# 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 retention, 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
  o Acid-etch technique (1955)
  o First commercial composite resin (1964)
    ▪ Resin matrix
    ▪ Inorganic filler
    ▪ Coupling agent (silane) – bond filler to resin
    ▪ Pigments
    ▪ Polymerization initiators (light or chemical)

- Anterior Restorations
  o 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
  o Translucency (relative amount of light that passes through an object) – degree depends on patient age
    ▪ Dentin = 52.6%
    ▪ Enamel = 70.1%
  o Fluorescence (form of luminescence, absorption of UV and spontaneous emission of visible light in blue spectrum, contributes to VITAL aspect of natural teeth)
  o Central incisor symmetry
  o Characterization – mamelons, incisal halo, crack lines, white spots, etc
  o Surface gloss (finish)
  o Resistance to abrasion more important than resistance to wear

<table>
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<tr>
<th>Shade Matching</th>
<th>Procedure</th>
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<tr>
<td>o Conventional shade guide</td>
<td>o Bevel enamel cavo-surface angle</td>
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<tr>
<td>o Spectrophotometer (electronic shade guide)</td>
<td>o Acid etch 15s, rinse, dry gently</td>
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<tr>
<td>o Hue = different colors</td>
<td>o Single bond 15s, air dry</td>
</tr>
<tr>
<td>o Chroma = white to specific color (intensity)</td>
<td>o Cure 20s, insert/shape composite, light cure</td>
</tr>
<tr>
<td>o Value = white to black (grey scale)</td>
<td>increments of 2mm thickness</td>
</tr>
<tr>
<td>o Filtek – only one opacity (body)</td>
<td>o Finish, check occlusion</td>
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<tr>
<td>o Esthet.X – for shade layering, available in enamel AND dentin</td>
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<th>Matrix Systems</th>
<th>Layering technique</th>
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<tr>
<td>o Free hand</td>
<td>o Lingual enamel – translucency</td>
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<tr>
<td>o Mylar strip/Matrix Band</td>
<td>o Dentin – opacity</td>
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<tr>
<td>o Custom-made matrix – wax up and putty</td>
<td>o Buccal enamel – translucency</td>
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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
    o 50% mineral
    o 30% organic
    o 20% water
- Dentinal tubules get larger as you approach the pulp chamber
- 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
  o Neutralizes acid – potent buffer system
  o Tubular fluid under constant pressure outward (pulpal pressure)
  o 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 pulp 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
  - Clinical exam
  - Spontaneous symptoms
  - Vitality tests
  - Radiographs

- Prevention of pulpal complications
  - Avoid pins
  - Avoid cavity dessications
  - Avoid deep cavity preparations
  - Use materials backed with scientific evidence
  - Have enamel margins (composites don’t prevent micro leakage around dentin margins)
  - Have absolute isolation
  - Use abundant water cooling/refridgeration

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