An Update on Restorative Dental Care for Children

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DISCLOSURE

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2. Risk indicators contributing to caries include past and present caries activity, socioeconomic status, sealant status, biofilm status (dental plaque), fluoride exposure and salivary factors and biomarkers.

3. Ongoing surveillance is a crucial component of caries management in order to monitor the progression or arrest of caries lesions.

4. Dental caries management includes individualized prevention, therapeutic interventions, ongoing surveillance and necessary restorative therapy.
Prevention

- Daily oral hygiene maintenance
- Saliva stimulation and antimicrobials (i.e. xylitol, chlorhexidine) as necessary
- Professional evaluation as necessary
- Professionally applied topical fluoride
- CPP-ACP (casein phosphopeptide – amorphous calcium phosphate)
- Sealants
Fluoride Dentifrice Initiation

- When do we begin brushing children’s teeth with a fluoridated dentifrice?
  - Risk Assessment
  - Fluorosis data since “pea size” recommendation?
Xylitol

• 5 carbon sugar alcohol sweetener
• 40% fewer calories than sucrose
• Reduces acid production of plaque, plaque adherence and number of MS
• High doses can cause diarrhea
• MS dose response to xylitol gum (best effect at 6.88 g/d) through RCT (Milgrom et al. 2006)
• No data supports caries inhibitory effects of OTC xylitol gums available in the U.S.
• Recommend chewing 20-30 minutes three times per day.
• Use with mothers of infants (Soldering, 2000)
The Effectiveness of Xylitol in a School-Based Cluster-Randomized Clinical Trial; Caries Res 49:41-9, 2015

- 562 children (age 5-6) from 5 elementary schools in Cleveland
- Randomized by classroom to receive xylitol (7.8g/day) or placebo for 9 mo.
- Received oral hygiene instructions, toothbrush prophylaxis with fluoridated dentifrice and 5% fluoride varnish application every 6 mo.
- Received sealants on permanent first molars
- Final evaluation was at 30 mo. (dmfs)

Conclusion: Xylitol consumption did not have additional benefit beyond other preventive measures.
• In children aged 5 to 16 years, supervised consumption of chewing gum sweetened with sucrose-free polyol (xylitol only or polyol combinations) for 10 to 20 minutes after meals marginally reduces the incidence of caries (moderate level of certainty)

• In children reporting caries experience, consumption of xylitol-containing lozenges or hard candy reduces the incidence of caries (low level of certainty)
Chlorhexidine and Other Antibiotics

- Antibacterial activity with gram positive and negative bacteria
- Positive charge; attaches to pellicle, hydroxyapatite, mucous membranes and bacterial surface
- Disrupts bacterial membranes and enzyme systems
• Recommended to use 1-2 tsp/d for one week every three months prn or more often if necessary (Featherstone 2006)

• Disadvantages are alcohol content, bad taste and concern of ingestion in young children (Butler has alcohol-free)

• Can be applied with cotton-tipped applicator or toothette for young children
In children aged 4 to 18 years, professionally applied 10 to 40% chlorhexidine varnish does not reduce the incidence of caries (moderate level of certainty).

In children up to 15 years, application of a 1:1 mixture of chlorhexidine-thymol varnish does not reduce the incidence of caries (low level of certainty).

In children and adults, the use of 0.05 to 0.12% chlorhexidine rinse does not reduce the incidence of coronal caries (high level of certainty).
Professionally Applied Topical Fluoride

• 1.23% APF
• 8% stannous fluoride
• 2% sodium fluoride
• 5% sodium fluoride varnish (most appropriate for prevention of ECC due to age and cooperation level of patient)
2% NaF, 8% SnF$_2$ and 1.23% APF are all effective in caries inhibition (approximately 1/3 reduction).
Silver Diamine Fluoride (SDF)

- FDA reclassified (2014) SDF as an acceptable topical fluoride to be marketed and professionally applied in the USA.
- SDF, similar to action of silver nitrate, inhibits caries progression.
- We have known this for years but discoloration has been the primary reason for not gaining popularity.
Vanish XT Extended Contact Varnish (3M ESPE/OMNI)

