Extensive Amalgams

- Indications ○ Caries control ○ Questionable prognosis ○ Foundation/build-up ○ Economics ○ Replacement of restorations ○ Extensive primary caries ○ Unable to obtain isolation	- Disadvantages ○ Difficult to restore occlusion/proximal contours ○ Supplemental retention features required ○ Unpredictable longevity

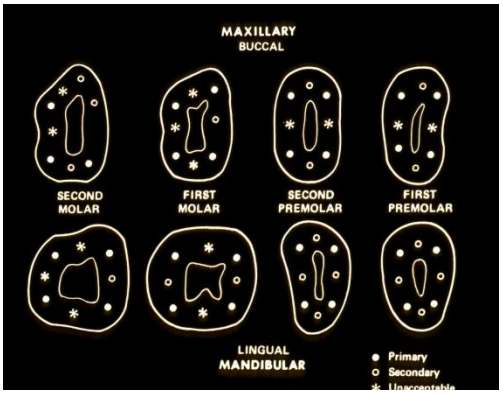
- Principles of Preparation (ORRC-CEC)
  - Outline
  - Resistance
    - Resist fracture of remaining tooth structure
      - Remove unsupported enamel
      - Remove weak cusps
    - Resist fracture of amalgam
      - Bulk of amalgam to resist occlusion
      - Cavity wall orientation perpendicular to occlusal force
  - Retention
    - Opposing axial walls diverge gingiva-occlusally
    - Occlusal walls converge pulpal-occlusally
    - Box form – supplemental on facial/lingual
    - Amalgam slot/pin (need stable matrix band)
    - Dentinal post (need stable matrix band)
    - Pins (increase retion, MAY decrease resistance)
  - Convenience
  - Caries removal
    - Remove decay closest to pulp LAST
  - Enamel margin
  - Clean prep

- Amalgam Selection ○ Blended alloy (dispersalloy) ○ Spherical alloy (tytin) ▪ High early compressive strength <24h ▪ Easier, NOT better, adaptability ▪ Difficult to achieve proximal contact ▪ Gingival overhangs more likely ▪ Less condensation force required	- Amalgam Condensation ○ Condensaire ▪ Less likely to dislodge unstable matrix ▪ Good for large class V preparations

- Matrix application
  - Tofflemire #2 band
  - Tofflemire and shim
  - Copper band
  - “T” band

Threaded Pins

- Indications
  - Inadequate tooth structure to retain amalgam
  - Questionably matrix stability – don't stabilize matrix; are more tolerant of unstable matrix
- Contraindications
  - High risk of pulpal/external perforation
  - Non-vital teeth
- Threaded pins
  - Gold plated self-threading placed in undersized pinhole
  - Convenient to use
  - Variety of sizes and instruments
    - 2 in 1
    - Self-shearing
    - Latch contangle accessories



- Use of Pins
  - Tooth must be large and have adequately think dentin
  - Pin too large = fracture tooth
  - Pin too small = insufficient retention
  - Mn anterior/Mx lateral – dentin too think for large pin
  - Pin should be in dentin – dentin is elastic, enamel is not
    - 0.5mm from DEJ, equidistant between tooth surface and pulp – prevent fracture, pulp perforation
    - Near line angles of tooth – prevent lateral perforation
    - 0.5mm from vertical wall – allow drilling/placement without lateral interference, allow amalgam condensation around pin
    - 2mm deep into dentin occlusally – provides optimal retention-depth
  - 1 pin per missing retentive feature or per cusp, max of 4 pins
    - Must be spaced at least 2mm apart, optimally 5mm apart
    - Too many pins weaken tooth, increase risk of fracture
  - Placement should parallel contour of tooth – prevent lateral perforation
  - Pin covered by 2mm of amalgam occlusally – prevent excessive stress concentration
  - Pin embedded in carved amalgam at least 1mm laterally – allow proper contouring, maximum retention
- Potential Problems
  - Perforate pulp
  - Perforate periodontium
  - Fracture dentin and/or enamel

- Technique
  ○ Slow-speed with latch-type contrangle
  ○ Self-limiting twist drill
  ○ Self-shear pin
  ○ Pin bender (if needed)
	- Pin depths
	  ○ Cemented – 3mm into dentin, 2mm exposed
	  ○ Friction lock – 3mm into dentin, 3mm exposed
	  ○ Threaded – 2mm into dentin, 2mm exposed

