

**M U N I  
M E D**

# **Preclinical dentistry I.**

## **Permanent filling materials**



# Permanent filling materials

Amalgam

Composites

Glassionomers

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# Amalgam



# Amalgam

Metal-like restorative material composed of silver-tin-copper alloy and mercury.

# Particles of the alloy

- ✓ Irregularly shaped (filings - lathe cut)
- ✓ Microspheres
- ✓ Combination of the two.

# Particles shape

## High – Copper Amalgam

Microspheres of the same composition  
(unicompositional)

Mixture of irregular and spherical particles of  
different or the same composition (admixed)

# Production of irregular particles

Metal ingredients heated, protected from oxidation, melted and poured into a mold to form an ingot.

Phases of the alloy: (intermetallic compounds)

$\text{Ag}_3\text{Sn} - \gamma$

$\text{Cu}_3\text{Sn} - \varepsilon$

$\text{Cu}_6\text{Sn}_5 - \eta$

$\text{Ag}_4\text{Sn} - \beta$

# Production of irregular particles

cooled slowly

Ingot heated at 400°C (6 – 8 hours)  
(homogeneous distribution of Ag<sub>3</sub>Sn)

Ingot cut on the lathe, particles passed through a fine sieve  
and ball milled to form the proper particle size.

Aging of particles (60 - 100°C, 6 – 8 hours)

*Particle size: 60 – 120 μm in length*  
*10 – 70 μm in width*  
*10 – 35 μm in thickness*

# Production of irregular particles

Molten alloy is spraying into water under  
high pressure



*Irregularly shaped high-copper  
particles*

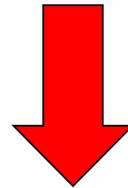
# Production of spherical particles

Molten alloy is spraying under high pressure of inert gas through a fine crack in a crucible into a large chamber

*Diameter of the spheres: 2 – 43 $\mu$ m*

# Amalgamation processes

alloy is mixed with pure mercury



Trituration

# Types of amalgam restorative materials

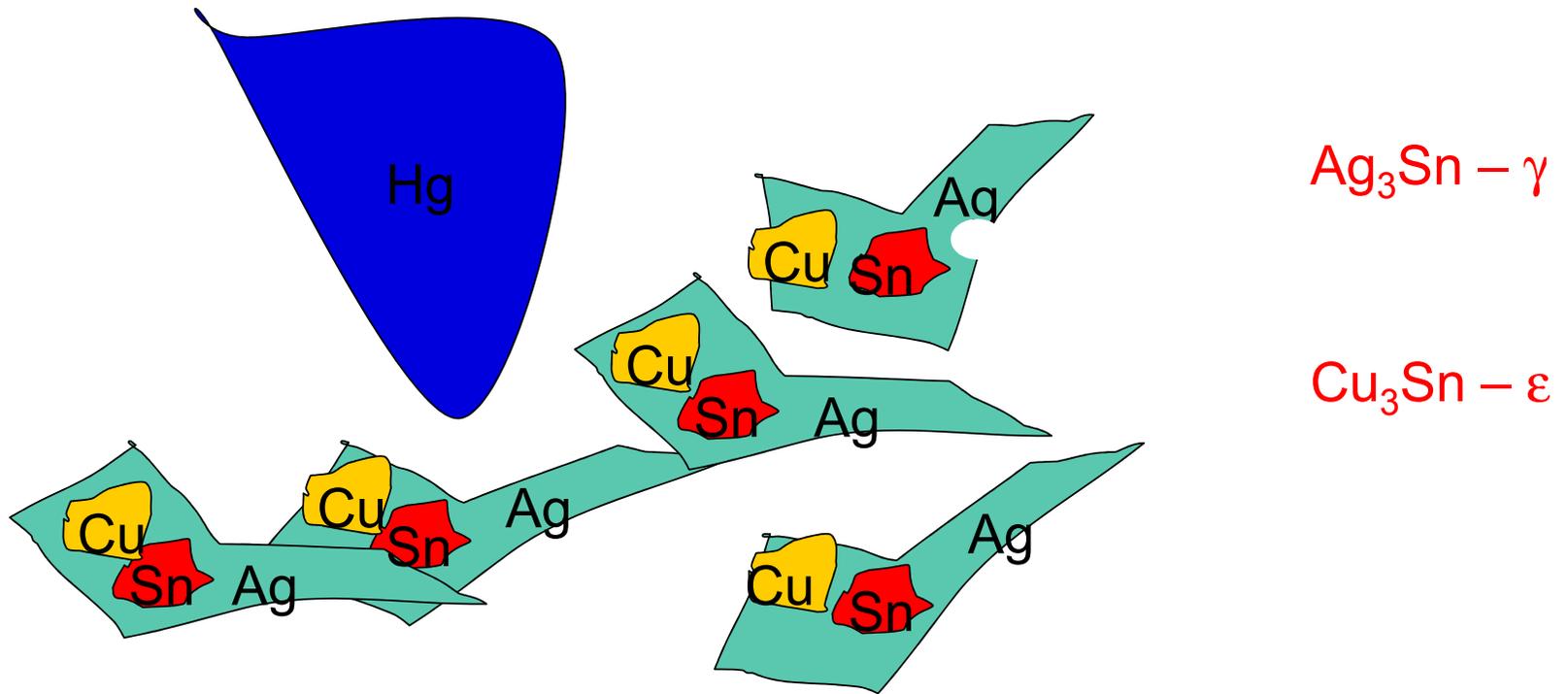
Low – Copper Amalgam (5% or less copper) conventional amalgam

