentin: 24.2 MPa

Courtesy Pacific University (Dr Marc Guisberger)

Shear Bond Test Results - 2012

Maximum/Minimum Shear Bond Strength per Bonding Material

Courtesy Pacific University (Dr Marc Guisberger)
New “Universal” Systems

- Simple & easy to use
- Direct & indirect techniques
- Use as Total, Selective or Self Etch
- Low sensitivity
- Pretty good bond strength capabilities
- Lots of MDP Based Products*
- Work great on dentin & also enamel when it is etched
When bonding to enamel, an etch & rinse approach is definitely preferred, indicating that simple micro-mechanical interaction appears sufficient to achieve a durable bond to enamel. *When bonding to dentin, a mild self-etch approach is superior, as it {MDP} involves (like with glass-ionomers) additional ionic bonding with residual HAp. This additional primary chemical bonding definitely contributes to bond durability.* Altogether, when bonding to both enamel and dentin, selective etching of enamel followed by the application of the 2-step self-etch adhesive to both enamel and dentin currently appears the best choice to effectively and durably bond to tooth tissue.


**MDP Adhesion Monomer:**

*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
Direct Composite Restorations

Placement Techniques

“Want to work in the upper 3-4mm for best adhesion and lower stresses”

Preparation

Bonding works best when the preparation is left slightly damp.
Application on Dentin

- Apply a puddle coat and agitate for 10 seconds
- Solvent chases the moisture in dentinal tubules, carrying the resin with
- The more it travels the better mechanical retention AND reduced sensitivity

Thinning/Drying

- Thinning: ½ inch – ½ air pressure direct (Don’t wave…)
- All adhesives should be “Saran Wrap" thin and glossy
- Solvents must be dried thoroughly for 10 seconds
**Dry air source**

Kerr Total Care
“Seal-Tight”

ADEC
Tooth Drier

Evaporate volatile solvents
Drying dentin & enamel
Do not desiccate

**Solvent**

Ethyl alcohol chases moisture in the tooth and carries the resin with it deep into the enamel rods or dentinal tubules.

Once the resin is in the tooth structure, the ethyl alcohol must be evaporated to ensure optimal bond strengths.
Polymerization

Cure with VALO Grand for 10 seconds or 20 seconds using lights with output <600mw/cm2

Posterior Composite

Rule of 2’s
“Adhesive dentistry could be expressed as a simple relationship between bonds and stress. If the bonds can withstand the stress, the restorative technique will be successful.”

Unterbrink and Liebenberg (1999)

“C-Factor” Definition

Configuration Factor:

“The ratio of bonded to un-bonded (free) surfaces”

Feilzer, DeGee, Davidson (1987), Universtiy of Amsterdam, ACTA
Internal (Polymerization) Stresses of Composites

“A Simple Pain-Free Adhesive Restorative System by Minimal Reduction & Total-Etching (1993)
Takao Fusayma DDS,
Tokyo Medical & Dental University

C-FACTOR 1
STRONGEST BOND
Less than 1:1 ratio of bonded to unbonded surface

C-FACTOR 2
MEDIUM BOND
Less than 1:1 ratio of bonded to unbonded surface

C-FACTOR 3
1:1 ratio of bonded to unbonded surface

C-FACTOR 4
WEAK BOND
2:1 ratio of bonded to unbonded surface

C-FACTOR 5
WEAKEST BOND
Greater than 5:1 ratio of bonded to unbonded surface

Lowest Stress
Low Stress
Medium Stress
High Stress
Highest Stress
“C-Factor”

Base/ Lining

Excellent Flow & Handling

Tokyo Medical & Dental University, 2010 J. Tagami et al

Flowable Composite Shrinkage (2mm Bulk Fill w/ 71%/wt)

Flowable ON DENTIN ONLY
Flowable composite injected into the cavity

Composite bulk placed into the cavity
Resin to Dentin Hybrid Zone

Rule of 2’s

Technique

Normally....

