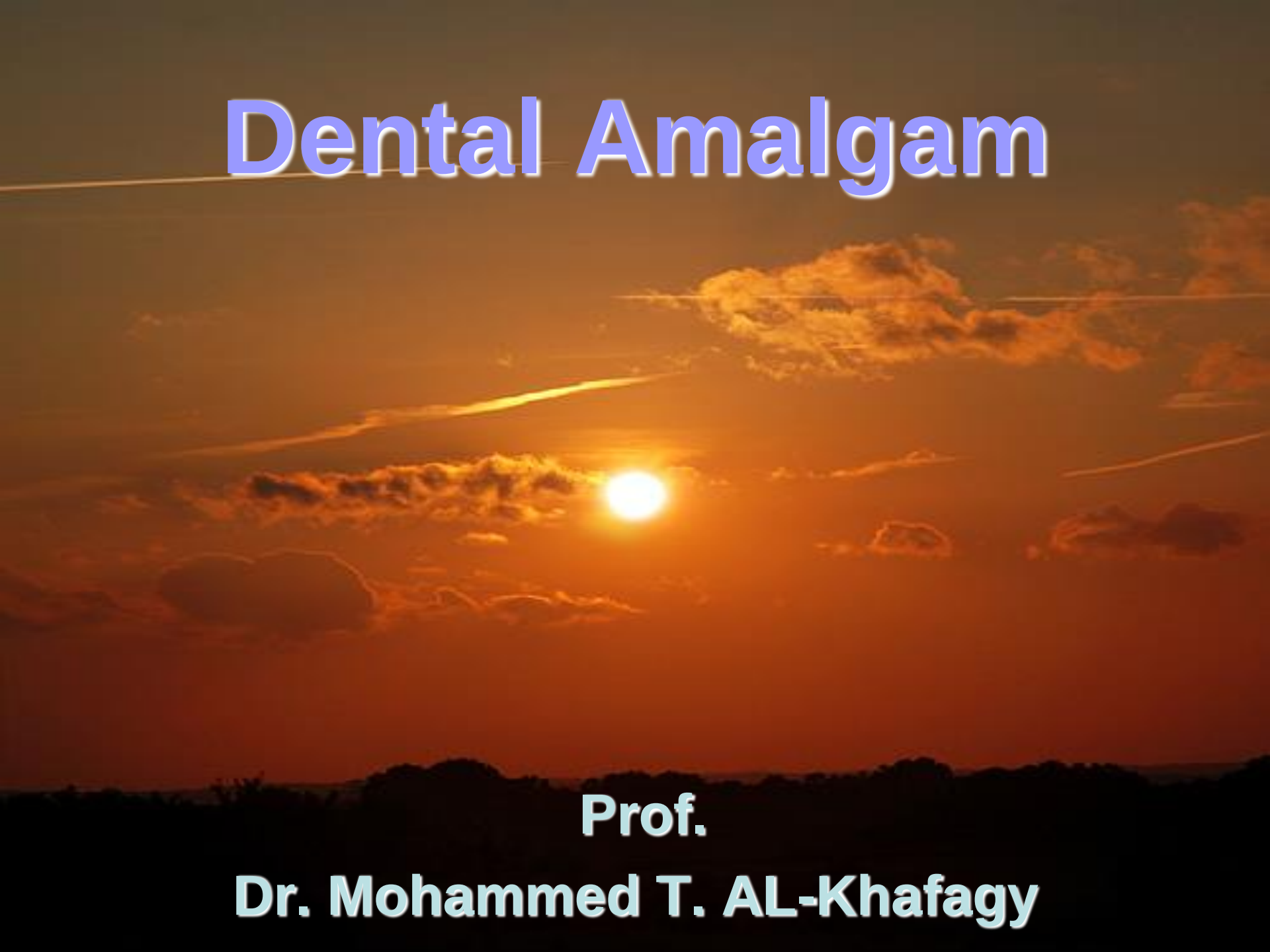
Dental Amalgam



Prof.
Dr. Mohammed T. AL-Khafagy

Dental Amalgam

Composition

The composition, of alloy powder is varies from one product to another.