Composition – wt%

Silver	63 - 70 %
Tin	26 – 28 %
Copper	2 - 5%
Zinc	0 - 2%

# Amalgamation processes

Intermetallic compounds

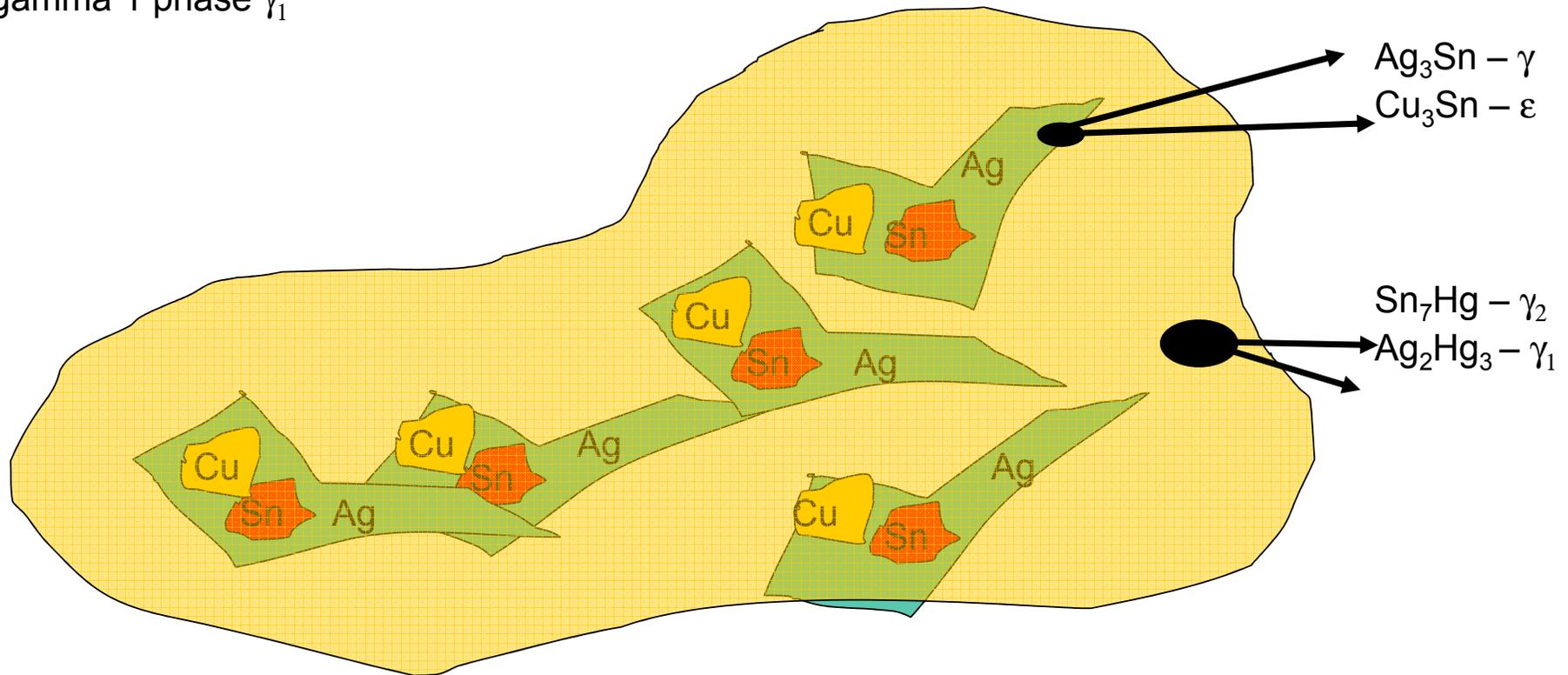


# Amalgamation processes low copper amalgam

The mercury dissolves the particles of the alloy

Sn – Hg: gamma 2 phase  $\gamma_2$

Ag-Hg: gamma 1 phase  $\gamma_1$



# Setting of low copper (conventional) amalgam

Principle of setting is crystallization

Structure of the amalgam filling

Ag-Hg: gamma 1

Sn-Hg: gamma 2

} These phases crystallized –  
become hard

Gamma phase (Ag-Sn) that did not dissolve  
completely – remains in the structure

## Risks of the gamma 2 phase

- Non stable
- Tin is released due to electrogalvanism in oral cavity and mercury from this phase reacts with remaining gamma phase.
- This is external electrochemical corrosion.