Composite

0.5mm Flowable & Bonding Agent?
82% of dentists report using a flowable as a liner in Class II restorations to increase marginal adaptation.¹

Effects of Composite Layering on Bond Strengths

MPa

<table>
<thead>
<tr>
<th>Layering Technique</th>
<th>Bulk Fill</th>
<th>Oblique</th>
<th>Vertical</th>
<th>Horizontal</th>
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</thead>
<tbody>
<tr>
<td>1 Layer (4mm)</td>
<td>11</td>
<td>17.6</td>
<td>15.7</td>
<td>16</td>
</tr>
<tr>
<td>2 Layers (2mm)</td>
<td></td>
<td>19.8</td>
<td>19</td>
<td>31</td>
</tr>
<tr>
<td>4 Layers (1mm Each)</td>
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</table>

Influence of C-Factor & Layering Technique on Microtensile Bond Strengths to Dentin; S. Nikolaenko, R. Frankenberger et al, University of Erlangen, Nuremburg Germany, Dental Materials, 2014 Vol. 20: 579-585

CLINICIANS REPORT research, SureFil® SDR® Flow from DENTSPLY Caulk had the lowest polymerization shrinkage and shrinkage stress of all brands tested.
REDUCES INTERNAL STRESS BY 60% COMPARED TO TRADITIONAL RESINS.
CURES IN 20 SECONDS
4MM SELF LEVELING
LOW POLYMERIZATION STRESS
1/3 OF OFFICE PRODUCTION IS SAID TO COME FROM DIRECT RESTORATIONS.
5 YEARS OF RESEARCH SUCCESS!

Protects the Most Vulnerable Interface

The #1 reason for composite failure is recurrent decay – and the floor of the proximal box of a Class II is the most vulnerable area.
Dentin Replacement with Composite Cap

Dentin substitute
- Composites
  - Thin Flowable Resins
  - Bulkfil Flowable Resin
  - Conventional Glass Ionomers

Enamel Replacement
- Modern NanoHybrid Composite
- CR April 2014 NanoHybrid offers best results

Operative Dentistry

Today's resin-based composite materials are excellent. The bulk-fill concept is desired by many dentists; however, CR research shows adequate depth of cure deeper than 3 mm remains questionable for most brands of resin composites and most resin curing lights. Concepts for making Class II resin-based composites predictable and profitable were published in Clinicians Report February 2014.

These CRA research results agree with Dr. Tagami’s results on a bulk fill. Tagami stated some bulk fill cure only 70% on bottom at 4 or 5mm depth of cure.
Internal (Polymerization) Stresses of Composites

“A Simple Pain-Free Adhesive Restorative System by Minimal Reduction & Total-Etching (1993)
Takao Fusayma DDS,
Tokyo Medical & Dental University

Drawbacks of Any Composite Resin

- Material placement techniques
- Variable substrate
- Polymerization stress & shrinkage
- Water absorption
- Hydrophobic bonding agents
- Decreased adhesive bond strength over time
- MMPs and Cathepsins
- Microleakage
Decreased Bond Strengths due to:

- Substrate
- Preparation technique
- Bur selection
- Hand piece oils
- Bonding technique
- Curing device and position
- Material selection
- Layering technique

Start using different materials or use indirect products to eliminate resin drawbacks and deep substructure.
• More conservative
• More enamel
• Microleakage / recurrent decay

Glass Ionomer Materials

- SDI-Riva LC, Riva SC, self cure HV, light cure HV
- G.C. America-Fuji II LC, Equia Forte
- VOCO-Ionolux, Ionofil Molar AC
- 3M/ESPE-Ketac Nano, Photac Fil Quick, Vitremer, Ketac Molar Quick, Ketac Fil Plus
Resin bonding is mostly due to the intertubular dentin.
- Deep preparations have less intertubular dentin.
- More moisture present due to odontoblastic tissues and fluid
- Higher risk of post-op sensitivity
- Use a New Advanced Adhesive and Flowable

Glass Ionomer (GI)
- True chemical adhesion to tooth structure
- Bonds to moist dentin
- Less technique sensitive
- Fluoride release
- Decreased gap formation and cusp deformation
- Coefficient of thermal expansion is similar to dentin
- No post operative sensitivity
- Use on dentin & cementum