- Desensitization of exposed root surfaces
- Protective coating for caries risk areas
- Short-term sealant for erupting molars where a high degree of moisture tolerance is needed
- Releases fluoride, calcium, phosphate
- Tooth-colored
CPP-ACP

- CPP-ACP (casein phosphopeptide-amorphous calcium phosphate): calcium and phosphate ions are stabilized into nanoclusters by CPP
- Marketed in the U.S. as MI Paste and MI Paste Plus (900 ppm F) by GC America
- Demonstrated demineralization inhibition and enhancement of remineralization in vitro and in situ
• CPP-ACP clinical trials:  
  - increase in calcium and phosphate levels in supragingival plaque (mouth rinse)  
  - gum inhibits proximal caries progression and enhances remineralization compared to placebo (radiographic assessment)  
  - CCP-ACP more effective at remineralizing post-orthodontic white spot lesions than fluoride mouth rinse in RCT

• Most studies out of Australia using gum

• Quality of existing studies indicate fair level of evidence; well-controlled RCT are necessary

One year double blind, placebo controlled (n=146) RCT of high-risk 2.5 to 3.5 year old children (n=150 received daily 10% CPP-ACP) from Thailand.

No significant difference (ICDAS).

- Double-blind, randomized, cross-over in situ study
- 13 participants
- Three 4 week experimental legs with patients wearing intra-oral mandibular appliances with 8 pre-demineralized enamel specimens
- Legs: (1) application of CPP-ACP cream (GC) after the use of fluoride dentifrice twice daily, (2) fluoridated dentifrice twice daily, (3) non-fluoridated dentifrice twice daily.

- Conclusion: The fluoridated dentifrice induced significantly higher mineral gain compared to the non-fluoridated dentifrice and the CPP-ACP cream applied after brushing with a fluoridated dentifrice.
Early Caries Diagnosis

- Visual Examination (white spot lesion)
- DiagnoDent
- QLF (Quantitative Light Fluorescence)
Visual Exam- Is Caries Present?
Results

- Early Lesions (less than 100 microns)
  - QLF demonstrates best success with more than 4 times the reliability to laser fluorescence and visual examination.

- Late Lesions (approaching dentin)
  - All examination techniques perform well.
EARLY CARIES DETECTION
How Will Dentistry Change?

- Lesions detected 1-2 years earlier than present visual technique (<50 microns depth)
- Early intervention techniques to remineralize or arrest lesion
- Monitor lesions over time
- Early diagnosis associates to “Risk Assessment”
Glass Ionomer Sealant
The dental literature supports:

1. Bonded resin sealants, placed by appropriately trained dental personnel, are safe, effective, and underused in preventing pit and fissure caries on at-risk surfaces. Effectiveness is increased with good technique, appropriate follow-up and resealing as necessary.

2. Sealants are effective in high caries-risk children but information on the magnitude of the benefit of sealing in other conditions is scarce. The relative effectiveness of different types of sealants has yet to be established.

3. Sealant benefit is increased by placement on surfaces judged to be at high risk or surfaces that already exhibit incipient carious lesions. Placing sealant over minimal enamel caries has been shown to be effective at inhibiting lesion progression. Appropriate follow-up care, as with all dental treatment, is recommended.
4. Presently, the best evaluation of risk is done by an experienced clinician using indicators of tooth morphology, clinical diagnostics, caries history, fluoride history, dental care history and present oral hygiene.