*Low copper amalgam has worse mechanical and corrosion resistance than high copper amalgam*

# High copper amalgam

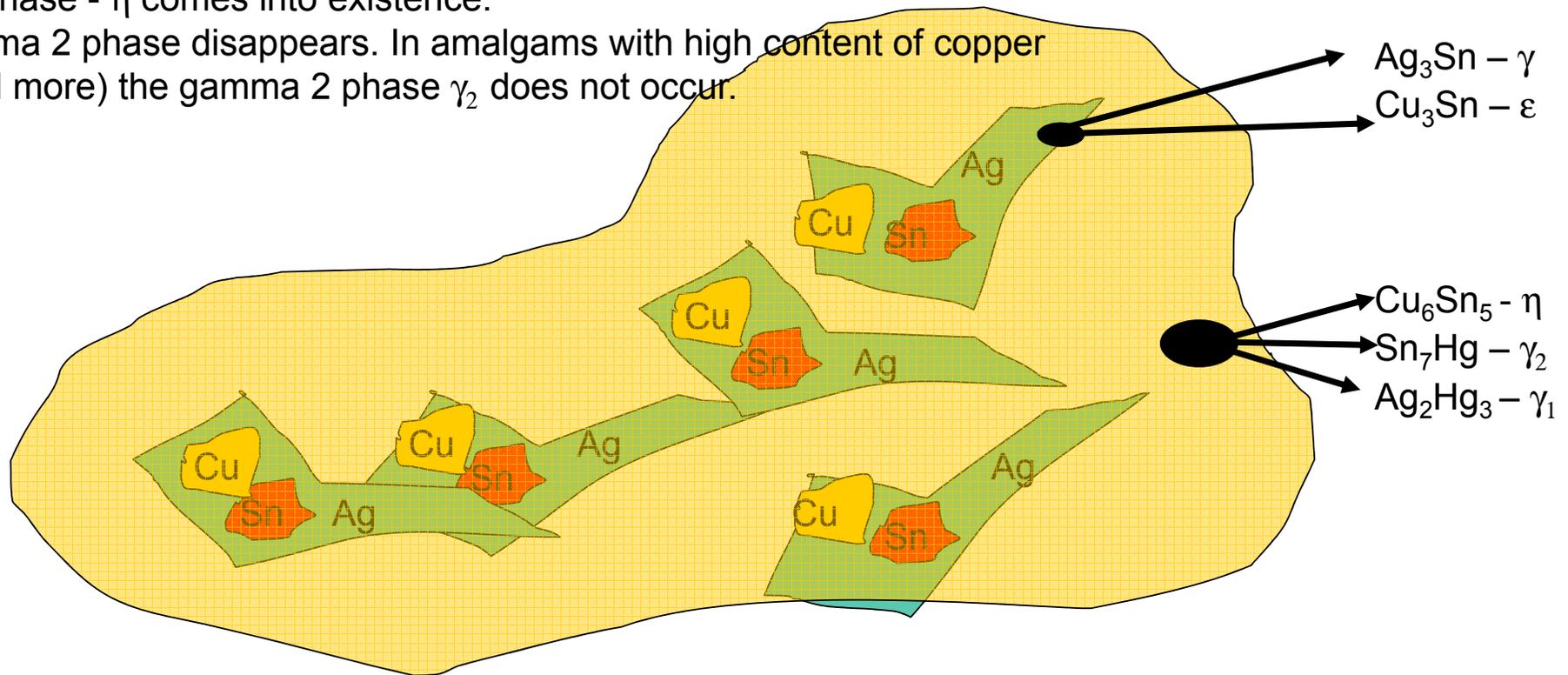
- Content of copper increased: 12 – 13%  
(Less tin)
- Or up to 25% up to 40% ( Less tin and silver)

Better mechanical and corrosion resistance

# Amalgamation processes – high copper amalgam

High copper amalgam – copper dissolved in mercury has high reaction affinity to tin that is also dissolved in mercury. It reacts with tin in gamma2 phase  $\gamma_2$  and eta phase -  $\eta$  comes into existence.

The gamma 2 phase disappears. In amalgams with high content of copper (25% and more) the gamma 2 phase  $\gamma_2$  does not occur.



