Restorative Dentistry FAGD Review 2013

Overview

Study Materials
Operative Dentistry Handout
AGD Review Materials
Fundamentals of Operative Dentistry
(Summit/Robbins/Schwartz)
Esthetic Dentistry Texts/Journals
Prosthodontics Texts

Dental Caries
Critical pH
Enamel = 5.5
Dentin = 6.5

Below this pH:
Hydroxyapatite is driven into solution
Net result is demineralization

Critical organism: S mutans

Caries Diagnosis: Traditional Methods
Visual
Tactile
Radiographic
Transillumination

Caries Diagnosis: Newer Methods
Caries disclosing agents
Elective tooth separation
Digital radiography
Qualitative Laser Fluorescence

Quantitative Light-induced (or Laser-) Fluorescence (QLF)
Light source may be visible light or laser diode
Viable for pit and fissures/occlusal caries only
Example: Diagnodent® (Kavo)

KaVo Diagnodent (QLF)
Recognizes pathological changes at early stage
Initial lesions, demineralization, etc.
Laser diode provides pulsed light onto tooth (655nm)
Healthy tooth structure: no fluorescence
Carious tooth structure: fluorescence ∝ extent of caries

KaVo Diagnodent (QLF)
9 receptors in the handpiece tip read the light transmitted back from the tooth
Translated into an acoustic signal and quantitative output indicative of caries depth
Numeric outputs >30: caries has reached dentin

Manufacturer careful not to tie treatment recommendations to the numbers

What about management of incipient lesions in the low or moderate risk patient?

A Remineralization Protocol
Duraflor® varnish application each visit
OHI to include use of fluoridated toothpaste/rinse
Dietary Counseling
Xylitol gum
Digital or conventional radiographic monitoring
Monitor closely with other diagnostic techniques

Cracked Tooth Syndrome

Symptoms
Pain on chewing, pressure
pathognomonic- pain on release
Sensitivity to cold, heat, sweets
Diagnosis
- Masticatory test - Tooth Slooth
- Stain
- Transillumination
- Periodontal probing

Cracked Tooth Syndrome
Evaluation
- Locate the fracture
- Evaluate the pulp/periodontium

Immediate treatment
- Ortho band, reduce/round off cusp, remove cusp, sedative restoration, bonded restoration?

Definitive Treatment
- Complex amalgam, partial/full coverage cast restoration

Biologic Width
- Connective tissue attachment = 1.07 mm
- Epithelial attachment = 0.97 mm
- Sulcus = 0.7 mm

Maynard and Wilson (1979)
- If impinged on:
  - Marginal tissue recession
  - Apical migration of attachment

Pulpal Considerations
Primary Dentin
- Forms before eruption
- Forms most of teeth
- Regularly arranged dentinal tubules
  - 1 micron wide at DEJ
  - 5 microns wide at pulp
  - 35,000/mm² at DEJ
  - 75,000/mm² at pulp

Secondary Dentin
- Forms after eruption
- Forms from very mild stimulus
  - Normal occlusion
- Uneven deposition
  - Floor
  - Roof of chamber

Tertiary Dentin
- AKA Reparative Dentin
- Forms in response to an insult
- Odontoblasts killed and replaced by mesenchymal cells
- Disorganized tubules
- Decreases dentin permeability
  - Increases protection
- 1.5-3.5μ/day