Dental Amalgam

Composition

I/ Conventional amalgam (Traditional)

Basic composition:

a) **Silver (Ag)** 65%: strength, promoting setting when mixed with mercury.

Disadvantage: high degree of setting expansion.

b- **Tin (Sn)** 25-29%: aids in amalgamation process of alloy with mercury at room temperature and decrease expansion within practical limit.

Large amount of tin cause decrease strength, prolong the setting time and decrease corrosion resistance of amalgam.

Dental Amalgam

Composition

I/ Conventional amalgam (Traditional)

Basic composition:

c- Copper (Cu) 6%: increase strength and hardness and setting expansion but decrease flow.

d- Zinc (Zn) 1-2 % max: aid in process of manufacturing by acting as a scavenger for oxygen and minimize the oxidation of other metals.

Increase in Zn cause delayed expansion.

Dental Amalgam

Composition

I/ Conventional amalgam (Traditional)

Basic composition:

-Alloy which contain > 0.01% ——————Zinc-containing alloys

-Alloy which contain <0.0l% ——————non zinc (Zinc free alloys).

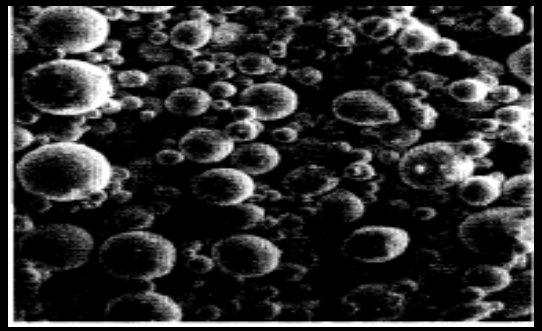
Dental Amalgam

Composition

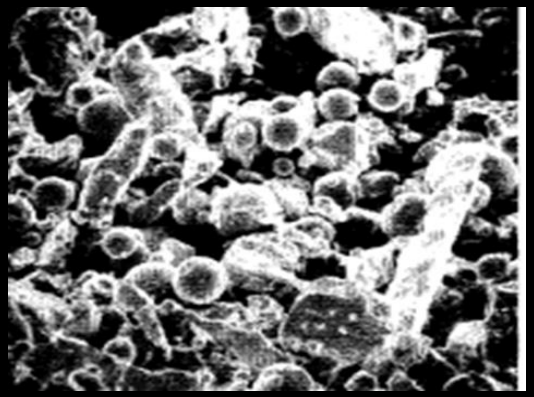
Two methods of production of alloy powder:

1- Lath - cut alloys:

2- Spherical particles:



3- Admixed particles:



Dental Amalgam

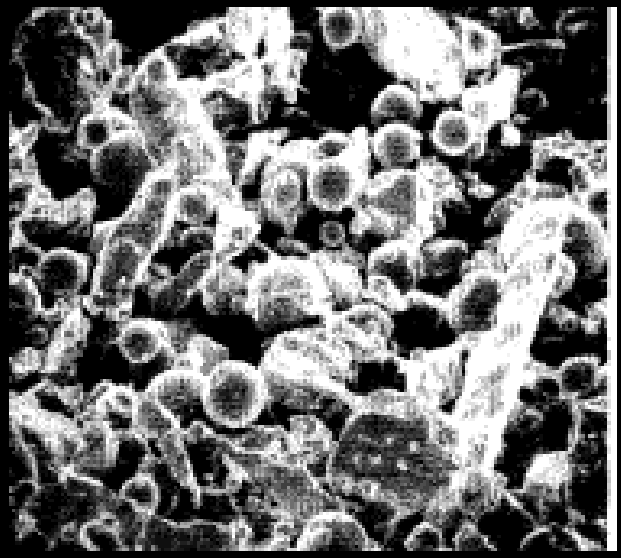
Composition

II) High copper amalgam:

The copper content is increase from 6% up to 10-30%.

a- Unicompositional system: either lathe - cut or spherical

b- Disperse alloy (admixed): a mechanical mixture of lathe-cut alloy with spherical alloy.



