Restorative Dentistry:  

Amalgam  
Thorough dental hygiene care will include the recognition of restorative materials, the ability to chart restorations, and talk intelligently with the patient and dentist about restorative care.
I. Use

- restoration of Class I, II, V, VI cavities

- core: build-up material prior to crown & bridge fabrication

- retrograde amalgam - filling of apices of roots after apicoectomies

What is the radiopaque object near the apex of this tooth?
Answer:
Pierced nose – jewelry stud.

Return
Why select amalgam as a restorative material?

<table>
<thead>
<tr>
<th>Attributes:</th>
<th>Drawbacks:</th>
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<tr>
<td>• clinical longevity - ↓ % of failures – 15+ yrs</td>
<td>• lack of aesthetic quality</td>
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<td>• low cost</td>
<td>• brittle</td>
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<tr>
<td>• relative ease of use – ease of insertion, not overly technique sensitive</td>
<td>• subject to corrosion</td>
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<td>• maintain anatomical form</td>
<td>• marginal breakdown</td>
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<td>• reasonably adequate resistance to fracture</td>
<td>• does not restore the strength of the crown</td>
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<td>• self-sealing mechanism forms a bacterial seal</td>
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Corroded metal: pitted, bubbled, by-products (rust!!)
Classification: Composition & Types

A. Composition

- Amalgamation (mixture) of an alloy (powder) and mercury (liquid)
- alloy/mercury ratio 1:1
- influences handling characteristics

1. Traditional/Conventional:
   low-copper amalgam

   **Liquid** – mercury (Hg)  45-50%

   **Powder** – alloy  50-55%
   · silver (Ag)
   · tin (Sn)
   · copper (Cu)
   · zinc (Zn)

2. Updated: high-copper amalgam

   **Liquid** – mercury (Hg)  40-45%

   **Powder** – alloy  55-60%
   · silver (Ag)
   · tin (Sn)
   · copper (Cu)
   · zinc (Zn)

   ** requires less mercury
   ** improved clinical performance; increased resistance to corrosion
What is the significance of each component?

- Mercury – allows for plasticity of amalgam mass
- Silver - ↑ strength & ↑ setting expansion
- Tin - ↓ setting expansion
- Copper - ↑ strength, ↑ hardness, ↑ setting expansion
- Zinc - ↓ oxidation
Types – shape of the alloy particle; influences handling characteristics: Hg/alloy ratio, trituration, condensation force.

1. Lathe-cut

2. Spherical

3. Admixed
III. Properties of Amalgam (4)
- ADA Specification #1!!
- influenced by Hg/Alloy ratio, trituration, cavity design, condensation technique, & moisture control

A. Dimensional change – should be minimal

1. Excessive expansion exerts pressure on the pulp.
   Result – post-operative sensitivity, protrusion of restoration from cavity prep, possible fracturing of tooth.

2. Excessive contraction can cause restoration to pull away from walls of cavity prep.
   Result – a “gap” permitting microleakage at tooth/restor interface.
B. Strength & Stiffness

1. high compressive strength
2. high modulus of elasticity - favorable placement in large preps
3. low tensile strength – brittle in shallow preps

C. Creep

1. dimensional change due to constant stress (chewing, bruxism)
2. result – marginal breakdown

D. Corrosion

1. galvanism – two dissimilar metals in wet environment contacting & producing an electrical current
2. contact with sulfides in food, salinity & acidity of the oral fluids
3. result – surface deterioration (pitted, darkened)
Self-sealing mechanism of Amalgam

After initial placement of the amalgam, **dimensional change** will produce a slight gap at the margins allowing oral fluids to extend into the tooth-restoration **interface** *(microleakage)*. As the restoration ages, **corrosion** products form in this interface & produce a **mechanical barrier** against the penetration of fluids, debris, & microorganisms. *This may be the significant characteristic that accounts for amalgam’s excellent clinical performance.*
Figure 2–1. Diagram of the microleakage phenomenon. In this case, the leakage of deleterious fluids and debris has extended along the tooth–restoration interface, through the dentin, and into the pulp. (Modified from Massler, M.: Adhesive Restorative Materials. Spencer, Ind., Owens Litho Service.)
IV. Manipulation - Placement of a Class II Amalgam Restoration

1. Local anesthetic administered
2. Dental dam placed

3. Preparation of tooth

4. Application of liner, base, varnish (as nec).
5. Matrix band, retainer, & wedge placed
6. Amalgam mixed - triturated
IV. Manipulation

Goal – sufficient mixing of Hg & alloy to allow for chemical reaction of components. Result: mass that has plasticity (can be molded) to allow for condensation & adaptability into a cavity preparation.