Replacing Existing Restorations & Decay

Glass Ionomer Sandwich

- Class I, II and V posterior restorations
- Open & Closed Sandwich techniques
- Composite replacement
- Amalgam replacement
- High caries risk patients
- Pediatric patients
- Geriatric patients
- Special needs patients
- Long term resistance to microleakage
Glass Ionomer Interface

Interface Analysis (TEM)

CARDOSO et al. J Dent 2010

microleakage testing in vitro using three different bases under composites

T. DUONG, L. TRAN, R. PERRY, G. KUGEL, Special Issues of the Journal of Dental Research. ABSTRACT #0366
> Tufts University School of Dental Medicine, Boston, MA, USA.

abstract:

Objective: To compare Class II microleakage in vitro of three different bases placed under composite restorations.

Methods: Thirty-six extracted molars were prepared as Class II MODD: 2mm occlusal depth, 2mm axial box depth, 3-5mm gingival box width, and 1mm gingival margin below CEJ. Teeth were randomly divided into three groups of twelve (groups 1-2 = glass ionomer; group 3 = flowable resin: Group 1 - Riva Light Cure GI (SDI), Group 2 - Riva Self Cure GI (SDI), Group 3 - Esthet-X Flow (DENTSPLY Caulk)). All groups were primed with Clearfil SE Bond Primer and Bond (Kuraray). All samples were then restored using ICE nano-hybrid Composite (SDI), finished and polished. Restorations were thermocycled for 300 cycles between 5°C and 55°C with a dwell of 30 seconds and then placed in 0.5% aqueous basic fuchsin dye for 24 hours at 37°C. Samples were sectioned mesiodistally and scored independently by two evaluators for microleakage at the occlusal-cavo and proximal-cavo surfaces under a 40x stereomicroscope.

Dye penetration was evaluated using a scoring system:

0 = no penetration, 1 = penetration in enamel/cementum, 2 = penetration at the axial wall, 3 = penetration beyond the axial wall.

Results: A Kruskal-Wallis test revealed no statistically significant difference in microleakage between the three groups at the occlusal-cavo surface (p>0.05). Group 3 was found statistically different at the proximal-cavo surface. Group 3 yielded the most microleakage at both interfaces while Group 2 showed no axial wall penetration at either interface.

Conclusion: Both light-cured and self-cured glass ionomers were more resistant to microleakage than a flowable resin on both occlusal-cavo and proximal-cavo surfaces.
Direct Restoration Layering Review

- Glass Ionomer + Bonding Agent + Composite
  - Lack of enamel or on dentin & cementum interproximally
  - Close proximity to gingiva
  - Subgingival
  - Moisture control poses an issue
  - Close pulpal proximity
- Bonding agent + Flowable + Composite
  - Enamel is present around cavosurface margins
  - Moisture control is achievable
  - No pulpal proximity

- Open Sandwich with glass ionomer & nanohybrid composite
V3 Ring & WedgeGuard by TrioDent

V3 Ring by TrioDent
EQUIA FORTE

EQUIA™ FORTE is a complete system that is an ideal solution for posterior restorations:

- Class I, II, III and V posterior restorations
- Composite replacement
- Amalgam replacement
- High caries risk patients
- Pediatric patients
- Geriatric patients
- Special needs patients
- Buildups
- Long term provisionals
Compressive Strengths

- GC EquiaFil Compressive Strength 255mpa
  - EQUIA FORTE is reported as higher with Class II indications
- Riva SC compressive strength 271mpa
- Voco Ionolux had higher compressive strength than Equia Fil or Chemfil Rock
- Surefil SDR compressive strength 220mpa
- Dentin 280mpa-297mpa
- Enamel 384mpa
- Grandio SO HF has compressive 417mpa
- Fuji II LC 170mpa (RMGI) Compressive strength

Minimally Invasive Preparations
Restoration variations for durable class I & II restorations

Class V Defect and Flowables?
Microleakage and missing fillings from high occlusal loads on teeth can cause large cervical stress concentrations resulting in disruption of the bonds between the hydroxyapatite crystals and the eventual loss of cervical enamel and dentin.