Sealers/Liners/Bases
Cavity Sealers 2-5μm
- Varnishes
- DBAs
Cavity Liners < 0.5mm
- Resins in thin layers
  - RMGI, GI,
  - CaOH
Cavity Bases >0.5mm
- RMGI
- ZnPO₄
ZOE
Minimum Basing Concept
Use minimum thickness necessary
0.5 - 0.75 mm under amalgam
Minimize extent of liner/base
Do not base to “ideal” outline
Function
Reduce bulk of “shrinking” materials
Block out undercuts
Choose high MOE material under amalgam
Cavity Preparation
Conservative Class II Restorations
From extension for prevention to ...prevention of extension or ...constriction with conviction
   Bottom line: Restoration size no larger than necessary for caries removal and to provide adequate retention and resistance
Goals of the Conservative Preparation
Conservative preparation (prevention of extension)
   Minimal loss of sound tooth structure
   Maintain tooth strength
Restoration strength increased
   Smaller condenser size (amalgam)
   Occlusal contacts not on margins
Modern Cavity Preparation Principles
Narrow occlusal outline (or none)
Rounded internal line angles
Beveled axio-pulpal line angle
Sharp axio-gingival
"S" or reverse curve
Proximal B-L walls converge occlusally
Amalgam
GV Black Formula
72.5% Silver
27.5% Tin
Mix with Mercury
ANSI/ADA SPEC. #1
   Compressive strength 1 hr 80 Mpa(11,600psi)
   Creep- maximum 3%
   Dimensional Change +/- 20 um/cm
Amalgam Chemistry
Amalgam is an alloy of metal and mercury
Hg %
   lathe cut 54%
   Unicompositional High copper 43%

40% Silver
20-30% Tin
3-13% Copper
0-2% Zinc
0-1% Others
   Palladium
   Indium
   Gallium
Amalgam Classification
   Lathe cut irregular filings
   Spherical round particles
   Admixed lathe cut and spherical
Setting Reaction

Low Copper Amalgam

Ag₃Sn(γ) + Hg → Ag₂Hg₃(γ₁) + Sn₇-8Hg(γ₂) + Ag₃Sn(γ)

Gamma (γ) strongest, greatest strength, least creep

Gamma₁(γ₁) 2nd strongest, least corrosive

Gamma₂(γ₂) weakest, most corrosive

High Copper Amalgam

Setting Reaction

Ag+Sn+Cu+Hg → Ag₃Sn+Ag₃Hg₃+Cu₆Sn₅
+Cu₆Sn₅+Ag/Sn/Cu (gamma+ gamma₁+ eta)

Etaprevents Gamma 2 formation

High Copper

Why no gamma-2?

Tin is drawn to surface of Ag/Cu sphere

Tin (Sn) reacts with Cu easier than with Hg, SnCu formed instead of SnHg (gamma-2)

Tin is unavailable to form gamma-2 phase (Sn₅Hg)

12% Cu

Amalgam

Low copper amalgam (<12%) associated with increased creep

High copper amalgams are the standard

Advantages

Low microleakage

Strength

Ease of use

Cost

Less susceptible to water

Track record of clinical success

Amalgam

Disadvantages

Esthetics

Mechanical retention

Preparations more extensive

Thermal conductivity

Representative Types of Amalgam

DISPERALLOY:

High-copper (12% or >) admix lathe-cut with eutectic spheres (ALE)

Easier to obtain contact with adjacent tooth

Large amalgam condensers used

TYTIN:

High-copper, Single compositional spherical

Less Hg than lathe cut or admix

More difficult to obtain contact

Smaller amalgam condensers used

High early compressive strength

VALIANT PhD

High-copper, Admixed lathe-cut, single-compositional spherical

Know the clinical advantages/liabilities of what you use…

Pins: Indications

Extensive loss of tooth structure

Insufficient coronal dentin remaining to provide retention

Sufficient occluso-gingival height (4 mm)

Disadvantages

Weakens amalgam

Pulp/periodontal perforation
Cracking/crazing of tooth structure
Corrosion
Slippage
Extra armamentarium needed
Complications during placement

Preparation
Place ≥ 0.5 - 1.0 mm from DEJ
Allow for amalgam condensation
Place starter hole
Parallel external surface
Drill to appropriate length
Prepare 1.0 mm at a time
Rule of Two’s

Amalgapins/Slots: Advantages
- Rapidly placed
- No additional armamentarium
- Reduced chance of perforation
- No stress on the dentin
- Does not weaken amalgam/tooth
- Added occlusal reduction not required
- Less traumatic to the pulp