# Types of amalgam restorative materials

High – Copper Amalgam (13% - 40%)

Admixed regular: Irregular particles:Ag 40 - 70

Sn 26 – 30

Cu 2-30

Zn 0-2

Spherical particles Ag 46 – 65

Sn 0 – 30

Cu 20 - 40

# Types of amalgam restorative materials

High – Copper Amalgam (13% - 30%)

Copper

Admixed unicompositional: Ag 52 - 53

Sn 17 - 18

Cu 29-30

Zn 0

Spherical particles Ag 46 – 65

Sn 0 – 30

Cu 20 – 40

# Types of amalgam restorative materials

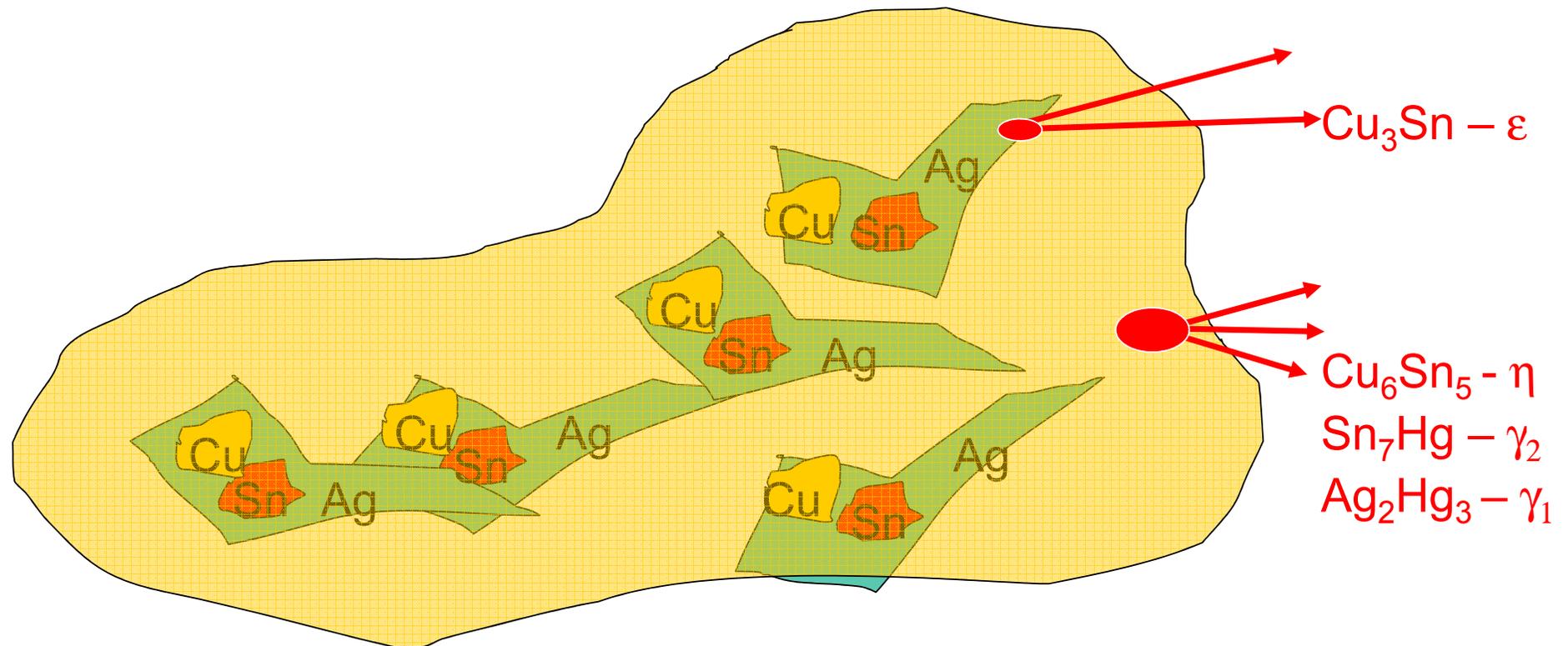
Unicompositional - Spherical

Ag 40 – 60

Sn 22 – 30

Cu 13 – 30

# Amalgamation processes



Gamma two disappears or it does not occur when content of copper is high



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# Amalgam - properties



# Amalgam

- **Wear and pressure resistance (2mm thickness at least)- brittleness**
- **Easy handling**
- **Low price**
- **Thermal and electrical conductivity**
- **Corrosion**
- **Bad aesthetics**
- **Flow (deformation of not completely set amalgam if the filling is loaded)**
- **Creep – completely set amalgam can be deformed due to bite forces. The filling is principally hammered.**

# Biocompatibility

- More than 160 years, more than 200 millions Ag fillings every year in USA.
- Allergy rare
- Precautions in children and in pregnancy.

AMALGAM IS STILL A MATERIAL OF CHOICE

# Toxicity and environmental risks

## ■ Organic compounds

Vapours, aerosol

Precautions

- Ventilation
- Rests of amalgam in water
- Amalgam separators
- Dangerous waste (180 110)

# Amalgam indications

- Posterior area
- I. a II. class : moderate or large cavities,
- V. class

Other factors for consideration

When oral hygiene is not excellent

When patient wants low cost filling.