Posterior Direct Restorations

What Is Your First Step??

- Starts off by marking occlusion & selecting color
- Anesthetize
- Preparation
- Caries indicator & Base
- Materials?
- Mark occlusion again at end with different color
Red Blood Cells: 2 – 5 um
200-500 nm

Human Hair: 60 – 120 um
6,000 – 12,000 nm
Shimstock & Articulating Paper

What do you use.....

.....and why?

8µm articulating paper
Available in blue
And red too!
Abfraction Lesions & Class V Restorations
Latin words, ab – “away”, fraction – “breaking”

- Pathological loss of tooth structure caused by biomechanical loading forces.
- Static and cyclic flexural overloading of tooth structure ultimately leading to fatigue and failure of tooth structure away from the point of loading.

Resin Modified Glass Ionomers (RMGI)

- Light cured & Dual cured
- High flexural strength
- Lower compressive strength than conventional G.I.
- Good polishability
- Excellent wear
- Hydrophillic
- Fluoride release
- No microleakage
- No adhesives
- Acid resistant layer
- Reduces sensitivity
- True chemical adhesion
Resin Modified Glass Ionomer Restoration
Post-Op Photo – notice unlike typical class V composite RMGI restorative material.

Restorative Therapy- Case
Typical treatment involves the placement of a #00 retraction cord on each tooth followed by a shade selection. Roughen tooth structure with air abrasion. Place cavity conditioner on all areas to be restored for 10 seconds, then wash and dry.
Mix RMGI and syringe into place. Utilize hand instruments to shape and remove gross excess. Cure each tooth for 20 seconds. Remove excess and contour using a handpiece with fine diamond burs. Teeth should be isolated from saliva.

**Restorative Therapy - Case**

After contouring the restorations can be coated with a self etch adhesive coating, and cure for 10 seconds.
Restorative Therapy- Case

Six year post-op photos show the integrity of the material is still excellent. Note the lack of marginal microleakage stain often present with composite restorations.

Resin Modified Glass Ionomer
Fig. 15 – Graph representing the mean annual failure rates per adhesive class, determined according to a systematic review of Class-V clinical trials of adhesives during the period 1998–2004 [2].


Anterior Adhesion for resin

01 Maintain enamel and minimize dentin exposure.

02 Air abrasion to create surface area and a clean surface to adhere to

03 Bevel only when necessary
Anterior Adhesion for resin

01
Etch enamel only as MMP activity will damage hybrid zone adhesion.

02
Self-etch Dentin to minimize risks of MMP activity.

One Shade of Mosaic
Three Shades of Mosaic
One Shade of Mosaic
EFFICIENCY. DURABILITY. ARTISTRY.

mosaic™
Universal Composite

- Nanohybrid
- Superior handling
- High polishability & gloss retention
- Exceptional wear
- Unique syringe design
- Intuitive shade offering

Layered shade guide made of composite

13 Dentin Shades
- Tapered Handle = Dentin Only
- Tooth = Dentin + Enamel Neutral

Opaque White
- Not Layered

6 Enamel Shades
- Not Layered
Consistent chromatic progression between shades

Shade is printed on syringe barrel and handle tip of syringe

Shade category indicated by color-coded syringe handles
Enamel = White
Dentin = Beige

Convenient flip cap stays connected to the syringe

Unique, hygienic syringe design is easy to clean. The ergonomic handle covers syringe threads for reduced risk of contamination.
Shade category indicated by color-coded snoods
   Enamel = White
   Dentin = Beige

Unit-dose Singles contain .2g of material and are compatible with standard composite dispensing guns.