5. Sealant placement methods should include careful cleaning of the pits and fissures without removal of any appreciable enamel. Some circumstances may indicate use of a minimal enamoplasty technique.
Occlusal vs. Proximal Caries in the USA

84%

16%

Occlusal

Approximal

# TABLE 10-3. CLINICAL STUDIES OF Bis-GMA SEALANTS

<table>
<thead>
<tr>
<th>Study</th>
<th>Time</th>
<th>Sealant Retained*</th>
<th>Caries Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royhourse[^40]</td>
<td>36</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>Rock[^38]</td>
<td>24</td>
<td>80</td>
<td>99</td>
</tr>
<tr>
<td>Horowitz et al.[^22]</td>
<td>24</td>
<td>73</td>
<td>67</td>
</tr>
<tr>
<td>Courley[^19]</td>
<td>24</td>
<td>78</td>
<td>57</td>
</tr>
<tr>
<td>Merrill et al.[^33]</td>
<td>15</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Going et al.[^18]</td>
<td>24</td>
<td>69</td>
<td>55</td>
</tr>
<tr>
<td>Meurman and Heiminen</td>
<td>36</td>
<td>80</td>
<td>88</td>
</tr>
</tbody>
</table>

* Completely present, data for permanent teeth
15-Year Single Sealant Application Recall

(Simonsen, *JADA* 122:34-42, 1991)
# Retention of White Sealant by Surface on Permanent First Molars

<table>
<thead>
<tr>
<th>Status</th>
<th>5 Years</th>
<th>10 Years</th>
<th>15 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete Retention</td>
<td>82% (173)</td>
<td>56.7% (131)</td>
<td>27.6% (53)</td>
</tr>
<tr>
<td>Partial Retention</td>
<td>10.9% (23)</td>
<td>20.8% (48)</td>
<td>35.4% (68)</td>
</tr>
<tr>
<td>Missing</td>
<td>0.5% (1)</td>
<td>6.9% (16)</td>
<td>10.9% (21)</td>
</tr>
<tr>
<td>Restored/carious</td>
<td>6.6% (14)</td>
<td>15.6% (36)</td>
<td>26% (50)</td>
</tr>
<tr>
<td>Total</td>
<td>100% (211)</td>
<td>100% (231)</td>
<td>100% (192)</td>
</tr>
</tbody>
</table>
## Sound vs. Carious or Restored Surfaces on Permanent First Molars at 15 Years

<table>
<thead>
<tr>
<th></th>
<th>Group with Sealant</th>
<th>Group without Sealant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound surfaces</td>
<td>68.8% (88)</td>
<td>17.2% (22)</td>
</tr>
<tr>
<td>Carious or restored</td>
<td>31.3% (40)</td>
<td>82.8% (106)</td>
</tr>
<tr>
<td>Total surfaces</td>
<td>100% (128)</td>
<td>100% (128)</td>
</tr>
</tbody>
</table>

Matched pair analysis (n = 128 surfaces, 16 subject pairs)
SEALANTS

1. Filled versus Unfilled
2. Detrimental Effects (Bisphenol A)?
3. Fluoridated Sealants
4. Primers Prior to Sealant Placement
(1) 50% uncured bisphenol A leaches within 3 hours (Ferracane, 1990).

(2) Saliva dose not equal to blood dose.

(3) Estrogenic effects in breast cancer cells, not normal cell culture.
Bisphenol A
90-931 µg/30 ml saliva
*Environmental Health Perspectives*
March, 1996
6. A low-viscosity, hydrophilic material bonding layer as part of or under the actual sealant has been shown to enhance the long-term retention and effectiveness.

7. Glass ionomer materials can be used as transitional sealants, and may prove to be effective as longer-term pit and fissure sealants.

8. The profession must be alert to new, effective methods for preventing pit and fissure caries, including changes in dental materials or technology, and improvements in caries risk assessment.
FLUORIDE RELEASING SEALANTS

- Glass Ionomer
- Fluoridated Resin
Lesion Initiation (Mean ± S.D.)

- Control Sealant: 138 ± 18µm
- Fluoride Sealant: 109 ± 21µm
- GIC: 83 ± 12µm

PRIME & BOND 2.1  
(Caulk/Dentsply)
Self-etching Sealants and Hydrophilic Sealants
ICON (DMG)

- Penetrating (enamel subsurface) resin
- Etch with hydrochloric acid first to make surface more easy to penetrate
- Smooth surfaces (facial and proximal)
- Not radiopaque

• 42 children (mean age 7.17 yrs.) – Split mouth design

• After 1 yr., using ICDAS Scores: 31% of resin infiltrate lesions progressed 67% of fluoride varnish lesions progressed

Radiographically, 23% of infiltrate and 62% of varnish lesions progressed
Randomized Controlled Clinical Trial on Proximal Caries Infiltration: Three-Year Follow-Up; Caries Research 2012; 46: 544-548.