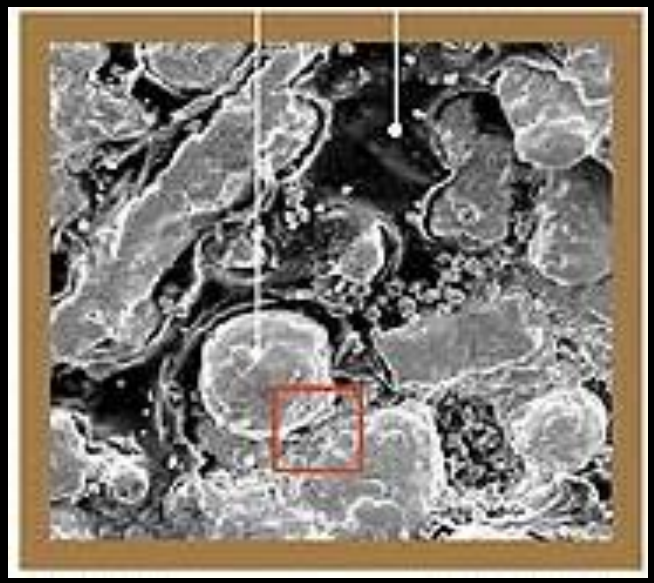
Dental Amalgam

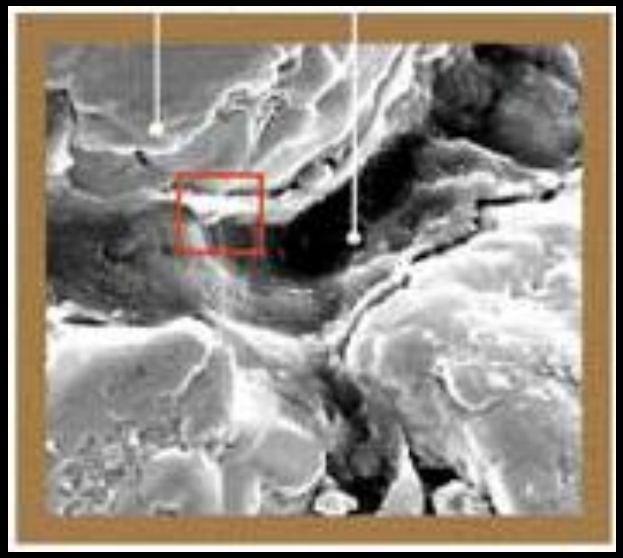
Setting Reaction

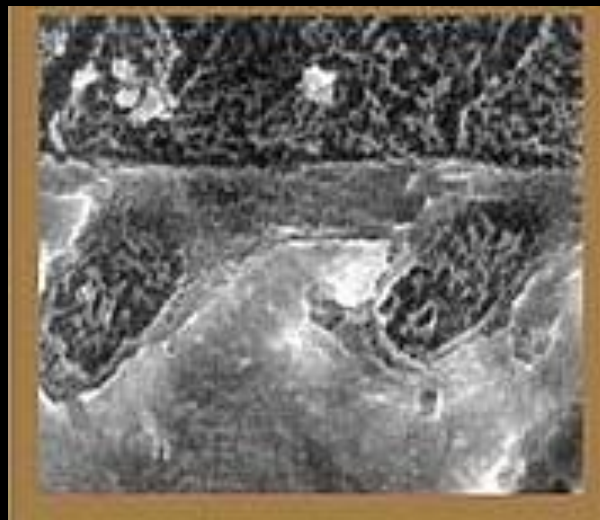
The reaction of conventional amalgam is given by this equation:

Dental Amalgam

Setting Reaction







Dental Amalgam

Setting Reaction

The reaction of conventional amalgam is given by this equation:

