**بسم الله الرحمن الرحيم**

Last time we talked about monomer for the composite...

**What's the active component of that monomer?**

the double carbon bond, this double carbon bond turns to single carbon bond upon polymerization.

**-** The active double carbon bond is very important for the composite properties.

**-** Upon polymerization , as light cured or chemical cured or dual cured, the double bond turns to single bond.

**Unreacted C=C Bonds**

**- Does all the double bonds will be transferred into single bonds upon polymerization in the composite?**

No, clinically, only about 70% - 75% of double bonds will turn into single bonds (polymerized), 25% -30% of the double carbon bonds will stay unreacted in the final composite set.

**Is this important?-**

Yes, it's important and good, because if all carbon bonds polymerized (transferred) into a single bond, it will be stronger (more bonding), so the material itself mechanically will be better.

**-** So, if you want to turn your composite harder or higher mechanical properties you have to increase the degree of conversion, that we call it the degree of conversion.

**\* The degree of conversion:** the percentage of the carbon bonds that will react in the reaction and form single bonds.

**-** The higher the number of degree of conversion we will expect your composite will be harder and all the terms of mechanical properties will be higher for the composite.

**-** We would like to get more than 75% polymerization, and if we get 100% that's will be perfect, however, clinically with the current conditions, like the light cure and chemical cure, we usually don't get higher than 75%.

**How can we increase the degree of conversion?-**

we can do that in the lab, by increasing temperature, so not the composite itself and the light or chemical activation, we also have to increase some other environmental conditions like heat or introduce pressure into the reaction in order to force more carbon bonds to react in the reaction.

**-** So, you would expect that the composites that's processed in the lab to be harder than the composites that we do in the patient mouth, however, the thing that we do in the patient mouth which does have the 75% degree of conversion, is good enough for our clinical use.

**-** There is one benefit of that incomplete conversion of the double bonds:

 which is the repair or addition possibility of the composite.

**-** Example: if a patient has a stripping in his composite or part of it is fractured ,you can just clean the surface then add new composite, it will bound together.

 The fact that you don't have all the double bond reacted , will let these bonds to react when we addition the new composite(bound together), so you don't have to replace the whole padding, we can just add or repair the old composite.

**>>>** The higher the degree of conversion, the higher the mechanical properties.

 **Shades**

Last time we said that composite restorations are: aesthetic or function restoration, and we know that our teeth are not exactly the same color, some have darker shades and others have lighter shades (variation of shades).

**-** Same as composites, we have to have a variable shades and this is very important in composite restorations and properly this is the most aesthetic material we currently use.

**-** We have to match the translucency and the color of the teeth (we have multiple dimensions of the color: lightness, brightness, saturation and the color itself) all these variables determine the final shade of the tooth and the composite.

**Opaque Shades**

Usually we tempt to use opaque shades of composites to mask any staining in the teeth (hide the color of the enamel and dentine).

Example: if we have a patient that he have round discoloration in the teeth (ex.: tetracycline and fluoride) , so you mask the color that's in the teeth before you replace something aesthetic.

**Translucent Shades**

We tend to use translucent shades of composites in build up incisal edges of the teeth, because incisal edge is more translucent than the rest of the tooth.

So, in one filling of anterior tooth you tend to mix 3 or 4 different shades of composites in order to match the exact same tooth shade.

Incisal edge : translucent

Cervically : more opaque

In between : as the color of the teeth itself

In translucent shades sometimes the composite itself be really free of any stains. Sometimes it's colored by adding blue stain, and because the blue color is complementary to the yellow color so it's look like translucent, but in real it's not.

**>>>** The thing that it's translucent it's much better than the composite that blue stained.

**Detecting Composite Restorations**

 **How to detect composite restorations inside the patient mouth?** **-**

(It's difficult to be detected by shade or color.)

**1-** Feel the composite by probe

Because composite is softer than enamel.

**\*Probe:** is a metallic instrument that have a very sharp pointy tip.

**2-** Take a radiograph (x-ray)

Composites will have different radiodensity than tooth structures.

**\*Radiodensity:** the degree of whiteness that shown in the x-ray.

**-** When the rays reach the tooth it will penetrate the soft tissues, but it will not penetrate hard tissues, so it will return back to the film. So, radiodensity will be different for enamel, dentine and composite.

**-** Enamel & dentine : appears white

 Pulp: appears black

**-** But when composites started to come up many manufactures use to produce a composites that are radiolucent.

**\*Radiolucent:** it's color dark on x-ray as anything soft like pulp, soften enamel and dentine (carious enamel and dentine).

**-** Radiolucent density = Carious density.

**-** Here we have problem, that we aren't able to distinguish between carries and filling. So, the most used nowadays is the radiopaque.

**\*Radiopaque:** show white color in x-ray, however, this white color is not exact the same density as enamel and dentine.

**- What's make the composite radiopaque?**

By adding barium and some other heavy elements to the filling particles in the composite.

**Filler Content**

**-** The most important feature or characteristic to distinguishtypes of composite is the filler element, filler distribution, filler percentage.

**Types & Properties of Dental Composite**

**1- Macrofilled Composites**

**-** **Size of fillers:** 20 - 30 µm (very large)

**-** The first type of composite to be developed in the 1960s.

**>>>** Physical properties: are determined by the volume percent (more admirable to scientists).

The most important to me as an clinical is the percent by volume not the percent by weight ( I don't care about how much is the weight of the filler, as much I care about the surface area that filler occupied inside the matrix).

