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?

**Attributes:**

- clinical longevity - ↓ % of failures – 15+ yrs
- low cost
- relative ease of use – ease of insertion, not overly technique sensitive
- maintain anatomical form
- reasonably adequate resistance to fracture
- self-sealing mechanism forms a bacterial seal

**Drawbacks:**

- lack of aesthetic quality
- brittle
- subject to corrosion
- marginal breakdown
- does not restore the strength of the crown
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, trititated & 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
- burnishing

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!!

![Dental Chart Diagram](image-url)
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 program equipment]
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
*** Surprise ***
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.