Amalgapins/Slots: Disadvantages
- Susceptible to early fracture
- Greater thickness of dentin necessary
- Risk of inadequate condensation, voids
- Decreased tensile strength

Amalgapins/Slots: Indications
- Extensive loss of tooth structure
- Insufficient coronal dentin remaining
- Short clinical crowns
- Minimal occlusogingival height
- Young permanent molars, large pulp spaces

Amalgapins: Technique
- Round nosed bur (1156, 1157, 1158, 330)
- Prepared in dentin
- Chamber 1.0 - 2.0 mm deep, 1.0 mm wide
- Bevel at cavosurface margin
- Parallel external surface of tooth

Slots: Technique
- Inverted cone bur (33 1/2, 34, 35)
- Place in dentin
- Follow contour of DEJ
- Channel 0.5 - 1.0 mm deep by 0.75 mm wide

Amalgam Bonding: Postulated Advantages
Gwinnett 1993
- Conservation of tooth structure
- Added retention
- Tooth reinforcement
- Better marginal adaptation
- Reduced microleakage
- Decreased postoperative sensitivity
- Reduced secondary caries

Bonded Amalgams: Disadvantages
- Expense
- Technique sensitive
- Caution: effect of bond over time
Decreased post-op sensitivity overstated

Amalgam Bonding

Amalgam composition is important:

Diefenderfer (1997) increased shear bond strength when he used a spherical amalgam + adhesive for amalgam repair materials

Composition of adhesive important

Bagley, Wakefield, & Robbins - found a trend toward higher bond strengths using filled adhesive systems

AmalgamBond Plus (HPA)
All Bond 2 + Resinomer
SBMP Plus
Optibond

Bonded Amalgams: Conclusions

Impressive 6 years results (Summitt et al, 2001)
Numerous studies indicate decreased microleakage
Claims of decreased sensitivity not supported by literature
May be of value as retentive adjunct (core build-ups)

Long term benefit:

- Diminished by cyclic loading
- Possibly subject to hydrolysis

Technique must be meticulous

Restoration Repair vs. Replacement

Significant increase in surface area if restoration replaced
Potential for damage of adjacent teeth

Tailor the decision based on:
- Caries risk status
- Size and location of the defect
- Access

Ditched Amalgam Repair

Poor correlation between marginal ditching and secondary caries (Merrett and Elderton, 1984)
Clinical or radiographic detection of caries should drive replacement

Amalgams are generally better than they look!

Ditched Amalgam Repair

Repair if indicated
Air abrasion of alloy surface
Etch/prime/bond with DBA

Can’t ensure dry surface under a ditched margin
so use hydrophillic primer

Flowable composite or sealant for repair

Roberts et al 2000

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Esthetic Restorative Continuum

- Conventional Glass Ionomers
- RMGI Resin-Modified Glass Ionomers
- COMPONENTERS Polysaccharide-Modified Composite Resins
- Resin-Based Composite

↑ Fluoride Release
↑ Coefficient of Thermal Expansion (COE)
↑ Translucency
↑ Tensile Strength
↑ Fracture Toughness

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Esthetic Restorative Continuum

Composites:
Composition
- Resin (matrix phase) - UDMA/Bis-GMA/TEGDMA
- Dispersed phase (fillers)
  - Inorganic - Quartz, Silica, Zirconium Silicate, etc
  - Organic - ground microfill
Cured by free radical polymerization
Coupling phase - silane adheres particles to matrix
Resin adhesive chemically links (polymerizes) to resin matrix

Particle Size

Microfills
- Better esthetics and polishability
- Tiny particles
  - 0.04 micron colloidal silica
  - Increases viscosity
- Increase filler loading
  - Filler added to resin
  - Heat cured
  - Ground to large particles
  - Remixed with more resin and filler
  - More difficult to repair

Hybrids
- Popular as “all-purpose”
- 0.6 to 1 micron average particle size
  - Distribution of particle sizes
  - Maximizes filler loading
  - Microfills added
  - Improve handling
  - Reduce stickiness