For high copper amalgam:

$$Ag_3Sn + Cu + Hg \longrightarrow Ag_2Hg_3 + Cu_6Sn_5 + Ag_3Sn$$

$$\gamma + Cu + Hg \longrightarrow \gamma\,1 + Cu_6Sn_5 + \gamma$$

Dental Amalgam

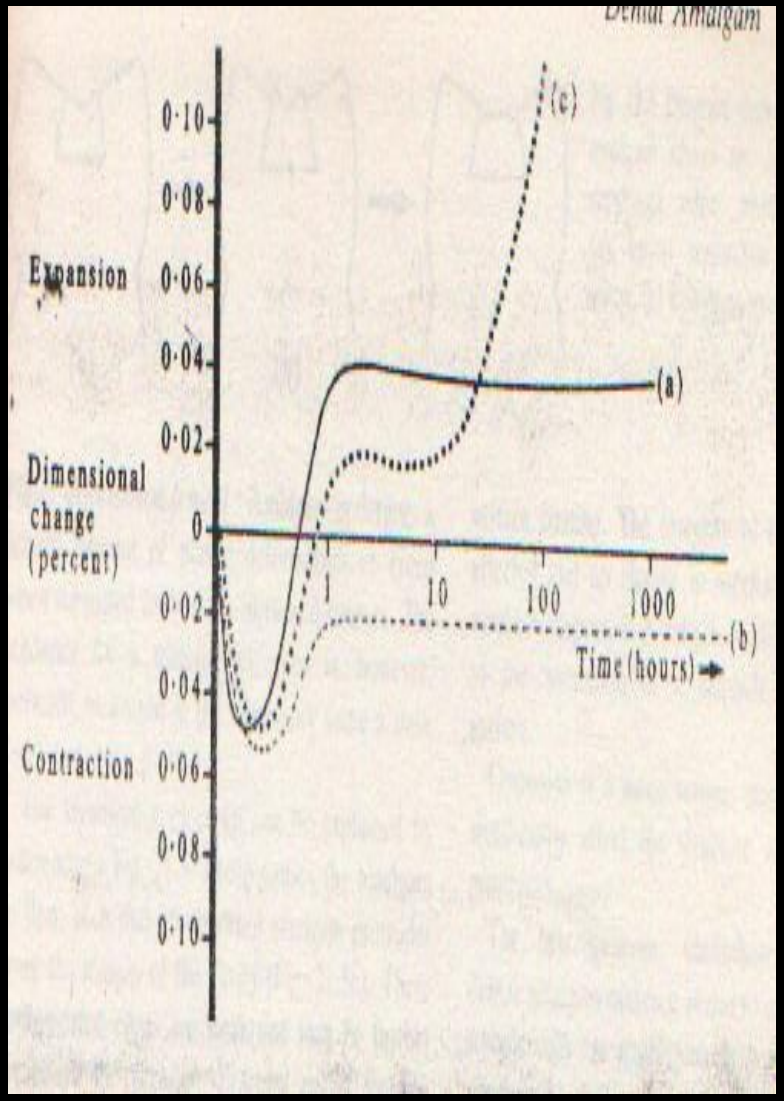
Properties

1- Dimensional changes:

A small contraction takes place in the first 1/2 hr as mercury still diffusing in alloy powder.

Then when crystallization begun the outward thrust of growing crystals cause expansion.

The overall effect of the final set material may cause slight final expansion or slight final contraction.



Properties

Factors which affect a final expansion or contraction:

1- Type of alloy

2- Particle size and shape.

3- Pressure used to condensed amalgam (most significant).

A standard test permit a slight expansion typically (0.2%) max. or slight contraction of. 0.1% max.

large contraction would result in a (what??)

marginal gap down which fluids could penetrate.

large expansion would result in (what??)

the protrusion of the filling from the cavity.

Delayed expansion:

for zinc containing amalgam when contaminated with moisture during condensation zinc will react with water, hydrogen will produced as products of such reaction, hydrogen will be collected internally, this cause pressure which may cause expansion.