- 22 Adults with proximal lesions (radiographically in the inner half of enamel to outer third of dentin) with a total of 29 lesion pairs in a split mouth research design.

- ICON or nothing (control) on each pair of lesions.

- After 3 years, radiographically, 4% of the infiltrated ICON lesions progressed and 42% of the control lesions progressed being significantly different (p< 0.002).

- 39 Adults with 3 proximal lesions (outer third of dentin progression).

- One received ICON, one received sealant and one was a control.

- At three years, radiographically there was no significant difference (p<0.05) between ICON and sealant, however, both ICON and sealant were significantly better than the placebo.
Implementing Restorative Treatment

- Treatment plan according to risk assessment
- Obtain consultations
- Provide treatment options to patients and parents, including restorative materials and location (i.e. outpatient dental clinic; operating room)
- Utilize restorative materials within their limitations (resin-based composite, amalgam, glass ionomer cement, stainless steel crown)
GLASS Ionomer Cements

Types of Restorations

- Preventive Glass Ionomer Restorations
- Class I
- Class II
- Class III
- Class V
- Intermediate Restorations
Types of Restorations

- Preventive Resin Restorations
- Class I
- Class II
- Class III
- Class IV
- Class V
GLASS IONOMER CEMENT
Developed in England by McLean and Wilson in 1972. They were looking for a dual purpose material that would function as both a cementing agent and direct esthetic restoration.
Glass Ionomer Cement is basically a hybrid of silicate and polycarboxylate cements:

1. The liquid is an aqueous solution of polyacrylic acid, similar to the liquids utilized in polycarboxylate cements.

2. The powder is mainly aluminosilicate, which is similar to the powder in silicate cements.
Polyacrylic acid (proton donor) → Aluminosilicate glass (proton acceptor) → Metal polyacrylate gel matrix

siliceous hydrogel → glassy core
The original glass ionomer cement (ASPA) had the disadvantage of a slow rate of surface hardening.

**Tartaric Acid** (Accelerator)

\[ \text{HOOC (CHOH)}_2 \text{COOH} \]
Benefits

- Physical properties similar to dentin
- Fluoride release – Caries inhibition
- Bonding to tooth structure
- Solubility less than silicate cements
ADVANTAGES

- Time efficient
- Minimal preparation
- No need to acid-etch
- Behavior
GLASS IONOMER MATERIALS

The dental literature supports the use of glass ionomer cement or resin modified glass ionomer cement systems in the following situations:

1. Luting cement:
   a. stainless steel crowns,
   b. orthodontic bands,
   c. orthodontic brackets (limited).
2. Surface protectant/sealant.
3. Cavity base/liner
4. Class I restorations in primary teeth.
5. Class II restorations in primary teeth.
6. Class III restorations in primary teeth.
7. Class III restorations in permanent teeth in high-risk patients or teeth that cannot be isolated.

8. Class V restorations in primary teeth.

9. Class V restorations in permanent teeth in high-risk patients or teeth that cannot be isolated.

10. Caries control:
    a. high-risk patients,
    b. restoration repair,
    c. Interim Therapeutic Restorations (atraumatic restorative treatment)
Stainless Steel Crown Cementation
FACIAL CUT-OUT STAINLESS STEEL CROWN
Glass Ionomer Cement used in Conjunction with Composite Resin
Glass Ionomer Base/Liner

- Following Caries Removal
CLASS I
RESTORATION
Advantages

- Minimal Tooth Preparation
- Fluoride Release
Concerns

- Bond strength
- Compressive strength
- Wear
CLASS II RESTORATION

Light Cured Glass Ionomer Restoratives

Traditional
- Fuji II (GC)
- Vitremer (3M)
- Photac Fil (ESPE)