# Indications and contraindications of amalgam

## Indications

- Moderate and large cavities in posterior area (class I., II. V)

## Contraindications

Fillings in frontal area

Pregnancy, children till the age of 15

Allergy

*Other factors for consideration*

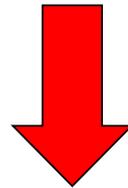
*When oral hygiene is not excellent*

*When patient wants low cost filling.*

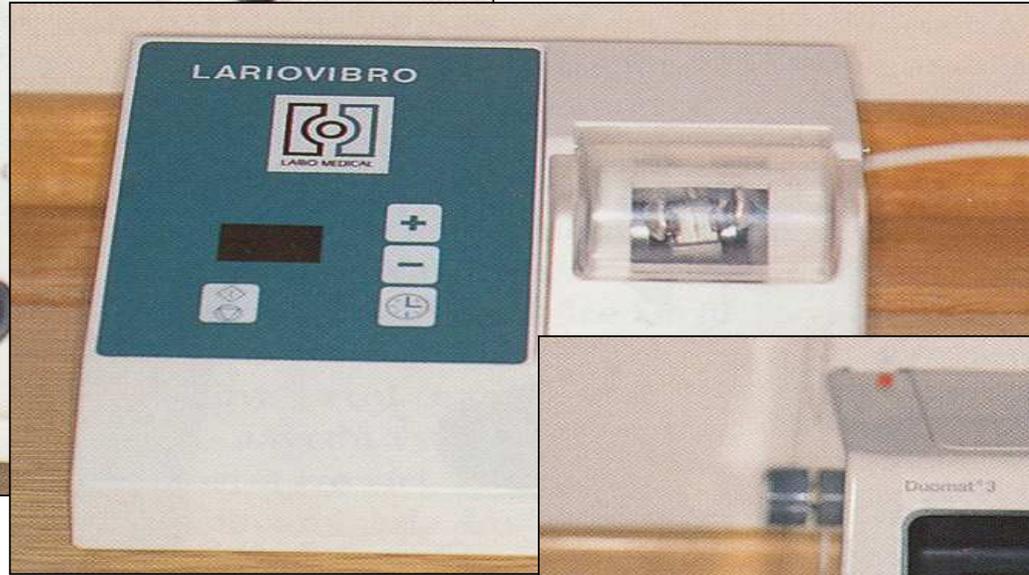
# Mixing of amalgam

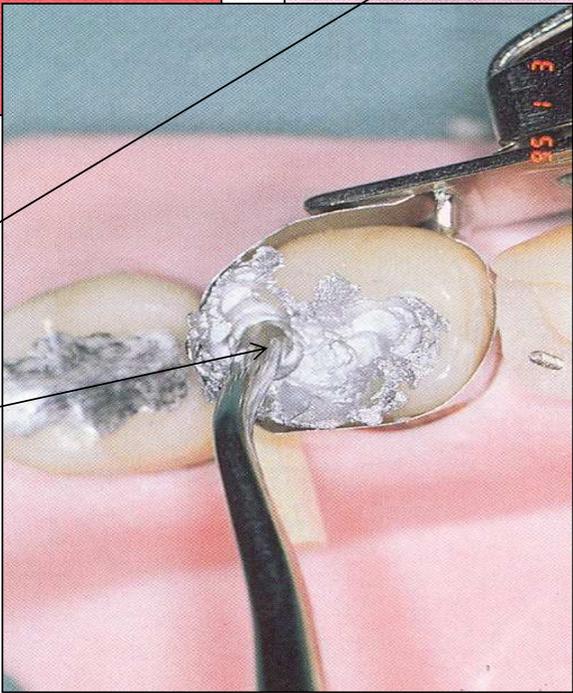
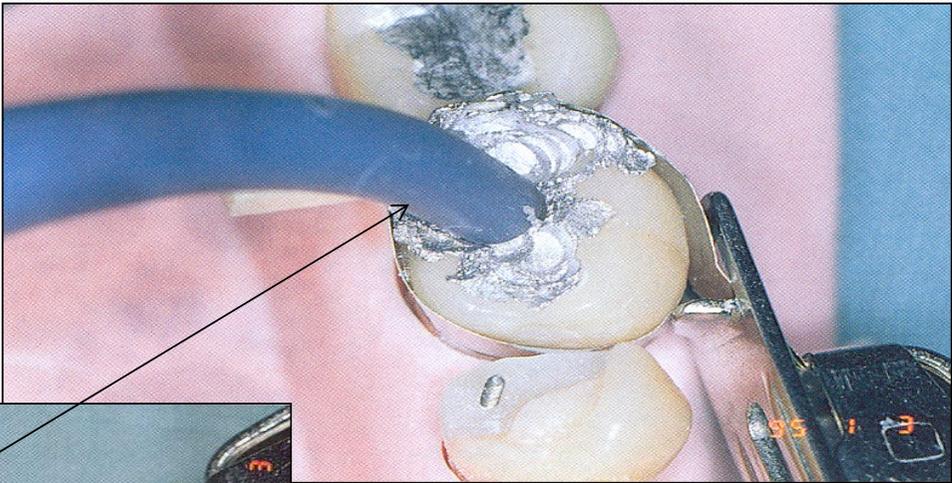
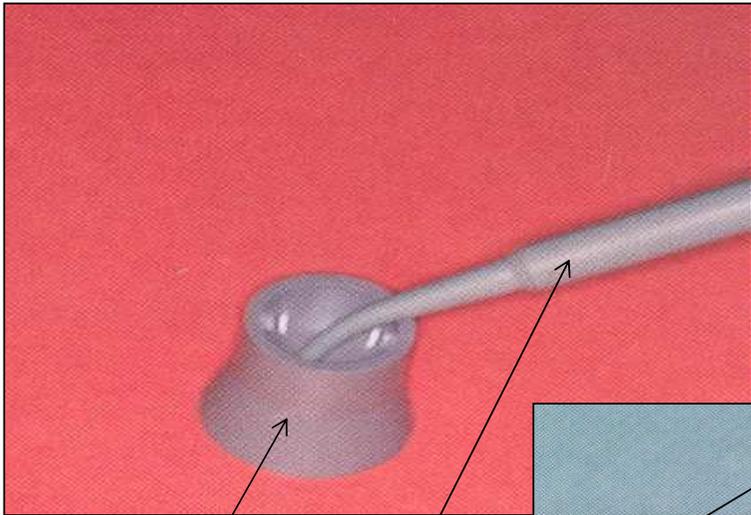
➤ Hand mixing (obsolete)