Newer Classification System
Based on particle size
- Megafill
  - 0.5 - 2 millimeters
- Macrofill
  - 10 - 100 microns
- Midfill
  - 1 - 10 microns
- Minifill
  - 0.1 - 1 microns
- Microfill
  - 0.01 - 0.1 microns
- Nanofill
  - 0.005-0.01 microns

Most new systems
- Minifillers

Newest trend
- Nanofillers
- Trimodal loading
  - Prepolymerized

Hybrid RBC
Filler
- Glass/quartz, 1-10 μ (80+%)”
- Colloidal silica, .04 μ (10 - 20%)
- 50 - 88% filled by wt
- 40 - 70% filled by vol
Hybrid RBC
Herculite XRV
Prodigy
Z-100
Filtek Z-250
Aelite-fil
Tetric Ceram (ceromer)
Prisma TPH
Charisma
Charisma F
Clearfil AP-X
Pertac Hybrid
Marathon

Clinical Considerations: Hybrid RBC
Pro
Good esthetics, reasonable polishability
Good physical properties
Low CTE, low shrinkage, strong

Con
Higher MOE than microfill (possible implications for “abfractions”)
Less flexible

Uses
Suitable for class 1,2,3,4,5

Microfills
Epic-TMPT
Heliomolar
Silux Plus
Filtek A110
Renamel

Properties of Latest-Generation Microfills
Very smooth finish, excellent esthetics
Poor lab behavior, good clinical behavior
Higher coefficient of thermal expansion than hybrids
May show greater water sorption over time
MOE may actually improve performance in Class V’s (abfraction?)

Micro-Hybrids
Average particle size is 0.4 \( \mu \) m
An attempt to have the “best of both worlds”
Layered, anatomical build-up advocated for maximum esthetics
Examples:
Point-4 (Kerr)
Esthet-X (Caulk)
Synergy (Coltene/Whaledent)
Apollo (DMD)
Vitalescence (Ultradent)
Renew (Bisco)

Flowable Composites
The concept:
Higher resin content
Less viscosity
Better adaptation to cavity walls
Shock absorption through gasket effect

Flowable Composites
Pro
Flow easily
Elastic modulus permits flex and flow which may absorb stresses (Think class V)
Con
   More resin, less filler and all the downsides
   Questionable ability to withstand high stress and wear
   Flowability = runny, difficult to control
Bottom Line: Minimal data to support use in Class II boxes; Better margins, less leakage have not been demonstrated
“Condensable” or “Packable” Composites
The concept:
   Highly loaded RBCs with irregularly shaped particles
   Attempt to create a material that “handles like amalgam”
   Goals: improved handling and physical properties
Condensable is inaccurate
   Implies loss of volume
“Packable” is best descriptive term
“Packable” Composites
   Alert (Jeneric/Pentron)
   Solitaire (Heraeus Kulzer)
   SureFil (Densply Caulk)
   Pyramid (Bisco)
   Prodigy Condensable (Kerr)
   Filtek P60 (3M)
Packable Composites
   No improvements in physical properties
   Some handling characteristics improved using higher molecular weight monomers and different filler combinations
   Most hybrid/ micro-hybrid composites perform well in appropriate posterior applications
Marketing driven sales
   Amalgam replacement?
   More than 50% of general dentists employ the use of a composite specifically marketed for posterior use
Packable Composites
   High viscosity (low flow) = potential voids
   Initial increment at base of box, but also between increments
   Some suggest flowable as first increment in box
Jury still out on:
   Wear (significant problem with some)
   Fluoride release (unlikely significant)
   Long term surface smoothness
Clinical studies underway
   Superior clinical results have not been demonstrated
Enamel Etching Potpourri
   Clean surface: pumice preferred
      F doesn’t affect etch but avoid glycerin in prophy paste
   15-20 seconds adequate according to literature
      Frosty appearance good guide; over-etching bad (insoluble Ca ppt)
   Rinse: 20 seconds enough to remove surface precipitate
   Gel and liquid both effective
   Effective etch about 10 microns deep, beyond is a waste
   Cohesive strength of resin weak link
Problems with Dentin
   Character of dentin differs with depth or region
      Deeper dentin tubules larger, more numerous
      Reduced surface area for bonding
Dentin dynamic, wet substrate
   Tubule fluid - slight, constant outward pressure
   70% inorganic (hydroxyapatite), 20% organic (collagen, etc),
   10% H2O
Smear layer (1-5 μm)
   Debris/preparation by-products
Bonding to Dentin
Relies on three actions
- Etching (Conditioning) the dentin surface
- Development of resin impregnated hybrid layer
- Bonding composite to the hybridized dentin