Current
- riva light cure (SDI)
Tri-Cure Chemistry

1. $\text{CO}_2\text{H} + \text{H}_2\text{O}$
2. Light HEMA
3. Tri-Cure Catalysts "Dark Cure"

- One step, bulk cure
- Fast, easy
- High strength
- High toughness
VARNISH
CHEMICAL CURED GLASS Ionomer CEMENTS
Ketac® Molar
ESPE
Ionofil Plus
(VOCO)
Fuji IX
(GC)
CLASS III
RESTORATION
CLASS V
RESTORATIONS

INTERIM
THERAPEUTIC
RESTORATIONS
ADVANTAGES

♦ Time efficient
♦ Minimal preparation
♦ No need to acid-etch
♦ Behavior
## Restorations Evaluated

<table>
<thead>
<tr>
<th>Type of Restoration</th>
<th>Number of Restoration Evaluated</th>
<th>Age of Patient When Restoration Placed (Mean ± S.D.)</th>
<th>Age Restoration (Mean ± S.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>393</td>
<td>4 yrs. 8mo. ± 1yr. 4mo.</td>
<td>4 yrs. 3mo. ± 1yr. 1mo.</td>
</tr>
<tr>
<td>Class II</td>
<td>406</td>
<td>5 yrs. 10mo. ± 1yr. 3mo.</td>
<td>4 yrs. 1mo. ± 1yr.</td>
</tr>
<tr>
<td>Class III</td>
<td>15</td>
<td>5 yrs. 7mo. ± 1yr. 3mo.</td>
<td>4 yrs. 5mo. ± 1yr. 1mo.</td>
</tr>
<tr>
<td>Class V</td>
<td>50</td>
<td>4 yrs. 10mo. ± 1yr. 3mo.</td>
<td>4 yrs. 2mo. ± 1yr. 2mo.</td>
</tr>
<tr>
<td>Total</td>
<td>864</td>
<td>5 yrs. 2mo. ± 1yr. 5mo.</td>
<td>4 yrs. 2mo. ± 1yr. 1mo.</td>
</tr>
</tbody>
</table>
## Clinical Evaluation Data

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Type of Restoration</th>
<th>Rating*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wear</td>
<td>Class I</td>
<td>A-353 (89.8%), B-11 (2.8%), C-29 (7.4%)</td>
</tr>
<tr>
<td></td>
<td>Class II</td>
<td>A-349 (86.0%), B-30 (7.4%), C-27 (6.6%)</td>
</tr>
<tr>
<td></td>
<td>Class III</td>
<td>A-15 (100%)</td>
</tr>
<tr>
<td></td>
<td>Class V</td>
<td>A-50 (100%)</td>
</tr>
<tr>
<td>Marginal Integrity</td>
<td>Class I</td>
<td>A-353 (89.8%), B-11 (2.8%), C-29 (7.4%)</td>
</tr>
<tr>
<td></td>
<td>Class II</td>
<td>A-349 (86.0%), B-30 (7.4%), C-27 (6.6%)</td>
</tr>
<tr>
<td></td>
<td>Class III</td>
<td>A-15 (100%)</td>
</tr>
<tr>
<td></td>
<td>Class V</td>
<td>A-49 (98.0%), B-0 (0%), C-1 (2.0%)</td>
</tr>
<tr>
<td>Axial Contour</td>
<td>Class I</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Class II</td>
<td>A-349 (86.0%), B-30 (7.4%), C-27 (6.6%)</td>
</tr>
<tr>
<td></td>
<td>Class III</td>
<td>A-15 (100%)</td>
</tr>
<tr>
<td></td>
<td>Class V</td>
<td>NA</td>
</tr>
<tr>
<td>Secondary Caries</td>
<td>Class I</td>
<td>A-393 (100%)</td>
</tr>
<tr>
<td></td>
<td>Class II</td>
<td>A-405 (99.8%), C-1 (0.2%)</td>
</tr>
<tr>
<td></td>
<td>Class III</td>
<td>A-15 (100%)</td>
</tr>
<tr>
<td></td>
<td>Class V</td>
<td>A-50 (100%)</td>
</tr>
</tbody>
</table>

