**Amalgam**

composite materials are used as restorative they have big advantages
1-they are colored as the tooth.
2-they are attached to the tooth by a micro mechanical process “which means that we don’t need to remove much of the tooth structure”.

Amalgam has a strong mechanical structure

Disadvantages of Amalgam:
1-amalgam is an alloy “mixture of metals” so it can **conduct** heat.
2-it has mercury “Hg” which is **toxic** “It affects the central nervous system and may cause madness”
so we must use it in CAUTION

In some countries amalgam is forbidden because of its toxicity like “Norway ,Finland , DK ”
on the other hand some countries like U.S.A and British Dental Association consider amalgam one of the best options as a restorative material.
In our country dentists have the choice to whether use amalgam or not.
On future years we will consider amalgam from biomimetic point of view “which means :can the amalgam replace “resemble” tooth structures (enamel ,dentine ,pulp) to work like them”

In the past, amalgam alloy and mercury were mixed in the clinic manually “which is dangerous!!”
Then they started mixing it mechanically “but still in clinics”. Nowadays, it’s precapsulated “in the form of capsule from the manufacturer”

**Amalgamation** : means mixing two things.
Metals that should be present in amalgam:
\*Silver “Ag” +Copper “Cu” **mainly**
\*Tin “Sn”
\*Palladium “Pd”
\*Zinc “Zn”

where do we use amalgam ?
-we can use it as a filler material “when there is caries in the **posterior teeth** (we don’t use it in the anterior ones because of their black color)”

-we can use it for extensive restorations “more than 40 years”
-we can use them as core to make “crown preparation” on them.

the capsules that contain the amalgam are sealed and have two portions ,one of them contains **mercury** and the other has the **amalgam alloy** “powder like” and between them there is a membrane ,there is a little thing on the top of the capsule you should push it to break the membrane and mix them. Then we put the capsule on triturater “centrifugation ” on high speed for 8-10 seconds.

When there is caries ,we should do cavity design for the amalgam because amalgam doesn’t bind to tooth structure so we have to do what is called “macromechanical retention”

when we first apply amalgam in the cavity it appears as a plastic material ,then we start to condense it “condensation causes voids to disappear” …. The amalgam that remains without using is called “**non-contact amalgam**” the amalgam that we use is called “**contact amalgam**” (each type has its own way for being disposal or recycled”.
After this amalgam should be carved to resemble the normal tooth structure.( anatomy of tooth )

Amalgam safety issues have to do with the: patient, dentist or his personnel, and environment.

The main person who gets exposed to mercury “amalgam” all the time is the dentist, because dentists use amalgam on a daily basis so they get exposed a lot to mercury vapor, unlike the patient because the mercury will not come in direct contact with his body tissues “just the tooth”.

**Advantages of amalgam:**
1-easy to insert.
2-maintains anatomical forms. “because it is metal and metals bears occlusal forces “Young’s modulus is higher than tooth structure (unlike composite)”.
3-No micro leakage “because disintegration (sth like corrosion) happens to amalgam and it close any gap spaces”. (more corrosion than needed causes amalgam to break)
4-can be used at stress bearing areas.
5-have long life span.

**Disadvantages of Amalgam:**
1-amalgam is an alloy “mixture of metals” so it can conduct heat.
2-it has mercury “Hg” which is toxic “It affects the central nervous system and may cause madness”
so we must use it in CAUTION
3-they are brittle so we should use enough thickness of it “**1.5 mm**” at least.
4-If I use more than I need “marginal breakdown” will happen.
5-it’s not biomimetic.

Ag: main reactant

Sn: helps getting fluid and soluble state “to make the material workable”

Cu: there is high and low copper alloys “copper is important to prevent Hg from reacting with

Sn : to avoid having the weakest phase (Gamma 2 phase)”.

Zn: used rarely “it may cause rapid expansion if contamination with water happened (this when happens it causes severe pain to the patient)”

So why do we use Zn if it causes all these problems??
**To ease the manufacturing process**

How to mix metals?
\* We convert them to **lathe** “برادة” and mix them together, we do that to make their shape homogeneous
so mercury can fit between them “if too much mercury is added less mechanical properties will result”.

