Adhesives in Dentistry
ADHESIVE in DENTISTRY

- Replace carious and fractured tooth structure.
- Fill erosion or abrasion defects.
- Correct unaesthetic shapes, positions, dimensions, or shades.
- Cement crowns.
continued

- Bond orthodontic brackets.
- Treat hypersensitivity.
- Repair fractured porcelain, amalgam, and resin restorations.
- Core build up foundations.
Sealants

1. Etch enamel

2. Apply sealant
   - OR -

3. Light cure

37% phosphoric acid for 30 seconds
Enamel surface etched with 35% and 10% phosphoric acid gels for 15 and 60 seconds. Areas with preferential removal of prism core material and the prism peripheries relatively intact (SEM X2000).
Enamel surface etched with 10% maleic acid gel for 15 seconds. The apatite crystals were partially removed from the prism core (SEM X2000)
Enamel surface etched with 10% maleic acid gel for 60 seconds. The topographical view of the prism core structure is similar to the etching patterns produced by 35% and 10% phosphoric acid gels (SEM X2000).
Glass-ionomers

- Most commonly referred to as glass ionomer cements (GIC's).
- These are materials which consist of an aqueous polyacrylate and a fluoroaluminosilicate glass.
- These set by an acid-base reaction in the presence of water.
- These cements appear to adhere to tooth structure by formation of ionic bonds as a result of chelation of the carboxyl groups in the acid with the calcium and/or phosphate ions in the apatite of enamel and dentin.
COMPOSITION

Powder  = Calcium Fluoroaluminosilicate Glass

- Silicon    13.3%  Phosphorus    2.5%
- Aluminum   13.3%  Fluoride      22.7%
- Calcium    17.3%  Oxygen       28.0%
- Sodium     1.6%

- Liquid = Polyacrylic Acid or
  - Copolymer of Acrylic Acid
  - Water
Fig. 1. Morphology of original glass powders.

Fig. 2. Particle size distribution of glass powders from GC Fuji IX_G1

Fig. 3. Morphology of the powders after flame spheroidization.

Fig. 4. Particle size distribution of glass powders after flame spheroidization.
Most Common Dental Resin

bisphenol A glycol dimethacrylate

Bis-GMA

triethylene glycol dimethacrylate

TEGDMA
## Composites

### Table 1
Materials evaluated and their specifications

<table>
<thead>
<tr>
<th>Material</th>
<th>Manufacturer</th>
<th>Cure time (s)</th>
<th>Resin</th>
<th>Filler</th>
<th>Filler size (µm)</th>
<th>Filler content % by volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filtek A110 (lot no. 20001128)</td>
<td>3M ESPE, MN</td>
<td>40</td>
<td>BisGMA</td>
<td>Colloidal silica</td>
<td>0.01–0.09</td>
<td>40</td>
</tr>
<tr>
<td>Z100 (lot no. 20010404)</td>
<td>3M ESPE, MN</td>
<td>40</td>
<td>BisGMA</td>
<td>Zirconia/silica</td>
<td>0.01–3.5</td>
<td>66</td>
</tr>
<tr>
<td>Filtek Z250 (lot no. 20010402)</td>
<td>3M ESPE, MN</td>
<td>20</td>
<td>BisGMA</td>
<td>Zirconia/silica</td>
<td>0.01–3.5</td>
<td>60</td>
</tr>
<tr>
<td>F2000 (lot no. 20010122)</td>
<td>3M ESPE, MN</td>
<td>40</td>
<td>BisGMA UDMA</td>
<td>Fluroaluminosilicate glass, silica</td>
<td>3–10</td>
<td>67</td>
</tr>
<tr>
<td>Filtek Flow, FF (lot no. 20010410)</td>
<td>3M ESPE, MN</td>
<td>20</td>
<td>BisGMA</td>
<td>Zirconia/silica</td>
<td>0.01–6</td>
<td>47</td>
</tr>
</tbody>
</table>

BisEMA, ethoxylated bisphenol-A-glycidyl methacrylate.
BisGMA, bisphenol-A-glycidyl methacrylate.
CDMA, dimethacrylate functional oligomer derived from citric acid.
GDMA, glyceryl methacrylate.
TEDGMA, triethylene glycol dimethacrylate.
UDMA, urethane dimethacrylate.
Table 1
Resins and composites studied