Etching the Dentin Surface
Conditioner usually weak acid
- 37% H₃PO₄
  - May be combined with “primer”
Removes smear layer and tubule plugs
Demineralizes peri- and inter-tubular dentin
Increases dentin permeability
Leaves behind “mesh” of collagen
  - Excessive desiccation collapses this network and precludes resin penetration

Formation of Hybrid Zone
Hydrophilic, low viscosity “primer” applied
- Infiltrates collagen network to form union with dentin surface
  - May penetrate tubules (little to no benefit to bond strength)

Clinical Relevance
Adhesive placed
- Avoid excessive thinning of adhesive
  - O₂ Inhibition will prevent polymerization
Need at least 20 μm thick
Optimal 75-100 μm
Resin should “ripple” when thinned: if not, it is excessively thinned
Thicker adhesive layer serves as “elastic lining” serves as stress relief from shrinkage
  - Feilzer, 1997 Adhesion Symposium

Clinical Relevance
Follow manufacturer’s directions!
- Time & application techniques important
  - Will vary with system & generation
Do not routinely mix conditioners & primers from different systems
Keep DBA bottles clean!
  - Resins category #3 for hypersensitivity/allergic rxn
  - DBAs can penetrate latex gloves 6 seconds

Composite Surface Sealing
Penetrates microcracks, irregularities
Seals tooth-restoration interface
Enhances longevity of restoration (Leinfelder)

Technique
- Cure, etch accessible margins, dry
- Low viscosity bonding agent, cure
  - Fortify, Optiguard, Permaseal, Protect-it

Posterior Composites
Advantages
  - Esthetics
    - It’s not amalgam
    - environmental issues
    - “toxicity”
  - Non-conductive
  - Conservative preparation
Disadvantages
- Polymerization shrinkage
- Marginal leakage
- Secondary caries
- Post-op sensitivity
- Technique sensitivity
- Wear resistance

Polymerization Stress and Shrinkage
- All resin based composites shrink upon curing
- Polymerization shrinkage places stress on enamel and dentin bonds
- Resin shrinks towards the center of the mass of material, “pulling” on the walls as it shrinks
- The configuration of the cavity preparation is important to consider

Posterior Composites
- More disadvantages
- Interproximal contacts difficult
- Physical properties poorer than amalgam
- Water sorption
- Depth of cure?
- Lack of foolproof DBA
- Technique sensitive!

Posterior Composites: Indications
- Critical esthetics
- Conservative prep feasible
  - occlusal outline narrow
  - gingival margin in enamel
  - centric stops on tooth structure
- Not an area of excessive occlusal wear

Posterior Composite: Contraindications
- High caries risk
- Extensive preparations
- Heavy occlusal function
- Lack of enamel
- Subgingival extension
- Isolation inadequate

Technique
- Conservative, adhesive preparation
  - Rounded internal line angles
  - Occlusal width 1/3 intercuspal distance
  - Avoid centric stop

Proximal box
- Retention grooves may be beneficial
- Gingival margin in enamel if possible

Bevels - Current Thoughts
- Don’t bevel occlusal
- Consider bevel of F and L margins of boxes
  - improves access to enamel rod ends
  - improves access for finishing
- Bevel gingival wall only if abundant enamel

