**Dental materials sheet #2**

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Amalgam isn’t our preferred direct restoration anymore for many reasons such as its color , allergic toxicity, environmental hazards that are caused by it and the biological price that the patient will pay .

The objectives of this lecture : a comprehensive understanding of bonding systems ,the bonging methods and how to bond enamel and dentine .

Bonding with enamel differ than with dentine , also dentine itself has different qualities ; each one will have a different type of bonding . Such as secondary dentine ,tertiary dentine , radicular dentine , coronal dentine and so on .

Manufacturer instructions should be taken into consideration . before using any material we should read the instructions and know everything about the material we are using( its cost , how it works ..)

\*\* The dr said that he will provide us with 3 articles for the next 3 lectures .

\*Chlorexidiene deactivates metalloprotienases , so it is part of the bonding agents .

Last year we took the smear layer( the outer layer that covers the dentinal tubules) , smear plug (the part of the smear layer that enters the tubule) and the hybrid layer ( thin layer formed by resin infiltration within collagen network of the surface layer of the dentine that has demineralised ). So, in order to form the hybrid layer there should be demineralization in dentine then resin infiltration and then plasticization .

When we do acid etching ; the hydroxyapitite will be demineralized , and the collagen network shouldn’t collapse inorder to be able to enter a solvent around the collagen instead of water ( like ethanol or acetone) . This solvent will enter the monomer particles with it . This procedure will take 10 or 15 sec (depending on the manufacturer instructions ) and then dry it for 10 sec ( to remove the solvent) , after evaporation of solvent we will have now only the monomer that will bind to the collagen network and keep it on its spatial structure . As we know dentine is hydrophilic , so we use a primer to be able to put the adhesive material .

**The ideal requirements of the bonding agent :**

High surface area , good adaptation , intimate contact between adherent and the adhesive molecule , no degradation of the bond by metaloprotienases , no post operative sensitivity .

In the past ,They thought that rinsing of the acid etch will lead to post operative sensitivity , but the recent studies said that there is no solid evidence that phosphoric acid lead to sensitivity .

**The bonding strategies with enamel and dentine : either etch and rinse or the self etch ( two bottles or all in one adhesive )**

\*\*self etched adhesives 🡪 acid etch and primer and bonding agent at the same bottle

\*\* self etched primer 🡪 less acidulated monomer and the self etched primer

Etch and rise technique :

It’s the oldest technique , formed by Bonocoure (the father of modern dentistry) . At the beginning he used 95% of phosphoric acid , then started to decrease the concentration gradually until 20% , then increased it little to 37% ( the current concentration is 37-40 %)

* The first generation : they put the acid etch then composite (no good bonding)
* The second generation : acid etch and bonding agent
* The third generation : little modifications were done , and its only applied on enamel

{{In the past they put vasline on the dentine inorder not to put acid etch on it , cuz it’s a live structure , and that was called **Selective etch technique** ( etch the enamel only ) }}

* The fourth generation : etching for enamel and dentine ( proposed by Nakabaiashi and Fusayama ) , starting with acid etch then rinse then dry then put primer then bonding . Its called **Total etch technique**
* The fifth generation : etching then rinse then dry then (primer + bonding) together
* Primer is a bifunctional molecule , cuz it contains solvent that replaces water between the collagen network , so this will preserve the collagen structure and prevent the collapse **( plastisization of the collagen)** . then when we dry ; the solvent will evaporate but the collagen will still in its shape (due to plastisization effect of the solvent) .
* In total etch technique, they found that there will be a very high post operative sensitivity ! , so they decided to go back to the selective etch technique (that was used in the 3rd generation) but with small difference 🡪 they put **phosphoric acid** etch on **enamel only** and a **primer** (that contain acidulated monomer and adhesive molecules) **on dentine** .

**\*\*\* Recall that the bonding strategies with enamel and dentine are only two : 1- etch and rinse (**etch ,rinse, dry,....)  **, 2- self etch .**

* We can dry the dentine by using cotton plagitte or by using the suction or by 3 in 1 syringe then re-moisturing the dentine again .**We should keep the dentine moist.**

Most of primers contain HEMA molecules , but it’s a cytotoxic material ! so we must keep it away from the pulp as much as we can .

Note : The Dr said that 95% of bonding agents that we use contain primer . But ideally if the cavity was in enamel only we use acid etch and then adhesive . but if it was in dentine we should use a primer ( if we didn’t use primer the bonding ability of the adhesive with dentine will not be good ).

**Functions of the primer :**

1. Improve the contact with collagen
2. Increase permeability of the smear layer
3. Provide chemical bonding ( by doing a nanolayer )
4. Provide micromechanical retention

Note : If the bonding with dentine was made in a good way ; it will be stronger than enamel bonding . In enamel bonding ; the flexural bond strength is 20 mPa , but if dentine bonding was very good the bond strength could reach 50 or 60 mPa ! .

**Adhesives** : most of them contain

1. HEMA , that binds with HEMA molecules that present in the primer
2. hydrophobic resins (Bis GMA) ,that bind with the resin matrix of the composite

{UDMA and TEGDMA are added to Bis GMA to decrease its viscosity }

The gold standard in bonding is the 4th generation in etch and rinse .

\*Post operative sensitivity : it happens when putting the acid etch on dentine (the itched layer wont exceed 5 micron ) and then putting a primer that will impregnate only **0.2** micron (of the etched layer) , then due to the intrapulpal pressure this will lead to collapse in the area that didn’t receive the primer and lead to post operative sensitivity.

**Self etching primers** : contain acidic monomer (that etch the hydroxyapiptite) , water or ethanol solvent , crosslinking agent , photoinitiator and stabilizers (that increase the shelf life ) .

As we know , when we do composite restoration we should should isolate by rubber dam ,

There is strong , mild, ultra mild acidic monomer , their pH is 2, 3.6 , 4 respectively . But the pH of the phosphoric acid is less than 1 . note that we don’t use the strong acidic monomer on the tertiary dentine , we tend to use mild or ultra mild self etchants .

We must do **agitation** for the acid etch to fasten the etching and demineralisation process .

 If we have intact enamel its better to etch it with phosphoric acid (selective etch) and on dentine we use mild self etchant adhesives .

\*The permeability of dentine : higher on the occlusal surface > coronal dentine > radicular dentine .

\*when we do etching for hydroxyapatite ( which are 70% ) , so we expect to have 70 % of resin infiltration , but actually it will be less than 70% due to plasticization and retaining of water .

**\*\* The dr highly recommend to study a table that’s in the article and there will a q from it in the exam ☺**

Capillary retraction : the continuous intrapulpal pressure on the dentinal tubules will lead to weaken the bond between the restoration and dentine and at the end will debond ; and that’s whats called capillary retraction .

GOOD LUCK :D