* Ratings were as follows: Alfa, or A, clinically ideal; Bravo, or B, clinically acceptable; Charlie, or C, clinically unacceptable.36
CARIOLOGY

Deminerlization Inhibition and Remineralizing Effects of Fluoride Releasing Materials
COMPOMER

Dyract®
(L.D. Caulk/Dentsply)
Compoglass®
(Vivadent/Ivoclar)
Hytac®
(ESPE)
Compoglass®

Vivadent
COMPOMER

Composition:
- Aluminum fluorosilicate glass
- Dicarboxylic acid with curable double bonds.
- Photoinitiator
- Monomers with free double bonds

Curing reaction:
- Radical polymerization (composite reaction)
- Acid-base reaction (glass ionomer reaction)
Compoglass Composition (1.0g)

- Propoxylated Bis-GMA: 0.03g, 0.2g, 20%
- Urethane dimethacrylate: 0.07g
- Tetraethyleneglycol dimethacrylate: 0.04g, 0.06g, 30%
- Cycloaliphatic dicarboxylic acid dimethacrylate: 0.06g, of 0.2g
- Silanized spheroidal mixed oxides: 0.06g
- Ytterbium trifluoride: 0.10g, 0.8g, 80%
- Silanized Ba-fluorosilicate glass: 0.63g
- Initiators, stabilizers, pigments: 0.01g
Compoglass SCA

- Methacrylate-modified polyacrylic acid 0.06g
- HEMA 0.44g
- Water 0.45g
- Maleic acid 0.03g
- Initiators, catalysts, stabilizers 0.02g
Compomers

Etch VS. No Etch

Why?
Why Not?
Dyract AP
(Caulk/Dentsply)
Compoglass F
(Vivadent/Ivoclar)
Dyract (Dentsply)

THREE-YEAR RESULTS
The dental literature supports:

1. The use of tooth-bonding adhesives, when used according to the manufacturer’s instructions sometimes unique for each product, as being effective in primary and permanent teeth in enhancing enamel-dentin tooth structure preservation, minimizing microleakage and reducing sensitivity.
Smear Layer
Contemporary Dentin Bonding

1. Hydroxyethyl Methacrylate (HEMA)
2. 4-Methacryloxyethyl Trimellitic Anhydride (4-META)
Prepared Dentin
Conditioning and/or Primer Components to Alter or Remove Smear Layer for Mechanical and Chemical Retention
CONDITIONER (Etchant)
10% Phosphoric Acid (15 sec.)
- Dehydrating Agents
  - Aldehyde
  - Acetone
  - Alcohol
Scotchbond® Multi-Purpose (3M)
Scotchbond Multipurpose Adhesive (Dry Technique)
Scotchbond Multipurpose Adhesive (Wet Technique)
Contemporary Light
Cured Primers
ONE-STEP® (Bisco)
Self-Etching Primers
Advantages
No concerns on how wet or dry
Low postoperative sensitivity
Disadvantages

Low bond strength to sclerotic dentin
Low bond strength to sound enamel
Long-term weakens over time
Minimal etch depth
Poor bond to self or dual cure composite
Self-Etch Adhesives

RESIN-BASED COMPOSITE

For all resin-based composite restorations, teeth must be adequately isolated to prevent saliva contamination. The dental literature supports the use of highly filled resin-based composite in the following situations:

1. Small pit and fissure caries where conservative preventive resin restorations are indicated in both the primary and permanent dentition;
2. Occlusal surface caries extending into dentin;
3. Class II restorations in primary teeth that do not extend beyond the proximal line angles.
4. Class II restorations in permanent teeth that extend approximately one-third to one-half the buccolingual intercuspal width of the tooth;
5. Class V restorations in primary and permanent teeth;
6. Class III restorations in primary and permanent teeth;
7. Class IV restorations in primary and permanent teeth;
8. Strip crowns in the primary and permanent dentitions.
“PREVENTIVE RESIN RESTORATION”