➤ Power driven trituration



*Amalgamators*



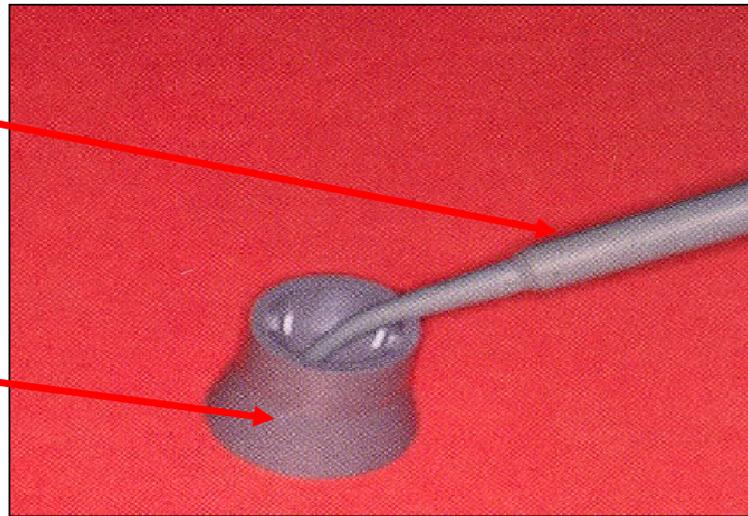


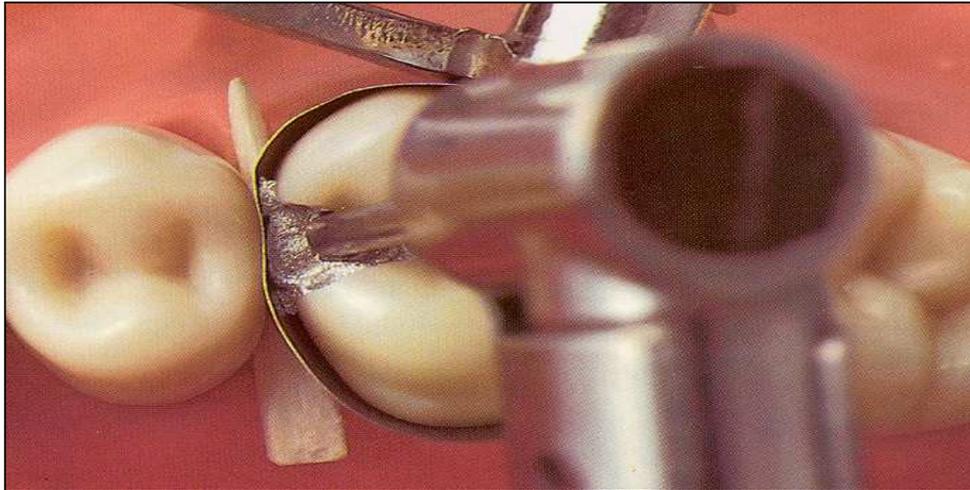
Cup  
Amalgam gun  
Condensor



Amalgam gun

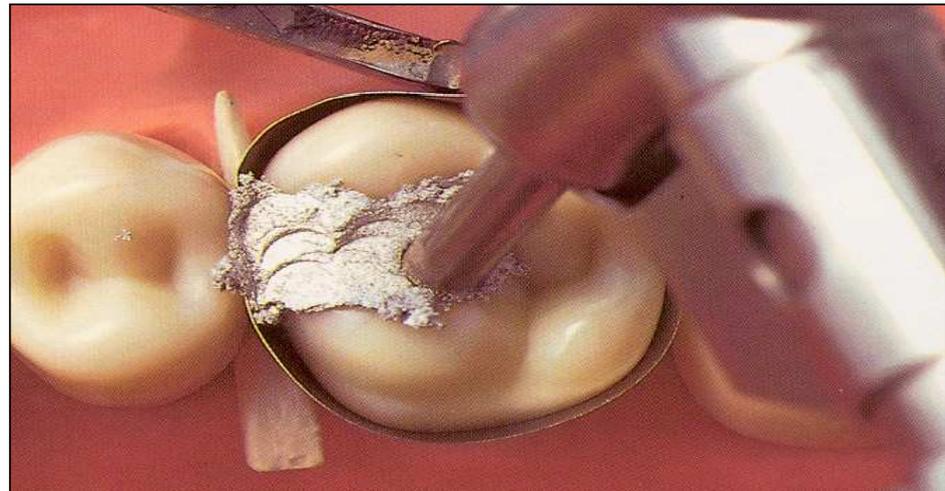
Crucible (cup)





Power driven condensation

handpiece  
condensor





# Instruments

➤ **Preparation instruments**