One shade this week
Anterior Ceramic Adhesion for Resin

01
Maintain enamel and minimize dentin exposure.

02
Create mechanical retention.

03
Finish lines in enamel when possible.
Minimal Prep Case in Enamel:
NSK Electric Handpieces
Run at 6,000 rpm for margin refinement
Small, light, incredibly low noise
Aesthetic Contouring
Aesthetic Contouring

Connective Tissue Attachment 1.07 mm
Junctional Epithelium 0.07 mm
Sulcus 0.55 mm

Time??
ROI??
Visalys Temp - Kettenbach

- BPA Free
- Highest Strength
- Fluorescence
- Low air inhibition layer
- Easy trimming & polish
Deep dentin adhesion??
PICASSSO SOFT TISSUE PROCEDURES

- Gingival Toughing for Crown Impressions
- Gingivectomy & Gingivoplasty
- Gingival Incision & Excision
- Soft-Tissue Crown Lengthening
- Hemostasis & Coagulation
- Excisional & Incisional Biopsies
- Exposure of Unerupted Teeth
- Fibromyal Removal
- Frenectomy & Frenotomy
- Implant Recovery
- Incision & Drainage of Abscess
- Leukoplasia
- Pulpotomy as an Adjunct to Root Canal Therapy
- Operculectomy
- Oral Papillectomies
- Reduction of Gingival Hypertrophy
- Vestibuloplasty
- Treatment of Canker Sores, Herpetic & Aphthous Ulcers of the Oral Mucosa

PERIDONTAL PROCEDURES

- Sulcular Debridement (Removal of Diseased, Infected, Inflamed, & Necropsied Soft-Tissue in the Periodontal Pocket to Improve Clinical Indices Including Gingival Index, Gingival Bleeding Index, Probe Depth, Attachment Loss, & Tooth Mobility)
- Laser Soft-Tissue Curettage
- Laser Removal of Diseased, Infected, Inflamed & Necropsied Soft-Tissue Within the Periodontal Pocket
- Removal of Highly Inflamed Edematous Tissue Affected by Bacteria Penetration of the Pocket Lining & Junctional Epithelium

Panasil Initial Contact (VPS)
Panasil ® = Hydrophilicity

- Hydrophobic water droplet
- Hydrophilic water droplet

Lowest contact angle of any VPS impression material

Panasil® Initial Contact (PIC) Hydrophilicity Demo
Hydrophilicity: comparison

Comparison of spreading behavior 30 s after mixing starts within the first 3s after applying a water drop: relative humidity 50 % - 80 %

Hydrophilicity: comparison

Contact angle after 30 min at 23°C: relative humidity 50 %
Cracked tooth

Kettenbach
Panasil Initial Contact

- Exceptional Flow Properties
- Exceptional Detail
- Exceptional Performance even in a moist environment
CEMENTATION MATERIAL OPTIONS

Cement Selection

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
- Silanate Restorations
Cementation
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
- Ceramic Primer II (MDP) prior to tryin (5 min & heat)
- Ultrasonic clean with ethanol
- Place FujiCEM2 RMGI cement in restoration

DEEP DENTIN IS RESIN THE BEST, AND CAN YOU ISOLATE? OR CREATE FULL COVERAGE & RETENTION FOR LONGEVITY?
Features

- Number #1 dental laser in the world
- More power – 3 watts
- New easy to use presets
- New treatment timers for perio treatment
- Wireless foot control
- Optional battery pack
- Perfect for first timers or hygienists
- Affordable
- Disposable tips or fibers
- Certification included
- MSRP: $4,495
- CE Price: $3,495

Use code CESNYDER16

CERAMIC PRIMER

- Feldspathic
- Leucite
- Lithium Disilicate
- Lithium Silicate
- Zirconia
FUJICEM 2

- Resin Modified Glass Ionomer Cement
- Disposable Tips
- Slide & Lock technology
- Moisture Tolerant
- Biocompatible
- Hypermineralized Dentin
What do you use?

- 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

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
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)(^a)</td>
</tr>
<tr>
<td>Saliva</td>
<td>Water</td>
<td>Z-Prime</td>
<td>20.6 (7.1)(^b)</td>
</tr>
<tr>
<td>Saliva</td>
<td>Ethanol</td>
<td>Z-Prime</td>
<td>20.3 (4.2)(^b)</td>
</tr>
<tr>
<td>Saliva</td>
<td>Ivoclean</td>
<td>Z-Prime</td>
<td>32.0 (6.2)(^a)</td>
</tr>
<tr>
<td>Saliva</td>
<td>Sandblast</td>
<td>Z-Prime</td>
<td>30.3 (6.7)(^a)</td>
</tr>
<tr>
<td>Z-Prime/Saliva</td>
<td>Ethanol</td>
<td>None</td>
<td>28.8 (7.7)(^a)</td>
</tr>
</tbody>
</table>

