Dental materials sheet No: #1

No slides

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Adhesion surface phenomena.

Dental materials, the core knowledge of Restorative Dentistry, and there is integration with chemistry, biology, and physics because we are replacing tooth structure.

There is a graph that describes 3 types of dental materials:

X: slope is toward 1. Stiff, ductile, strong, and tough. With elastic deformation. Can not be put within the tooth structure which has low elastic deformation.

Y: flexible and brittle. The slope is going down, resilient material with no elastic deformation.

Z: ductile and weak material.

Objectives of the lecture:

1-definition and importance of adhesion surface phenomena.

2-major applications of adhesion.

3-requirments for reliable and durable bonding adhesion.

4-methods of surface treatment.

5-effect of intraoral environment.

Our first 3 lectures will be about bonding to enamel, dentine and composite and how we can manage bonding to tooth structure in a nice way, then we are going to talk about the bonding phenomena ,requirements of the reliable bonding and its effect in our treatment and the oral environment .

The oral environment is one of the harshest environments in our body, there is many factors that are able to make damage to one of the strongest structures of the human body (teeth) either by masticatory forces, moisture, staining, fluctuation in the temperature and cyclic loading.

In enamel we said it is more reliable and easy to make bonding with it that’s why there is one generation of bonding (acid etching and bonding agent ), In the past it was not allowed to make acid etching to dentine (because it is a living structure, endangering the pulp by leading to pulp necrosis and unknown hybridized collagen fibers)

Now hybridization of collagen fibers can make dentine reliable to bond, but unfortunately there are collagenase proteins that destruct the collagen fibers which collapse causing loss of bonding.

Surface phenomenon:

1-adhesion

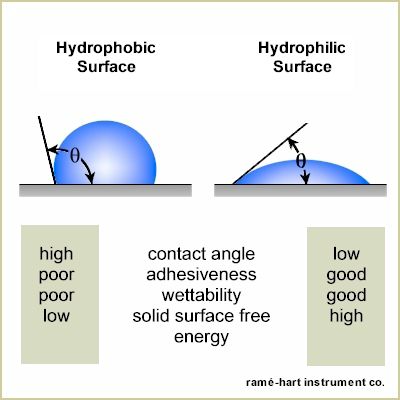
2-surface tension

Surface phenomena: we will talk exactly about loss of atoms and molecules, oxide layer, subsurface area and bonding hybridization layer.

In the 2nd year we talked about the **bulk properties,** materials have an outside layer (surface layer) and subsurface layers. in enamel and dentine we also have these layers and we have to take care in order to change them for bonding.

You have to remember that the **bricks** is the material that takes the place of the outer surface and underneath it there is the subsurface layer (that’s why steel is different than the Stainless Steel in the way of reacting with human temperature)

Surface tension and wetting



When there is high contact area we will have less wetting and we do not want that because the bonding agent that we are going to use will have high wetting, enamel is hydrophilic but less than dentine so enamel has less affinity to water than dentine.

Composite is hydrophobic so it is easier to make it bond to enamel because it is less hydrophilic while dentine is more hydrophilic , so we try to transform the high contact angle with low wetting into low contact angle and high wetting . The goal is to make spreading for the material.

Review of cavity preparation:

>>if we have good retention we can make amalgam filling with good condensation and carving.

>>if composite >> we need to maximize enamel conserving while prepare the cavity, a very important step is to produce proper moisture control by using the rubber dam, acid itching ( phosphoric acid 37% for 15 min if more time, less itching),,dentine needs less time than enamel ,In 1956 a scientist talked about the same mechanism of bonding with enamel (acid etching and bonding agent) but with higher concentration of phosphoric acid. So we decreased this amount to a suitable concentration of the acid >>bout 30-40%.

Acid itching that we use here:

Color : blue

Form: gel (has certain flowability ) or liquid

, and considering the hand piece>>after sterilization process, we can oil on it, oiling of the hand pieces delay friction of the head of the hand piece but this oil could contact with cavity and to prevent this ,we turn on the hand piece for 3 min before start making the cavity.

So duration of acid itching or color or format or if on enamel or dentin depend on the technique 1-total etch technique 2-self etching adhesive technique.

Hybrid layer:

The hybrid layer:

It depends on the micro roughness of the bonding .

Notes:

\*Bonding of the normal dentine is better than reparative dentine

\*Bonding of the primary dentine is better than secondary dentine etc.

So it depends on the clarity of the structure .

Lower viscosity of the bonding agent is better .

The efficiency of the polymerization process is not 100 % \*

The polymerization increases with heat so shrinkage when happened will lead to the debonding.

\*composite is meant to be the future of our work not amalgam or ceramometal crowns.

\*the composite is mainly used for direct restorations and maybe for indirect restorations.

\*fiber reinforced composite: use a micromechanical retention; we can use it with veneers or inlays or ceramic restorations.

\* in general we put oil on hand pieces to save them and increase their life span ,and because of the hand pieces oil we prefer the acid itching instead of the self-itching adhesive in order to remove the smear layer .

\*surface debris or plaque must be cleaned either by acid itching or at least by polishing.

Adhesive:

1-macromechanichal retention ….amalgam

2- Chemical ….. We still did not obtain this amount of chemical bonding.

In composite we use micromechanical retention.

Glass ionomer, there is chemical bonding with hydroxyapatite and it is very limited and weak bond.

In enamel it is easy to bond that’s why there is one generation of bonding (acid etching and bonding agent ) unlike dentine .

So if the bonding technique with dentine is weak the bonding strength will be weak also, even if it was strong in the beginning !! , since there is thermal cycle and cycle loading it will become fatigued ,also there is the collagen fibers that are denatured but we want that to be less than the demineralization of the hydroxyapatite because we are trying to maintain the dentine in a way that will allow filtration to happen by exchanging the water ( hydrophilic )from inside the dentine tubules with the resin (hydrophobic) ,and that will happen by using the primer (bifunctional molecule.. hydrophilic and hydrophobic) , so primer function is to make a connection between the bonding agent and dentine and it is formed 90% of solvent (acetone and ethanol ).

We don’t want the primer component to enter to the dentine tubules we only need it to cover the dentine structure to make plasticization. (ya3ne bas te'3ty aw te3mal tabaqa foq al dentine bdon ma todkhol la jowah ) so that the backbone of the collagen structure stay and still covered by the plasticization layer .

The main goal that we are trying to have is a dental adhesion (enamel and dentin) and for composite to have bonding agent.

Other cases we have porcelain or metal and we want to bond them to tooth structure by inserting luting agent (cement) in between.

We have 2 cements:

1-first surface (adhesive)

2-luting cement

Sometimes we use adhesive cement to cover the space.

\*any surface we make bonding on, there must be a selective component to get micromechanical detention:

In enamel the selective components are the enamel prisms and interprismatic area, interprismatic area will get itched faster than enamel prisms in order to get a rough surface, because it has less hydroxyapatite concentration.

In dentin we have hydroxyapatite in the intra and the enter dentinal tubules, which one of them get itched faster than the other and why? (Homework)

\*we need low surface tension to increase the wettability and the adhesive must be fluid and according to that we have different types.

\*acid:

1-strong acid …. Phosphoric acid

2- Weak acid …… tartaric acid

Sandblasting: mostly used with metals.

\* adhesive :

The main adhesive material particle is BCJM 95%.

sorry for any mistakes.

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