➤ **Filling instruments**

➤ **Carvers**

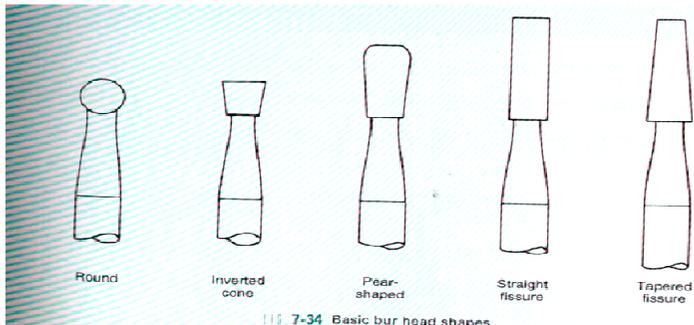
➤ **Burnishers**

# Instruments

## Preparation instruments - power driven

Burs

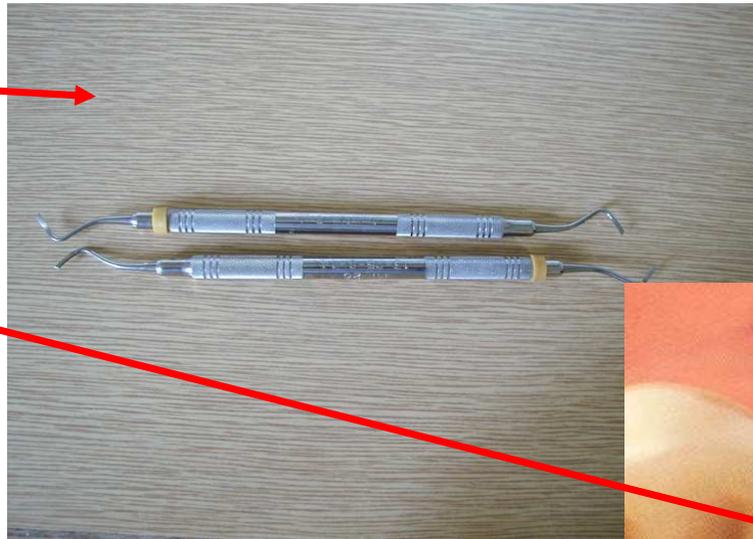
Diamonds



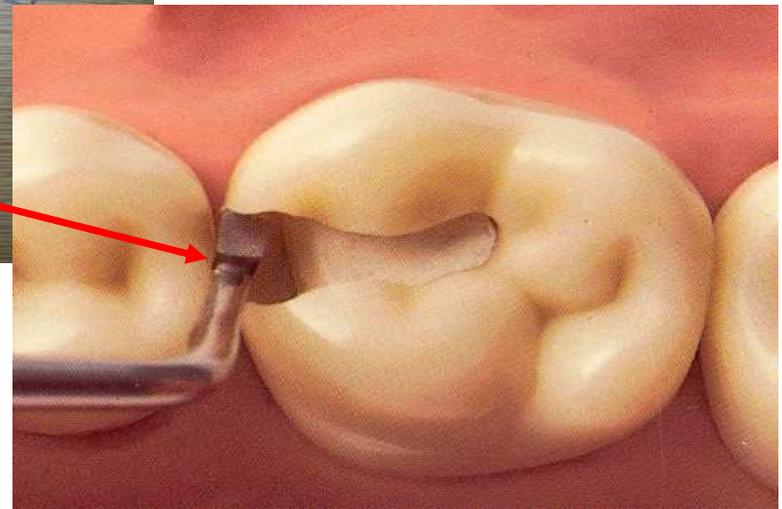
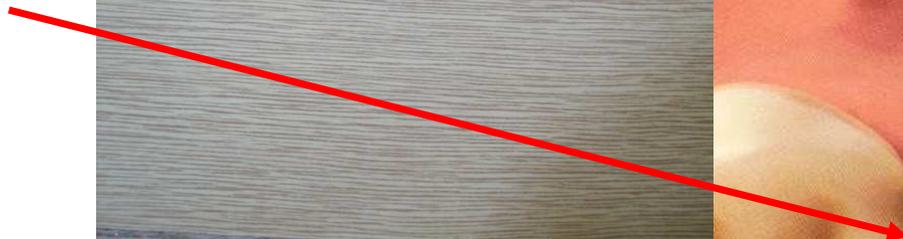
# Instruments