R.J. Simonsen, 1977
“PROPHYLACTIC ODONTOTOMY”
T.P. Hyatt, 1923
Clinical Studies (3 Years)

<table>
<thead>
<tr>
<th>Study</th>
<th>Restorations Placed</th>
<th>Caries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Houpt, et al. (1985)</td>
<td>273 Delton</td>
<td>10 (4%)</td>
</tr>
<tr>
<td>Simonsen (1980)</td>
<td>232 Concise</td>
<td>0</td>
</tr>
</tbody>
</table>
CLASS II
PREPARATION DESIGN

- Occlusal Bevel (0.5 - 1.0 mm)
- External Bevel on Proximal-Cavosurface Margin
- Rounded Axial-Pulpal Line Angles
- Rounded Internal Line Angles
- Proximal External Bevel
- Gingival Bevel
FILTEK™ Z 250 (3M)

Cross-section SEMs

Filtek Z250 Restorative

Z100 Restorative
Z100 Resin

- bis-GMA
- TEGDMA molecular weight 286
- Bis-GMA molecular weight 512
POSTERIOR COMPOSITE RESIN POLYMERIZATION SHRINKAGE
Shrinkage

D. C. Watts and J. A. Cash,
Polymerization Shrinkage

- Incremental filling reduces stress
- Bond strengths of > 18 MPa (MPa = 150 psi) needed to overcome polymerization shrinkage stress
- Less material, less shrinkage, therefore a base (GIC/RMGIC) reduces shrinkage stress
- Resins vary in polymerization shrinkage (2.5%-6%), lower filled resins shrinking more
Polymerization Shrinkage Reduction

Traditional

- Placement of bases/liners to limit amount of resin composite
- Incremental placement of resin composite
- Initial low intensity light then high intensity light for slower polymerization allowing plastic deformation (flow) to compensate for shrinkage.
Contemporary

- High level of fillers (nanofillers) lowering the resin matrix fraction
- Replacement traditional monomers with larger molecular weight monomers to have fewer double bonds, leading to less shrinkage
- Addition of silorane monomer where molecular rings are cleaved open to gain space which counteracts volume shrinkage.
BULK FILL RESIN-BASED COMPOSITES

- Frequently nanofilled
- Low shrinkage resin
- Polymerization depth up to 5 mm
# FLOWABLE COMPOSITES

<table>
<thead>
<tr>
<th>Product – Company</th>
<th>Filler Content %</th>
<th>Fluoride</th>
<th>Compressive Strength (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aeliteflo-Bisco</td>
<td>60</td>
<td>No</td>
<td>288</td>
</tr>
<tr>
<td>Versaflo-Centrix</td>
<td>63</td>
<td>Yes</td>
<td>220</td>
</tr>
<tr>
<td>Crystal Confi-Dental – Essence Products</td>
<td>64</td>
<td>Yes</td>
<td>225</td>
</tr>
<tr>
<td>Star Flow – Danville, Engineering</td>
<td>61</td>
<td>Yes</td>
<td>380</td>
</tr>
<tr>
<td>Flo Restore – Den-Mat</td>
<td>?</td>
<td>Yes</td>
<td>?</td>
</tr>
<tr>
<td>True-Look – Denpac Fivestars</td>
<td>70.5</td>
<td>Yes</td>
<td>254</td>
</tr>
<tr>
<td>Durafil Flow – Kulzer</td>
<td>46</td>
<td>No</td>
<td>400</td>
</tr>
<tr>
<td>Tetric-Flow – Ivoclar</td>
<td>68</td>
<td>Yes</td>
<td>230</td>
</tr>
<tr>
<td>Flow-It – Jeneric/Pentron</td>
<td>75.5</td>
<td>Yes</td>
<td>250</td>
</tr>
<tr>
<td>Revolution – Kerr</td>
<td>55</td>
<td>No</td>
<td>290</td>
</tr>
</tbody>
</table>