A. Trituration (amalgamation) – Hg & alloy mixed together to form a “plastic” mass; influences handling characteristics.

Instrumentation - capsule, activator, triturator/amalgamator
Scary Stuff from the past!!!!

Hg and alloy pellets were measured out, triturated & then the excess Hg was squeezed out by hand in a cloth!!
B. Condensation of amalgam

- mass is placed in amalgam well to be transferred to the cavity preparation.

Instrumentation –

amalgam carrier

condenser
C. Carving Amalgam – removal of excess amalgam & redefine anatomy

Instrumentation -

- carving

Matrix system & dental dam are removed, occlusion is checked.
Amalgam Placement Video

Begin video – approximately 14 minutes – move sliding timer bar below video to view any procedure section you wish to view.
V. Amalgam Polishing

**Primary purpose** – create a smooth surface, reduce surface irregularities. Improves marginal integrity, longevity of restor., & maintain gingival health.

**CAVEAT** – over heating during process results in thermal damage to pulp (odontoblasts) & Hg drawn to surface (marginal weakening).

Polishing kit – used in descending order of abrasiveness: Brownies, Greenies & Supergreenies.
Dental Charting – Paper Chart

Black’s Classification I – VI    Know them!!

Facial

Lingual

Maxillary

Lingual

Facial

Mandibular
VII. Clinical Success

- Longevity of 20 + yrs: average 12-18 yrs for Cl I & II restor.
- Major cause of failure: $2^{\circ}$ decay, followed by marginal breakdown & bulk fracture
• Retained in cavity prep by **mechanical retention** (undercuts)
Sometimes, the restoration is just too big.....
• Failure to form a “seal” is a deficiency of ALL restorative materials.
• Zinc within the alloy may expand the amalgam restoration excessively and corrode if moisture is incorporated during manipulation.
VIII. Mercury Toxicity

Concerns arise regarding the bio-compatibility of amalgam; toxic & allergic potential of Hg. There is no material that 100% of the population is immune to 100% of the time.

- Btw 1988 & 1991 news media brought to light the controversy regarding the safety of amalgam.
- Hg is a toxic material; a potential hazard exists when Hg vapor is inhaled during mixing, resulting in an accumulative toxic effect.
- Hg will penetrate into the dentinal tubules resulting in discoloration.
- Pt’s encounter with the Hg during insertion will be brief.
- Any Hg leached from the amalgam is excreted by the body through urine and feces, not converted to lethal forms of methyl or ethyl Hg.
- August 1991, NIH – no links to arthritis, MS, or other diseases.
- Dental office personal – exposed daily to risk of Hg intoxication: 1° risk from inhalation of vapors.
• Mercury vapor – no odor, color, taste.
• Maximum level of exposure = 0.05 mg per cubic meter of air (OSHA standard)
• Chronic accumulation of Hg depends on the dose, frequency, duration of exposure.
• Organs retaining mercury longest: brain, kidneys, testicles.
• Toxic effects are mainly neurological; early signs include symptoms as: fatigue, anorexia, weight loss, weakness.

• Potential hazard can be greatly reduced, if not eliminated, by attention to a few simple precautions…. establish a *mercury hygiene protocol* for the office.
Mercury Hygiene Program – should be established in every dental office!

1. Use of disposable, pre-measured capsules.
2. Cover closed during trituration.
3. Use of NO touch technique for handling amalgam.
4. Well vented operatory.
5. Use of water spray & HVE during clinical handling.
6. NO carpeting in operatory; avoid baseboard heating – heat releases Hg vapors.
7. Salvage all amalgam scrap, amalgam capsules, & disposable chairside traps. Store in tightly closed wide-mouthed container labeled “(Contact) Amalgam Waste for Recycling”.

![Image of mercury hygiene products]
8. Perform yearly urine analysis on dental personnel.
9. Determine Hg levels in dental operatory periodically.
10. Amalgam should not be discarded in the garbage – recycle according to city, county, or local waste authorities.

FYI -
American Public Health Association (APHA) - policy statement
TEST # 1 REVIEW

DENTAL CEMENT:
• intermediary materials & cements
• composition
• function/use
• special characteristics
• know the difference between temporary & intermediate (interim) restoratives and examples of each.

AMALGAM:
• characteristics
• composition
• polishing
• charting
• self-sealing mechanism
• workplace protocol

COLLECTIVELY:
• 3 atomic bonds
• know appropriate terminology
• guidelines for use
• All handouts and chapters 6&7 (read them!)
• chapters 23 & 26 – read for enrichment only.
• Computer programs (2) – O: drive only available on computers on campus

• TEST FORMAT:
  T/F, M. C., MATCHING, FILL-IN-THE-BLANK, & SHORT ANSWER.