Matrix Application
- Metal bands acceptable
  - Should be thin (0.0010”) and pliable
  - Burnish against contact
  - Use with conventional tofflemire
- Clear bands OK but:
  - Thicker, non-burnishable
Strong memory
High cost

Wedging
Wooden wedges preferable
Slight compression holds gingival margin tightly
Secure
Inexpensive
Clear wedges (e.g. Premier Cure-Thru®)
No resiliency
Quite expensive
Enhancement of cure unproven

Proximal Problems
Difficult to establish contact
Composite is not condensable
Some matrix systems aggravate situation
Proximal contours often not ideal
Finishing procedures can open contact
Wear can complicate matters
Results in flat surface

Proximal Solutions
Pre-wedge, proper matrix
Careful interproximal finishing
Pre-polymerized pellet
Ceramic insert
Condensable/Packable Composites
Belvedere Composite Contact Former
Curing tip (Denbur)
Segmental Matrices with Bitine ring

Gingival Margin Problems
Lack of enamel
Moisture control difficult
Bonding system manipulation challenging
Poor access
Curing “chancy”
Finishing difficult
Longevity of bond to cementum suspect

Posterior Composite Sandwich
Particularly indicated when no enamel at margin
RMGI fill apical to contact
Resin based composite coronal to contact
Decreased microleakage
Allows stress relaxation
Decreases bulk of composite
Predictable dentin bond

Burgess, et. al. Compend Cont Ed Dent 1996; 17: 731-748

Sandwich Technique
Advantages
Chemical bond to dentin
Chemical bond to resin
Anticariogenic effects
Volume reduction of resin
Elastic bonding layer

Light Curing
Most Common Lights = Quartz Tungsten Halogen!
Light intensity = mW/cm²
Conventional curing = 400-500 mW/cm².  
   Note increase from standard 300mW/cm² of 5 years ago
Why the interest?  
   Time savings, high-tech bragging rites
Radiometer Readings
Think about meaning of numbers!  
   Light tip diameter should approximate diode  
   Barghi, et. al. J Dent Res 1995; (abstr 152)  
   Large tip : diode overstates the output  
Demetron guidelines  
   > 300 is OK- 400-500 has become the standard  
   200 - 300 requires longer curing time (but OK)  
   < 200 a problem
Light Curing
New Curing Techniques  
   High intensity and Multi-mode curing  
   High intensity  
      Lasers  
      Plasma arc (PAC) lights  
   Newer lights will offer multi-mode (variable intensity) curing  
      Designed to allow stress relief before final set
Problems of High Intensity  
   Don’t cure to the advertised depth (< 3mm)  
   Wavelengths too focused  
      Photoinitiators in different materials may not be sensitive in narrow range  
   Generate high internal polymerization forces  
   May form shorter polymer chains (thus poorer physical properties)  
   Expensive
Multi-mode Curing  
   Continuous vs Discontinuous  
      “Soft Start” (pulse delayed)  
      Short burst, delay, final cure  
      Extends visco-elastic stage of resin curing  
      Often used as generic term  
      Specifically refers to discontinuous method  
      No solid science to prove efficacy
Light Curing: LED  
   Light Emitting Diode  
   No bulbs or filaments  
   Doesn’t heat up (as much)  
   More energy efficient  
   Longer life  
   First generation- much lower irradiance in milliwatts  
      <200 mW/cm²  
      Poor performance
Light Curing: LED  
   Second generation  
      600 mW/cm²  
      Very promising  
   Problem: some have narrow spectrum  
      Some materials won’t cure  
      Improving!
Incremental Fill: Do you do this?  
   Enhances completeness of cure  
   May actually increase stress in tooth
Potential for incorporation of voids
Takes time
Microleakage not significantly better, regardless of filling technique
Hilton. Quintessence Int 1997; 28: 135-144

Incremental Fill
- Studied seven techniques with incremental placement of Class II composites
- NONE produced gingival margin free of marginal leakage
- Best outcome with RMGI in box (closed sandwich)
- Flowable comp & condensable had poor performance