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.
Resin-dentin bonds are not as durable as was previously thought. Microtensile bond strengths often fall 30% to 40% in 6 to 12 months.
Factors that compromise bond durability in restorative dentistry

Hydrophilic dentin bonding (1956 - )

Instability of hybrid layers problem may be more severe than we realize

Intact hybrid layers created by a simplified etch-and-rinse adhesive in caries-affected primary dentin partially disappeared after 6 months of intraoral function

What substrate are we treating?

Cement Selection

What substrate are we treating?

Class I or II

3x Tubule Density Equals Higher Fluid & Increased Difficulty for Bonding 30% Decrease in Bond Strengths with most bonding systems.**
Self-Adhesive Resin Cements

Durability & Wettability ????

No Primer or Bond? Gel State?

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
- Convenience

No Primer or Bond

SELF ETCH RESIN CEMENTS

24 Hour Shear Bond Strength to Dentin
G-CEM LINKACE

- Dual Cure
- MDP based cement

FAST, SELF ETCH, ALL IN ONE, SELF CURE/DUAL CURE RESIN

- 24 hour shear bond strength for these products typically is between 4mpa-15ma
- Why not use a product with either better sealing capabilities and benefit to the patient’s health
- Use a stronger material that has better strength characteristics.
G-CEM LINKFORCE (GC AMERICA) AS AN EXAMPLE/HIGH STRENGTH

- Esthetic Universal Dual Cured Adhesive Cement
- BPA free
- MDP chemistry in bonding agent & primer
- Tryin pastes
- Etchant
- G-Premio BOND™ - Bonding to ALL Preparations
- G-Multi Primer™ - Primer for ALL Restorations
- G-CEM LinkForce™ - Strength in ALL Indications
- Color stability over time
- Tooth-like fluorescence
- Four shades to match all needs

Cement Selection

- 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
Bioactivity by Doxa

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

CEMENTATION TECHNIQUE

Mix for 8-10 seconds
3-4 restorations
LITHIUM DISILLICATE (EMAX) OR ZIRCONIA

- Silane is contraindicated
- Tooth etching or conditioning is not necessary
- Bonding agent is not needed

Cement Selection

**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, MSocD, 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 (Cerami® C2R, Denza Dental AB) for permanent cementation. The cement is a new formulation class, which is a hybrid material comprised of calcium aluminate and glass-ionomer components. A total of 38 crown and bridge were cemented in 17 patients; 31 of the abutment teeth were vital and were non-vital. Six restorations were bridges with a total of 14 abutment teeth (12 vital / two non-vital). One final split comprising two abutment teeth was also included. Preparation parameters were recorded, as well as cement characteristics such as working time, setting time, seating characteristics, and ease of use. A removal. Baseline data were recorded for the handling of the cement, gingival inflammation, and pre-cementation sensitivity. Post-cementation parameters included post-cementation sensitivity, gingival tissue reaction, marginal integrity, and discoloration. All patients were seen for recall examinations at 30 days and 6 months. Fifteen of 17 subjects and 13 of 17 patients were also available for subsequent comprehensive, 1- and 2-year recall examinations, and 21 patients were available for the 3-year recall examination. Restorations available for the 3-year recall examination included four single-unit full-coverage crown restorations, four three-unit bridges comprising eight abutments, and one two-unit split. Three-year recall data yielded no loss of retention, no secondary caries, no marginal discrepancies, and no subjective sensitivity. All restorations rated excellent for marginal integrity. Average visual analogue scale (VAS) scores for tooth sensitivity decreased from 5.5 at baseline to 3.84 at 6-month recall, to 2.39 at 1-year recall, and to 0.59 at 2- and 3-year recall. The gingival index (GI) score for gingival inflammation decreased from 0.26 at baseline to 0.11 at 6-month recall, 0.16 at 1-year recall, 0.21 at 2-year recall, and 0.07 at 3-year recall. After periodic recalls up to 3 years, Cerami C2R has performed quite favorably as a luting agent for permanent cementation of permanent restorations. In vitro crown coping retention studies were also conducted using this cement and various control cementation materials. Most laboratory retention force measured for Cerami C2R were comparable to other currently available luting agents for both metal and all-ceramic indirect restorative materials.