This occurs after 3-4 days and may be after a month.

This confirms the need for adequate moisture control when using this material.

Dental Amalgam

Properties

2- Strength : The strength of amalgam developed slowly it may takes 24 hrs after mixing

{Why we instruct the patient not to press on amalgam after 20-30 minutes}

High mercury affect the strength (weaken the final properties of the set material)

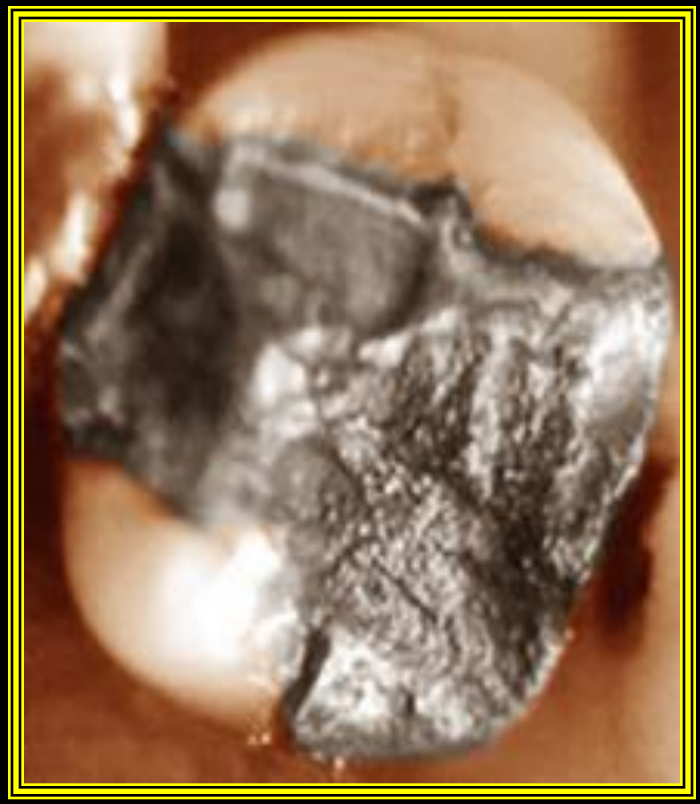
PROPERTY	INGREDIENT			
	Silver	Tin	Copper	Zinc
Strength	Increases			
Durability	Increases			
Hardness			Increases	
Expansion	Increases	Decreases	Increases	
Flow	Decreases	Increases	Decreases	
Color	Imparts			
Setting time	Decreases	Increases	Decreases	
Workability		Increases		Increases
Cleanliness				Increases

Table 1-1. Effects on properties of an amalgam restoration imparted by ingredients.

Properties

3) Creep: Is a plastic deformation of amalgam when subjected to intraoral stresses.

Creep causes protrusion of amalgam out of the cavity , the protruded edges are unsupported and weak and may be lead to fracture , this will cause a gap and microleakage.



Dental Amalgam

Properties

4) Tarnish and Corrosion:

***Tarnish*:** is a loss of luster from the surface of metal or alloy due to the formation of a surface coating.

The amalgam is usually tarnished due to the formation of *sulphide* layer on the surface.

This causes ***no*** change in the mechanical properties of the alloy.

Dental Amalgam

Properties

4) Tarnish and Corrosion:

Corrosion: The multiphase structure of amalgam makes it prone to corrosion.

The different phases from the anode and cathode and saliva (provides the electrolytes), electrolytic cell is readily setup.

Dental Amalgam

Properties

*The rate of corrosion is accelerated when the amalgam filling is contact with gold restoration. ***Why?***

*Corrosion will cause roughness of the amalgam which may lead to ????

- plaque and bacterial accumulation and inflammation of the soft tissue
- poor appearance of the filling surface
- may affect the mechanical properties of amalgam.

*Level of corrosion may be minimized by polishing, surface of restoration.