From Dentistry Today, April 1997.
CONDENSABLE RESIN
CONDENSABLE?
PACKABLE?
SCULPTABLE?
Solitaire
Kulzer
Solitaire Wear – 6 Months

Premolars  187µm
Molars      292µm

\textit{J Dent Res 77(A)237 (Abst. #1051)}
CLASS III and
CLASS IV
Bases and Liners
4-YEARS
STRIP CROWNS
Composite Restorative
Physical Properties similar to Natural Tooth Structure

Equilibrium of diffusion and absorbance of Calcium, Phosphate and Fluoride

Provides great strength, fracture resistance and moisture tolerability
AMALGAM

Despite existing controversy, the dental literature supports the safety and efficacy of dental amalgam in all segments of the population. The dental literature supports the use of dental amalgam in the following situations:

1. Class I restorations in primary and permanent teeth;
2. Two-surface Class II restorations in primary molars where the preparation does not extend beyond the proximal line angles;
3. Class II restorations in permanent molars and premolars;
4. Class V restorations in primary and permanent posterior teeth.
The findings from this systematic review support the use of stainless steel crowns in the following situations:

1. Primary molars that have caries lesions, in children at high risk, may be treated with stainless steel crowns.
2. Children with extensive decay, large lesions or multiple surface lesions in primary molars should be treated with stainless steel crowns.
3. Strong consideration should be given to the use of stainless steel crowns in children who require general anesthesia for restorative dental care.
4. There is evidence from case reports and one randomized controlled trial supporting the use of preformed metal crowns in permanent teeth as a semi-permanent restoration for the treatment of severe enamel defects or teeth with gross caries.
INDICATIONS

♦ Multiple surfaces decayed
♦ Pulpal involvement
♦ Preparation extends beyond line angles
♦ Risk Assessment (high)
HYPOPLASTIC ENAMEL
RESIN FACED STAINLESS STEEL CROWN
ZIRCONIA CROWNS
ANTERIOR ZIRCONIA CROWNS

65 (97%) of 67 SSCs placed with the Hall Technique (mean observation time 15 mos.) and 110 (94%) of 117 SSCs placed conventionally (mean observation time 53 mos.) were successful, with no significant difference in success (p<0.05).
DECIDING FACTORS

1. ISOLATION
2. RISK ASSESSMENT
3. PREPARATION EXTENT
4. LONGEVITY
Prepare Tooth (Primary)

Class III
- Isolate
  - Resin Composite*
- Not Isolate
  - GIC

Class IV
- Isolate
  - Strip Crown*
- Not Isolate
  - SSC

Class V
- Isolate
  - Resin Composite*
- Not Isolate
  - GIC

*Glass Ionomer base over exposed dentin
Prepare Tooth (Primary)

Class I
- Isolate
  - Resin Composite*
  - GIC or Amalgam
- Not Isolate

Class II (not beyond line angle)
- Isolate
  - Resin Composite*
  - GIC or Amalgam
- Not Isolate
  - SSC

Class II (beyond line angle)
- SSC

Pulp Exposure
- SSC

*Glass Ionomer base over exposed dentin
Prepare Tooth (Permanent)

Class III
- Isolate
  - Resin Composite*
- Not Isolate
  - GIC

Class IV
- Isolate
  - Resin Composite*
- Not Isolate
  - Reposition
  - Resin Composite* or Crown

Class V
- Isolate
  - Resin Composite*
- Not Isolate
  - GIC

*Glass Ionomer base over exposed dentin or dentin bonding system
Prepare Tooth (Permanent)

Class I
- Isolate
  - Resin Composite*
  - Amalgam
- Not Isolate
  - Resin Composite*
  - Amalgam

Class II
- (not beyond line angle)
  - Isolate
    - Resin Composite*
  - Not Isolate
    - Amalgam

Class II
- (beyond line angle)
  - Amalgam or Inlay/Onlay or Crown

*Glass Ionomer base over exposed dentin or dentin bonding system
THANK YOU!