Bonding Amalgam

- Indications
  ○ Compromised cusp
  ▪ Wide isthmus
  ▪ Deep pulpal floor
  ▪ Excessive lateral occlusal forces
  ○ Supplemental retention
  ▪ Does not substitute for conventional retention
  ▪ Bond strength ½ composite bonding
  ○ Reduce post-op pulpal sensitivity
	- Contraindications
	  ○ Inadequate isolation
	  ○ Unsupported enamel

- Advantages (in vitro studies)
  ○ Improved retention
  ○ Reinforcement of compromised tooth structure
  ▪ Increase in cuspal flexure of MOD somewhat offset with bonding
  ▪ Bonding does not replace retention form of preparation
  ○ Reduced post-op sensitivity
	- Disadvantages
	  ○ Additional time and expense
	  ○ Highly technique sensitive
	  ○ Inconclusive in vivo results

- Procedure
  - Etch enamel and dentin for 15s, rinse 10s, blot dry excess water
  - Single bond 2x consecutively, dry 2-5s, cure 10s
  - Brush cement onto all cavity prep surfaces (SAVE cement dispensing cap)
  - Condense amalgam before cement sets, clean all instruments before amalgam sets
  - Carve/burnish as per usual

Composite Resin

- Advantages
  ○ Esthetics
  ○ Lesion specific restoration
  ▪ Structural preservation
  ▪ No gross mechanical retention
  ▪ No material requirements
  ○ Low thermal conductivity
  ○ Bonds to enamel and dentin
  ▪ Nearly 100% recover of tooth strength
  ▪ No marginal leakage
  • Staining
  • Secondary caries
  ○ Repairable
	- Disadvantageous
	  ○ Absolute isolation needed
	  ○ Difficult to achieve proximal contact/contour
	  ○ Polymerization shrinkage
	  ▪ Marginal leakage
	  ○ Cost – difficult, time consuming
	  ○ Demanding technique – bonding, placement
	  ○ Resistance by older dentists

- Procedure
  - Wedge both sides of the tooth
  - Proximal clearance should be 0.65-1.00mm (0.30-0.65 for gingival seat)
  - Enhance = darker, finish
  - Pogo = whiter, polish

Direct Composite Extensive Restorations

- 2 milestones in adhesive dentistry
  - Acid-etch technique (1955)
  - First commercial composite resin (1964)
    - Resin matrix
    - Inorganic filler
    - Coupling agent (silane) – bond filler to resin
    - Pigments
    - Polymerization initiators (light or chemical)
- Anterior Restorations
  - Esthetics – different shade for enamel and dentin
    - Optical characteristics of enamel and dentin, such as translucency and fluorescence, make color match very difficult
    - Shades
      - Dentin – more opaque
      - Enamel – more translucent
      - Body – intermediate opacity
  - Translucency (relative amount of light that passes through an object) – degree depends on patient age
    - Dentin = 52.6%
    - Enamel = 70.1%
  - Fluorescence (form of luminescence, absorption of UV and spontaneous emission of visible light in blue spectrum, contributes to VITAL aspect of natural teeth)
  - Central incisor symmetry
  - Characterization – mamelons, incisal halo, crack lines, white spots, etc
  - Surface gloss (finish)
  - Resistance to abrasion more important than resistance to wear

- Shade Matching o Conventional shade guide o Spectrophotometer (electronic shade guide) o Hue = different colors o Chroma = white to specific color (intensity) o Value = white to black (grey scale) o Filtek – only one opacity (body) o Esthet.X – for shade layering, available in enamel AND dentin	- Procedure o Bevel enamel cavo-surface angle o Acid etch 15s, rinse, dry gently o Single bond 15s, air dry o Cure 20s, insert/shape composite, light cure increments of 2mm thickness o Finish, check occlusion
- Matrix Systems o Free hand o Mylar strip/Matrix Band o Custom-made matrix – wax up and putty	- Layering technique o Lingual enamel – transluceny o Dentin – opacity o Buccal enamel – translucency