<table>
<thead>
<tr>
<th>Material</th>
<th>Manufacturer</th>
<th>Lot No./shade</th>
<th>Organic matrix</th>
<th>Inorganic filler</th>
<th>Inorganic filler content&lt;sup&gt;a&lt;/sup&gt;</th>
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</thead>
<tbody>
<tr>
<td>Bis-GMA</td>
<td>Polysciences Europe GmbH</td>
<td>495282</td>
<td>Bis-GMA</td>
<td>—</td>
<td>0</td>
</tr>
<tr>
<td>TEGDMA</td>
<td>Aldrich Chem. Co.</td>
<td>461111</td>
<td>TEGDMA</td>
<td>—</td>
<td>0</td>
</tr>
<tr>
<td>UDMA</td>
<td>Ivoclar-Vivadent Schaan Liechtenstein</td>
<td>B00338</td>
<td>UDMA</td>
<td>—</td>
<td>0</td>
</tr>
<tr>
<td>Bis-EMA (4)</td>
<td>Aldrich Chem. Co.</td>
<td>03514HF</td>
<td>Bis-EMA (4)</td>
<td>—</td>
<td>0</td>
</tr>
<tr>
<td>PCDMA</td>
<td>Jeneric/Pentron Inc. CT, USA</td>
<td>24594</td>
<td>PCDMA</td>
<td>—</td>
<td>0</td>
</tr>
<tr>
<td>Z-100 MP microhybrid composite</td>
<td>3M St Paul, MN, USA</td>
<td>2FR A3.5</td>
<td>Bis-GMA/TEGDMA</td>
<td>Zirconia/silica</td>
<td>71 vol% 84.5 wt%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>without silane</td>
<td>treatment particle size</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>treatment</td>
<td>0.01–3.5 μm mean size</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>particle size</td>
<td>0.6 μm</td>
</tr>
<tr>
<td>Filtek Z-250</td>
<td>3M St Paul, MN, USA</td>
<td>2NW A3.5</td>
<td>Bis-GMA/UDMA/Bis-EMA(6)</td>
<td>Zirconia/silica</td>
<td>60 vol%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>without silane</td>
<td>treatment particle size</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>treatment</td>
<td>0.01–3.5 μm mean size</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>particle size</td>
<td>0.6 μm</td>
</tr>
<tr>
<td>Sculpt-It microhybrid composite</td>
<td>Jeneric/Pentron Inc. CT, USA</td>
<td>67020 A3</td>
<td>Bis-EMA/PCDMA</td>
<td>Barium boro-silicate glass silanated particle size 0.01–3 μm mean size 0.6 μm</td>
<td>62 vol% 74 wt%</td>
</tr>
<tr>
<td>Alert condensable composite</td>
<td>Jeneric/ Pentron Inc. CT, USA</td>
<td>43881 A2</td>
<td>Bis-EMA/PCDMA fiber matrix</td>
<td>Barium boro-silicate glass, silica</td>
<td>75 vol% 84 wt%</td>
</tr>
</tbody>
</table>

<sup>a</sup>Data from the products accompanying leaflet.
Fractured incisors

http://www.seattle-dentist.com/chipped-teeth.htm
Self-Etching Primer EP-A
Self-Etching Primer EP-B
50 Yellow & 50 Pink Micro-Tips
LINKMAX Clear Cartridge
Dispensing Dish
LINKMAX A3 Cartridge
Ceramic Primer
Metal Primer II Package
Mixing Pad
LINKMAX Clear Package
Micro-Tip Handle
Mixing Spatula
Paste Pak Dispenser

- Produces Ideal Consistency Every Time.
- Dispenses The Exact Mixing Ratio No Matter How Little Or How Much Material Dispensed.
- Metering Slide Enables The User To Control The Volume Of Material Dispensed To Reduce Waste.
Dual Cure: Light Cure & Self Cure

• Temporary Light-Cured Linkmax Removes Easily With Hand Instrument One Minute After Seating.

• No Radical Clean-Up Procedure Should Be Required.

• Light-Cure Each Surface Of Restoration 20 Seconds.

• When Used Under Metal Or When Cement is Difficult To Expose To Light, Linkmax Self-Cures In 6 Minutes From Placement Of Prosthesis.
BONDING PORCELAIN

- Etchant
- Ceramic Primer
- LINKMAX
- Self-Etching Primer

Ceramic Primer: LINKMAX
Etchant: Porcelain Inlay
Self-Etching Primer: BONDING PORCELAIN
BONDING METAL PROSTHESIS TO TOOTH STRUCTURE

Diagram showing the bonding process:
- Metal Primer II
- LINKMAX
- Self-Etching Primer
- Metal Crown
The future

- Adhesive dentistry
  - Improving the properties of adhesive materials. e.g. wear resistance, strength

- Biocompatible materials
  - Antibacterial, bioactive, drug delivery

- Increasing use of implants
  - Shorter healing periods
  - Poorer quality bone
  - Less bone

- Growing natural teeth