Keywords: dental cement, cementation, luting cement, bioactive, crowns, bridges, gold, PMM

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).
ZIRCONIA CEMENTATION TECHNIQUE

Lithium Disillicate (eMax)
Cement Selection

Technique
- Maintain Centric Occlusion
- Facebow & Wax Bites
- Beadline Provisionals
- Simplify Cementation
  - Silane is contraindicated
  - 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
What did the patient's teeth look like prior to veneers? Did she have any symptoms? Braces? Dental work? Trauma? Etc...
Restoration Placement?

- **Cemented**
  - Margin placement
  - Moisture Tolerant
  - Retention Required
  - Materials
    - RMGI
    - Ceramir

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

Cement Selection

Ceramic Try-in

- Make sure it is etched properly from lab
- Silanate prior to try-in (unless using Ceramir)
- Ultrasonic with ethanol after try-in

- Zirconia silanate prior to try-in
  (Ultrasonic with ethanol after try-in)
  - Or
- Sandblast after try-in and use a MDP based cement
Silanes

Silane Primers

Universal Adhesives (w/MDP)

Organo-Phosphate Monomer (MDP)

Silane Primer + MDP

Final Restorations
RESIN CEMENT COSMETIC CASES….

COSMETIC CASES….
COSMETIC CASES....
COSMETIC CASES....
COSMETIC CASES....
3 VITA® shades
2 chromatic shades
LITHIUM DISILICATE & SILICATE, LEUCITE AND FELDSPATHIC RESTORATIONS

IS AN ADHESIVE CEMENTATION SYSTEM THAT IS EASY-TO-USE, EFFICIENT AND HIGHLY EFFECTIVE
ContacEZ Restorative strip system

- Black Diamond Strip 0.06mm fine diamond single sided
- Orange Serrated Diamond Strip 0.05mm extra fine diamond single sided
- White Serrated Strip 0.035mm
- Blue Serrated Strip 0.065mm
- Gray Final Polishing Strip 0.05mm ultra fine diamond single sided
ContacEZ IPR Strip System

- Yellow IPR Starter 0.06mm
- Red IPR Opener 0.12mm
- Dark Blue IPR Widener 0.15mm
- Green IPR Extra Widener 0.20mm

ContacEZ IPR Optional Strips

- Clear IPF Single Sided Opener 0.10mm med-fine diamond
- Cyan IPR Single Sided Widener 0.12mm med-coarse diamond
- Purple IPR Super Widener 0.25mm coarse diamond
- Brown IPR Mega Widener 0.30mm coarse diamond
The Catapult Group rated the Quad-Tray Xtreme as better than, just as good, or tied with other available closed bite trays.
Quad Tray Extreme (Clinician’s Choice)

Futar® bite registration
6x The Choice

- Extremely high final hardness for precise restoration
- Comfortable working times
- Can be conveniently milled and cut with a scalpel
- Highly thixotropic, will not run into interproximal spaces, making it easier to remove
- Dispenses with little effort saving the user time

Bite Registration & Occlusal Indexing
Function & Failures

Built in errors!

- Rotation??
- Rocking??
- Thickness??

Articulators

- Disposables
- Non Adjustable
- Semi Adjustable
- Fully Adjustable
Disposable Articulators
Semi Adjustable
not on Hinge Axis
Semi Adjustable
not on Hinge Axis

OCCLUSAL RECORD/BITE REGISTRATION

Fast Setting Rigid PVS
Or
Wax
The range of PDL width: **0.15mm ~ 0.38mm**

- Average PDL width by age:
  - 11 ~ 16 years old: **0.21mm**
  - 32 ~ 52 years old: **0.18mm**
  - 51 ~ 67 years old: **0.15mm**