Pulpal Considerations

- Dentin – a continuous fiber reinforced composite, with the intertubular dentin as the matrix and the cuffs of peritubular dentin forming the cylindrical fiber reinforcement
- Dentin – regarded as a porous biological composite made up of apatite crystal filler particles in a collagen matrix
    - 50% mineral
    - 30% organic
    - 20% water
- Dentinal tubules get larger as you approach the pulp chamber
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- Secondary dentin – secreted after root formation complete, slow rate throughout life
- Reactionary dentin – tertiary dentin matrix secreted by odontoblasts in response to an appropriate stimulus
- Reparative dentin – tertiary dentin matrix secreted by new generation of odontoblast-like cells, after death of original odontoblast

- Smear layer – physical barrier that prevents any material from contacting dentin surface
- Dentin – some morphological features help prevent passage of bacteria and other potential pulp irritants
    - Neutralizes acid – potent buffer system
    - Tubular fluid under constant pressure outward (pulpal pressure)
    - Anatomical area of dentinal tubule > functional area

- Pulp injury from operative procedures
    - Remaining dentin thickness (RDT) – most important factor. Odontoblast injury increases as RDT decreases. Below 0.25mm, odontoblast # decreases 23% and forms minimal reactionary dentin.
        - Deeper cavity preps suppress odontoblasts – less subsequent dentin formation at all time periods
    - Bacterial leakage
        - 1927 – enough evidence to cast doubt on acid theory of pulp irritation under silicate fillings
        - 1965 – in rats, presence or absence of microbial flora major factor in healing of exposed pulps
        - 1987 – in monkeys, so long as surface is sealed (ZOE), filling material doesn't affect pulpal irritation
            - Chemically toxic factors are LESS significant than bacterial leakage in causing pulpal injury
    - Toxic component of dental materials
        - Unpolymerized composite
        - High intensity curing light
            - Longer curing time with low intensity light less toxicity
    - Pressure and speed of handpiece
        - Increase in EITHER speed or pressure can produce significant intrapulpal temp increase over range of 7000-15,000 RPMs and 20-60g
            - Doubling either increases temperature 50% during finishing
    - Cavity dessication
    - Threaded pins
    - Temperature increase (no water cooling)

- Protecting Pulp
    - Deep dentin (<0.5mm RDT) and non-carious pulp exposure (without symptoms of irreversible pulpitis)
        - No base used to cap exposure – persistent inflammation, delayed pulpal healing, failure of dentin bridging seen in human pulp directly exposed to bonding agents
            - Persistent inflammatory reaction and hyaline alteration of ECM inhibited complete pulp repair or dentin bridging
        - Use $Ca(OH)_2$ to cap exposure – after 1 week, odontoblast-like cells organized beneath coagulation necrosis, pulp repair evolved into apparent complete dentin bridging in 60 days
            - $Ca(OH)_2$ liner (ex:// dycal), covered with RMGIC (ex:// vitrebond plus)
            - RMGIC does not cover ALL dentin surface, only the liner
            - Rest of restoration as normal, evaluate at each recall
    - Superficial and middle dentin (>0.5mm RDT)
        - No base needed
        - $Ca(OH)_2$ – not recommended for superficial preparations
            - No therapeutic effect on superficial dentin
            - Weak mechanical properties
                - Low compressive strength, significantly weaker at 90 days than at 24h (as compared to Fuji lining, etc)
                - Dycal bases for amalgams – 50% softened after 1 year, 70% after 5 years
            - Easily dissolved by phosphoric acid
            - Prevents adhesive contact with dentin
            - Adhesive does NOT polymerize if it penetrates beneath $Ca(OH)_2$
    - Carious pulp exposure
        - Start immediate root canal treatment
        - If RCT not possible:
            - Pulpotomy
            - Sterile cotton pellet
            - Temporary restoration ZOE reinforced
            - Refer to endodontics

- Clinical diagnosis
  o Clinical exam
  o Spontaneous symptoms
  o Vitality tests
  o Radiographs
	- Prevention of pulpal complications
	  o Avoid pins
	  o Avoid cavity dessications
	  o Avoid deep cavity preparations
	  o Use materials backed with scientific evidence
	  o Have enamel margins (composites don't prevent micro leakage around dentin margins)
	  o Have absolute isolation
	  o Use abundant water cooling/refridgeration

- All substances can be remedies or poisons depending on dosage and mode of application