Properties

5-Thermal Properties:

*Dental amalgam has a high value of thermal diffusivity so requires insulating material so need ????

(cement base).

Rest for 5 min

Properties

6- Biological properties

The mercury has a bad effect on CNS also may cause contact dermatitis.

Some studies showed a higher concentration of mercury in blood and urine in patients with amalgam fillings than those without fillings, but the levels was within acceptable limit.

Mercury Toxicity

- People are exposed to mercury in daily life by the way of foods, vaccines, antiseptics, ointments, amalgam or occupation.
- The symptoms of mercury poisoning are:

1. Convulsions
2. Numbness in mouth and limbs
3. Constriction in visual field.
4. Difficulty in speaking.

Mercury Toxicity

- Harmful effects of mercury from the dental amalgam could be in the form of

1. Toxicity.
2. Hypersensitivity

Mercury Exposure in Dental Practice

Various means of exposure to mercury

- Storage of mercury
- Preparation and placement of amalgam restoration.
- Polishing silver amalgam restoration
- Removal of amalgam filling.
- Storage of waste silver amalgam.

Exposure of mercury may be either in the form of vapour or particulate amalgam dust (Hg^{2+}).

-The dentist and assistants should take precautions:

A) Freshly mixed amalgam and mercury should not be touched by hands. *Why???*

B) Instruments should be cleaned well before sterilization.

C) Wearing a mask and gloves will protect the dentist and the assistant from mercury toxicity.

Dental Amalgam

Manipulation

1- Proportioning and Dispensing

2- Trituration

3- Condensation

4- Carving

5- Polishing

1- Proportioning and Dispensing

For optimum properties, the final set amalgam should contain less than 50% mercury.

Those materials used at alloy/mercury ratios at or approaching 5:8 require the removal of excess mercury following trituration and during condensation.

1- Proportioning and Dispersing

Various methods of dispensation are available:

1- the most accurate method is to weight the mercury and alloy components using balance.

This method is rarely used however, and is commonly proportioned using volume dispenser.

Dental Amalgam

1- Proportioning and Dispersing

Various methods of dispensation are available:

2- Amalgamator.-:the device typically has 2 hoppers, one filled with alloy and the other with mercury, the alloy /mercury ratio is set by the operator and the required amount of each component is released in to a mixing chamber by pressing a button.

1- Proportioning and Dispersing

Various methods of dispensation are available:

3- Using capsulated materials: both alloy and mercury in proportion have been determined by manufacturer.

The two component is separated by impermeable membrane, which is readily shattered using a capsule press or starting vibrate the capsule in a mechanical mixer which is called self-activating capsule.

Dental Amalgam

2-Trituralion:

1- By hand using a ***mortar and pestle***: a glass mortar with pestle

2- Mechanically by ***amalgamator***: The time of mixing-vary from 5-20 seconds this depend on the speed of amalgamator and the type alloy used.

Advantages:

a) uniform mix is produced

b) shorter time .

c) less mercury / alloy ratio is used.

Dental Amalgam

3-Condensation: -

1- Hand condensation by using a flat -ended steel hand instrument (amalgam condenser)

2- Many mechanical devices are available for condensing amalgam. With the development of spherical alloys, the need for mechanical condensers was eliminated.

3- Ultrasonic condensers are *not recommended* because during condensation they increase the mercury vapor level to values above the safety standards for mercury in the dental office.

Dental Amalgam

4- Carving and burnishing:-

adequate condensation the excess mercury has been removed it will be sufficiently hardened within a few minutes to permit careful carving.

Burnishing, the newly condensed amalgam with a metal instrument having a broad surface contact, can be employed to smooth the surface, thereby making the amalgam more susceptible to finishing and polishing.

Dental Amalgam

5- Finishing and polishing

If final finishing and polishing are to be done at a second appointment,

the restoration should be left undisturbed for a period of at least 24 hours.

The patient should be cautioned that the freshly inserted restoration is relatively weak and that heavy biting forces should be avoided for a few hours after the time of insertion.