- The PDL width decreases with age.
- The PDL width is thinnest around the middle 1/3 of the root.
- Tooth with more function has bigger PDL space

**QUADRANT & DISPOSABLE ARTICULATORS**
MODEL ARTICULATION & EQUILIBRATION
INCISAL PINS

KEY TO NO ADJUSTMENTS

• Full Arch Impressions
• Facebow
• Bite Registration
• Semi Adjustable Articulator
Impression Trays

HeatWave by Clinician’s Choice

- 4 upper & lower trays
- 60 sec. @ 158°F
- Fast, efficient
- Virtually custom
- 30% less impression material used
Impression Trays

*HeatWave* by Clinician’s Choice
Impression Trays

HeatWave by Clinician’s Choice
Simplified Provisionals**

Siltech Putty Matrix

Provisionals (Bead Line Technique)

Duplicate waxup model in stone
Scribe a 0.5-1mm line with a sharp instrument into the model where the tissue and tooth come together.

Duplicate model with a fast setting polyvinyl impression material. I have used light and medium body washes with a heavy body tray material.

The scribed line creates the Bead Line in the over impression of the cast.
The Bead Line in the over impression creates pressure along the tissue and preparation margin. This causes a thin cut or separation of the acrylic flash from the provisionals for easier clean up.

Provisionals (Bead Line Technique)

The Bead Line Provisional Technique creates less work and risk of damaging tissues and tooth structure. Typically the process takes 5-10 minutes to make provisionals. Consepsis (Ultradent) can be placed on the teeth and dried prior to fabricating provisionals.
Provisionals
- Visalys (Kettenbach)
- TempSmart (GC America)
- Inspire (Clinician’s Choice)
- ExperTemp (Ultradent)

My Favorite Temporary Cements
ClearTemp LC (Ultradent)
For either veneers or thin anterior cosmetic restorations

Cling 2 for all my full crowns & bridges, retentive inlays & onlays
Provisionals

- Utilize an accurate preliminary over impression
- Maintain over impression
- Check contacts and occlusion

Provisionals

- Utilize an accurate preliminary over impression
- Maintain over impression
- Check contacts and occlusion
- Place temp cement only on margins
  - Do not fill temp with cement
  - Otherwise create vent holes
Cosmetic Provisionals (Bead Line Technique)


Scribe a 0.5mm-1mm groove into tissue & a little on tooth
Cosmetic Provisionals (Bead Line Technique)
Cosmetic Provisionals (Bead Line Technique)

No Polish Necessary if you use a good model
Cosmetic Provisionals (Bead Line Technique)
Cosmetic Provisionals (Bead Line Technique)

Dirty Model Not Scribed Well
Cosmetic Provisionals (Bead Line Technique)
Cosmetic Provisionals (Bead Line Technique)

Bead Line Implant, Crown & Veneer Provisionals
Visalys® Temp

For the strongest, aesthetic temporaries ever!

BPA Free
Highest Strength currently on the market
Fluorescence
Low air inhibition layer
Easy trimming & polish
Bead Line Implant, Crown & Veneer Provisionals
Word of mouth was all that existed and all that mattered.
Responsive Web Design & Fast Upload

- Mobile websites are outdated and ranked lower by Google
- Websites on WordPress technology are not as robust or fast as modern website platforms.
- Use a platform or service that allows you to monitor all work done and gives you the ability to change anything. Non-code base platforms

88% of patients looking for health information start with SEARCH ENGINES,

Takeaway: Digital marketing is no longer optional
Google Website Speed, Responsive Design and Build Issues/Code
Proof of Work / Transparency

AN ANALYSIS ENGINE THAT INFORMS AND OPTIMIZES YOUR SITE OVER TIME

We love Google Analytics too but we've made it even easier for you to learn about user behavior.
NGēnys

Websites, SEO and Social Media assistance
Nowadays good business is the very important. These are my must haves.
• Weave
• VOIP Phone system ties into practice management system

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FIND OUT WHERE YOUR BUSINESS IS AT.

CHECK YOUR PRACTICE – FIRST 20 DENTISTS GET A FREE EVALUATION
TECHNOLOGY ONLINE

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- Accountability

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Questions?