## ➤ Preparation instruments - hand

Chisel



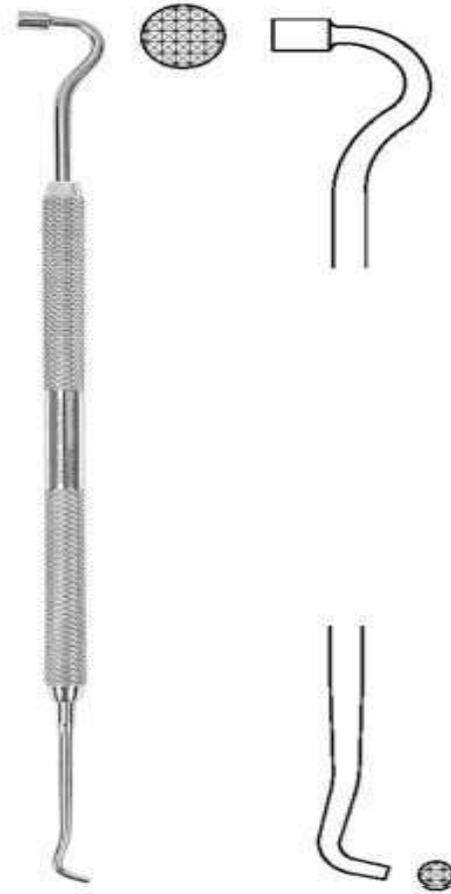
Excavator



# Amalgam carrier



Amalgam carrier



# Condensor with flat front

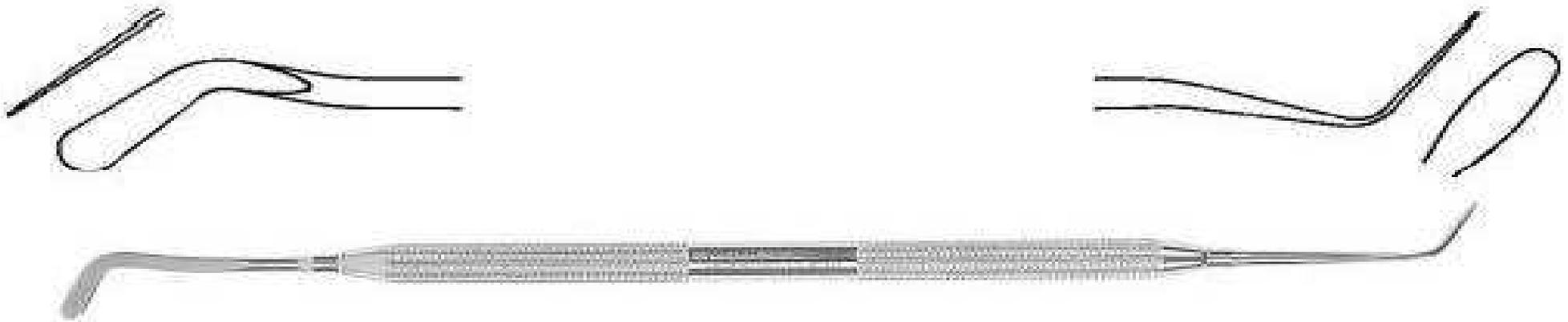


# Condensor and burnisher - spatula combined



# Burnisher - spatula

## Angular- trough edge trough face



# Carver - Frahm



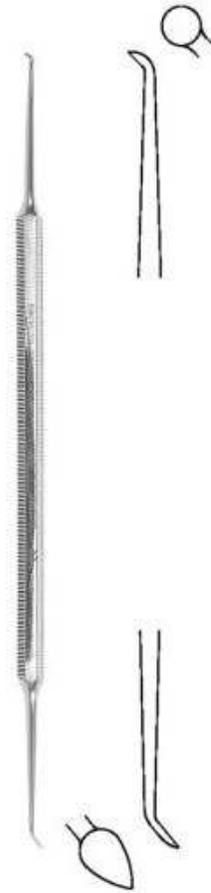
# Carver - Sapin

Carver - Sapin



# Carver discoid-cleoid

Carver Discoid-cleoid



# Burnisher – spatula, angular three face



# Ball condensor – used as a burnisher at most



# Principle of the retention of amalgam

- Macromechanical retention
  - Undercuts
  - Grooves
  - Cavities for retention

# Undercut



# Amalgam step by step procedure

- Preparation of the cavity
- Base – protection of dentin wound
- Mixing
- Application portion by portion, condensation
- Carving
- Burnishing
- Finishing and polishing