Example: when a I buy a content that manufactures say that it's 90% filled .... this percent will be for weight and then the percent for volume will be lower than 70%.

-**The major drawback macrofill composites:**

**A-** Black accumulation and staining.

The large size of fillers results in restoration that feels rough to the dental explorer. Anything that's rough in the oral cavity will be site for bacteria accumulation, so we don't like rough surfaces.

**B-** It's wear resistance very low, so it tends to wear very high in oral cavity.

**- For what we use composites:**

When we make restore for the teeth we care to restore aesthetic or function, but this composite don't restore aesthetic or function, so macrofill composites should not be use ( we can't find it nowadays in the markets).

**-** The filler particles type: Quartz or glass (usually they are present in macrofill since they are very huge particles).

**-** When they try to mix the chemical cure macrofill composite, that huge filler particles will tend to abrade the metallic instrument, therefore you start mixing the composite when your done the composite is gray, because that filler particles abraded the metallic instrument itself and that abraded product come incorporated in your composite and change the color o it.

**2- Microfill Composite**

**- Size of filler particles:** 0.04 - 0.2 µm (very small)

**- The problem of using it:** when you have multiple smaller filler particles you would have to have greater matrix in order to surround all the filler particles, so with this type of composite can't fill the composite more than 30% - 52% by volume (filler percentage is low).

**>>>** Smaller particles **....** Smother surface.

**>>>** Lower percentage of filler and High percentage of matrix **....** High wear than macrofill composites.

**- The type of filler particles:** fused silica (you can engineer silica to a very tiny sizes).

**- Usage nowadays:**

**A-** In an area in the mouth that needs very high aesthetic appearance (example: labial aspect of incisors).

Since it has low filler content, so physical properties are lower than what you expect when you have higher filler content. This low filler content and low physical properties, tells you that this type of composites is not very rigid, so it's elasticity is very low (lower than other types of composite).

**B-** Class V restoration: in this clinical indication we need to use microfill composite.

**\*Class V Restoration:** restoration of the cervical one third on the buccal or lingual surfaces of the teeth.

**Why?** occlusal loops on the teeth that have vertical component and lateral component ( lateral component will affect on CEJ).

" CEJ: the area that flexion of the teeth will tempt to flex around (microscopic movement)".

When we will not match the flexibility of the tooth with the flexibility of the filling ( the filling is harder than the tooth), then the filling will deboning. However, if the filling have an elasticity that's close to that of the teeth, it will bind to the tooth itself and it will stay bonded on its place.

**3- Small - Particle Composite**

**- Size of filler particles:** 1 - 5 µm (medium sized fillers).

**-** There is no problem if you want to use it in posterior teeth restorations, because it have a higher wear resistance than both microfill and macrofill composites.

**-** In this type we have range of particles from 1 - 5 µm so we have small particles and large particles , then small particles can occupy the space between large particles.

**-** Stronger than macrofillers and microfillers.

**-** Not for aesthetic restorations.

**4- Microhybrid Composites**

**-** Multipurpose composites.

**-** It was developed late 1980s.

**- The filler content of this composite:** 60% - 70% by volume.

**- Size of filler particles:** 0.04µm and 0.2 - 3 µm (as microfiller and small particles mixed with each others).

**-** Very strong and polish well, so you can use it for posterior and anterior teeth at the same time. we use it for restorations on occlusal surface of the posterior teeth and the areas you want to have a high polish ability for aesthetic in anterior areas. Also, because of its high mechanical ability we can use it in Class I and II restoration.

**\*Class I and II restorations:** restoration in the occlusal surface of the teeth.

**5-Flowable Composites**

**-** First 4 types of composites comes as dope كالمعجونة , but flowable composite is injectable (you can have it in an syringe), so the viscosity of it is very low.

**Why do we want use this type of composite?**

Because some areas in the cavity are difficult to adapt regular composite to it, and by this composite you can reach this areas.

**-** Less strength than microhybrid composite.

**-** The microhybrid and flowable composites have the same filler size (constancy), but however, the flowable composite has less fillers (42% - 62% by volume), it's mechanical properties is lower than microhyoid composite, so we can't use it in restore the occlusal surface of the teeth, so it should be always protected with something stronger,and we use it as a base layer for microhybrid composites.

**- Benefits of flowable composites:**

**A-** Better adaptation for composites.

**B-** It's polymerization shrinkage is lower than polymerization shrinkage of microhybrids (the more shrinkage in the filling the more stress we interface between the filling material and the tooth, so we will have debonding and sensitivity.

**6- Condensable Composites**

**-** You insert the composite and press down with pressure.

**>>>** The higher the filler percentage, the higher the viscosity of composite.

**-** Prevent sliding of filler against each other so when you condense it down, it will stay in its position and will not move.

**- The filler content of this composite:** 80% by volume.

**- Size of filler particles:** 0.04 - 20 µm (It combines all sizes of other composite fillers).

**- Usage:** Usually use for posterior teeth, not for anterior teeth, because of large fillers it doesn't have a smooth surface just like microhybrid or microfill, they have slightly rough surface for posterior teeth.

 