Sealant Effectiveness
50% sealant retention (single application) 10-15 years
Effective caries resistance even when majority sealant lost; resin remains in deeper fissure

Indications
- Selected fossa well isolated from another fossa containing restoration
- Incipient caries in pit & fissure confined to enamel
- Occlusal caries on contralateral tooth

How about over caries?
- Carious lesions, diagnosed & undiagnosed at the base of the fissure are arrested by sealants
  (Mertz-Fairhurst, 1986; Handelman 1991)
- Decision to use sealants on known carious lesions “is responsibility of the dentist” ADA Report on Sealants, JADA April 1997

How about with amalgam?
- Pit and fissure sealants in combination with small amalgam restorations
- Non-coalesced pits and fissures around restoration sealed
- Significantly improved marginal integrity

Preventive Resin Restoration Simonsen  Quint Int  1978
- Restore carious lesions with minimum of tooth removal
- Small access for caries removal, RBC, sealant
- Prevent caries from attacking other pits and fissures

Glass Ionomer
Advantages
- Sustained fluoride release/rechargeable
- Biocompatibility
- Adhesion to tooth structure
  - Ionic bonds to tooth mineral
- Coefficient of thermal expansion

Ionic Bond of Glass Ionomer to Dentin

Fluoride Reservoir
Exposure to exogenous fluorides results in a transient rise in F⁻ release (“recharge” phenomenon)

Avoid acidic F formulations - may degrade surface
  - Burgess, 1996

Fluoride Release
- High initial FL release
- Recharged by FL (dentifrice, rinses etc…)
- Sustained release

Conditioning Dentin (GI and RMGI)
- Smear layer removal allows access to dentin surface
- Softens surface to facilitate ion exchange
- Energizes surface for better wetting

Rule of 200
  - Concentration x time = 200
Glass Ionomer Restorations
Dentin Conditioned > Not Etched
Packable GICs (high viscosity)
   Designed for use with "Atraumatic Restorative Treatment" (A.R.T.)
      Pediatric, military, and 3rd world applications
      Minimal instrumentation available
Simplified handling characteristics
   Self-cure (conventional) GIC
      Maintains value as "definitive" restoration
      Must be covered with varnish/resin
Fuji IX, Ketac Molar, HiFi, Hi Dense
Packable GICs
   Fuji IX
      Developed in conjunction with WHO for ART
      Smaller particle size
      Better wear characteristics, faster set
Designated as the default provisional restorative material, replacing IRM, in military contingency operations
Resin-Modified Glass Ionomer
Advantages
   Combines benefits of glass ionomers and composite resin
   Increased working time
   Improved physical properties
   Improved esthetics
   Immediate finishing
   Record of clinical success
Resin-Modified Glass Ionomer
Powder
   Ion-leachable aluminafluorosilicate glass
Liquid
   Water
   HEMA/Bis-GMA
   Polyacid  (may contain photocurable side chains)
      methacrylate groups grafted onto PAA molecule
   Photoinitiator
Net resin content is approximately 5%
Sandwich Technique
   Replace lost dentin with ideal Dentin Replacement - GI
   Replace lost enamel with enamel replacement -Composite
   Eliminates post-op sensitivity from dentin bonding
Open sandwich
Closed sandwich
Compomers: Polyacid Modified Composite Resins
Resin-based composites that contain GI components
   Radiopaque alumino fluoro-silicate glass
   Acidic polymerizable monomers
   Light-curing polymers
   Insufficient GI components for significant acid-base reaction
      Won’t cure w/o light
Examples
   Dyract AP, Compoglass F, Hytac, F 2000
Compomer: Clinical Performance
   “Successful restorative material”
      Despite 190 microns of wear in 1 yr
      Despite decreased color match and marginal integrity
   Burgess (1996): “Little indication for use”
Lower F release than GICs
Physical properties, wear resistance < composite
Growing number of favorable studies (Pedo, etc.)
May be OK for class V restorations