Restorative DentistryFAGD 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
  - DIAGNOdent

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 $\propto$ 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 thelow or moderate risk patient?
A Remineralizaton Protocol
- Duraflor® varnish application each visit
- OHI to include use of fluoridated toothpaste/rinse
- Dietary Counseling
- Xylitol gum
- Digital or conventionalradiographic monitoring
- Monitor closely with otherdiagnostic 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
- Research by Garguilo, *et al* (1961)
    - 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 ConsiderationsPrimary Dentin
- Forms before eruption
- Forms most of teeth
- Regularly arranged dentinal tubules
    - 1 micron wide at DEJ
    - 5 microns wide at pulp
    - 35,000/mm^2 at DEJ
    - 75,000/mm^2 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 preventionto ...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 cutirregular filings
  Sphericalround particles
  Admixedlathe 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
- $Gamma_1(\gamma_1)$ 2nd strongest, least corrosive
- $Gamma_2(\gamma_2)$ weakest, most corrosive

High Copper Amalgam
Setting Reaction
- Ag+Sn+Cu+Hg $Ag_3Sn+Ag_2Hg_3+Cu_6Sn_5$
- $+Cu_6Sn_5$+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 (SN_8Hg)
- 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
- DISPERSALLOY:
  - 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 $\geq$ 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

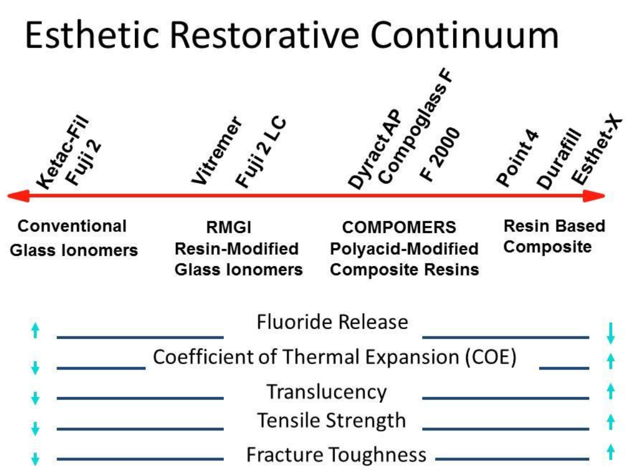
Slots: Technique
- Inverted cone bur (33 1/2, 34, 35)
- Place in dentin
- Follow contour of DEJ
- Channel 0.5 - 1.0 mm deep by 0.75 mm wide

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



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
    - midifill
        - 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 μm
  - 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% H_20
- 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% H_3PO_4
    - 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)
- Formation of Hybrid Zone
  - Primer molecule serves as a link between dentin surface and composite
    - Bifunctional molecule (Example: HEMA)
      - Wets surface, mechanically binds to dentin surface
      - Reacts chemically with methacrylate component of resin
- Clinical Relevance
  - Adhesive placed
  - Avoid excessive thinning of adhesive
    - O_2 Inhibition will prevent polymerization
    - Need at least 20 □ m thick
    - Optimal 75-100 □ m
    - 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 <u>6 seconds</u>
- 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
  - (Summitt, et al. *Quint Int* 1994; 25:251-257)
- 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
    - (Ciamponi, et al. *Quint Int* 1994; 25:599-601)

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/cm^2

- Conventional curing = 400-500 mW/cm$^{2.}$
  - Note increase from standard 300mW /cm^2 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)
  - Leonard, et. al. *Oper Dent* 1999; 1:31-37
- 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/cm^2
  - Poor performance

Light Curing: LED

- Second generation
  - 600 mW/cm^2
  - 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

Versluis, et. al. *J Dent Res* 1996; 75: 871-877
Potential for incorporation of voids
Takes time
Microleakage not significantly better, regardless of filling technique
Hilton. *Quintessence Int* 1997; 28: 135-144
Incremental Fill
Wibowo et al (1999)
Studied seven techniques w/ incremental placement of Class II composites
NONE produced gingival margin free of marginal leakage
Best outcome w/ 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 <u>small</u> 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)
Wistrom, et al. *J Dent Res* 1995; 74: abstr 767
Hatibovic-Kofman. *J Dent Res* 1994; 73: abstr 260
Alvarez & Burgess. *J Dent Res* 1994; 73: abstr 259
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

- 25% PAA x 8 sec

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