\* Another way is converting the metals to **spherical particles** “under pressure” , mercury is less in them so mechanical and physical properties are improved.

\* We can also use an **admix** between the past two ways “lathe and spherical” to have enough percent of mercury “it should be 42-50% of the set amalgam by volume”.

Amalgam can be divided based on the **percentage of copper** in it.
Until 70’s the only alloy present was the low copper alloy “<6%” the main reactant here is **Tin** and **Silver**
From 6-60% it’s called *high copper alloy* “but it usually doesn’t exceed 30%.
The high copper alloys are either **admix or spherical “they don’t present as lathe”**
“high copper alloy is better than low copper alloy but it is more difficult to manipulate and for the manufacturer to make”

the reactions are important.
Gamma 2 phase is the weakest phase, it may be attacked by environment and it has weak resistance to corrosion.

The spherical type of high copper alloy **doesn’t** produce gamma 2 phase.

In low copper alloys **original** gamma phase is the strongest from mechanical point of view but to make it workable we should have gamma 1 and gamma 2 phases.

Unconsumed particles are smaller than gamma 1 and gamma 2 phases and they work as a **binder** at the end.

**This letter  “η” is called “eta”.**

*Properties of amalgam*

-it can expand more than 20 micron/centimeters between 5 minutes and 24 hours. But some types as we said can expand more than that when **zinc** is contaminated with water.

I can know if the time of trituration is enough or not from the **texture of the amalgam** that results, if it came out shiny then this means that **not** all the mercury have reacted so I have to put it with the non-contact amalgam “and I should do another one for **longer time** of trituration” (we shouldn’t put it again in the triturator we should use a new one because the **setting time for it has begun already).**
If the amalgam came out totally dry and not workable then this means that we’ve mixed it a lot, so I should do another one and **lower the time** of trituration.

-corrosion is another property of amalgam especially for gamma phase 2, and corrosion causes the surface of amalgam to be rough surface and trap a bio-film of bacteria that may cause secondary caries
“amalgam has high rate of secondary caries if it is not done in a proper way”

-when there is two amalgam restorations **galvanic reaction may** **result “electric shock”** because they will make a cathode and an anode with the presence of saliva. “because of this reaction mercury may cause the filling to become dull and black or gray in color”.

After we put an amalgam filling a space usually results “under amalgam” and this causes the patients to feel **post operative sensitivity.**

With time corrosion products will result on the surface of the amalgam so we should put a varnish or a liner or a dentinal sealing agent because amalgam is a thermo and electro-conductor

as we said amalgam can be used as a core to prepare crowns but we should consider this:
low copper alloy usually can’t be used to prepare the crown and put the crown on it “because it will be soft at the beginning” immediately, if it’s a high copper alloy then I can prepare it after 8 minutes “because it will reach its proper state after 8 minutes”. But ideally I should wait 24 hours before I put the crown on the amalgam core.

**Most of the amalgam (70-80 % )nowadays in clinics is high copper alloy.**
Amalgam can go under “**viscoelastic**” change “the filling will expand under continuous forces on it” and excess amalgam will affect the tooth structure so it needs to be replaced.

We can make the amalgam shiny by polishing “but most dentist will not do that, because the last thing the patient want is to have a shiny black material on his teeth when he laughs” so most dentists will not polish amalgam.

The poisoning compounds of mercury are the organic compounds of it “especially methyl and ethyl mercury” and the vapor of mercury (which we have in clinic).

Most toxic mercury is methyl and ethyl mercury “like mercury in fishes”.

If mercury reaches more than 50 micrograms/m^3 in mercury vapor it causes irreversible damage to the tooth structure “when we do removal of amalgam we should use high volume suction, because we melt the material to remove it so the risk of getting mercury vapor is high that’s why we should use high volume suction”.

We mustn’t wear or use the stuff that we use in our clinics outside the clinics!!“we mustn’t touch amalgam with our hands”.

Sometimes when you open the amalgam capsule after “trituration” there may be some mercury still present “not reacted” we should **Not** wipe it with a towel or sth, instead we should contain it in a special container and gives it to the environment ministry to get rid of it in the proper way, and we should **Not** also try to titrate it with ammonia or fluoride, and we should **Not** use vacuum machine or wash it in the sink.

