  
  
***Title of Lecture: liners and bases***

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***Sheet #5***

***Refer to slide # 5***

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Slide 2 :

Liners and bases have 2 functions :

1. Pulpal protection
2. Pulpal response ( pulp medication ) .

Slide 3 :

Pulpal protection : depends on the preparation and the restoration material that will be used .

1. Chemical protection (residual reactants that diffusing out of the restoration, oral fluids that may penetrate leaky restoration).
2. Electrical protection (because of ions and electrons so to protect the pulp from the electricity of the amalgam ).
3. Thermal protection
4. Mechanical protection ( provide protection for the pulp from mechanical stresses which is distributed to the pulp from the restoration itself )
5. Pulpal medication

Slide 4 :

Thermal protection is needed because metallic materials is thermal conductor, while ceramic and composite are not.

* Thermal insulation is proportional to the thickness of the material so as the liner or base thickness increase the protection will be better.
* 1-1.5 dentin thickness is acceptable but 2 mm is ideal.

Slide 5 :

If the remaining dentin is too small and I used amalgam filling , while I am drinking smthn hot the heat will be transmitted to the pulp through the restoration itself which make sensitivity as the result of direct thermal shock.

Slide 6 :

Pulpal hydrodynamics: we have dentinal tubules which is extended from the pulp towards the DEJ with certain diameter and length, inside these tubules we have odontoplastic processes and spaces between these tubules, so any response that encourage the movement of fluids inside these tubules , they will move from the pulp to the space , which is painful because we have receptors and neurons in the pulp .

While drinking smthn cold the fluid will move from the pulp inside the dentinal tubules or when u are drinking smthn hot which will evaborate the fluid that present in the space between the dentin and the restoration , also fluids will move outside the pulp which is painful as we said before .

slide 7 :

Before doing cavity preparation we have smear layer and its not always covered with dentinal tubules.

Pulpal pressure :

Lets assume that most of dentin has been exposed and now the pulp is exposed to the outside surfaces too , with different pressure , so fluid flow depends on different factors :

1. (d)^4 🡪 fluid flow α diameter
2. ΔP 🡪 fluid flow α ΔP .

* Inflammation increase the pulp pressure 🡪 fluid flow increase too .
* The diameter of the dentinal tubules that is closer to the pulp is larger than the diameter of the tubules that is away from the pulp , so the diameter depends on the extends of the cavity .

1. Fluid flow α 1/ length

* The length increase when the depth of the cavity decrease.

Slide 8 :

Dentin is better in pulp protection than any liner or base … so try as much as possible to be conservative.

So as a conclusion:

**Theory of pulpal hydrodynamics**

The more widely accepted theory of thermal sensitivity holds that temperature sensitivity is based on pulpal hydrodynamics. Most restorations have a gap between the wall of the preparation and the restorative material that allows the slow outward movement of dentinal fluid (Fig 6-1 b). Cold temperatures cause a sudden contraction of this fluid, resulting in a rapid increase in the flow, which is perceived by the patient as pain.50 As dentin nears the pulp, tubule density and diameter increase,1,68 as does permeability,69 thus increasing both the volume and the flow of pulpal fluid susceptible to the hydrodynamic effects of cold temperatures. This may explain why deeper restorations are sometimes associated with more problems of sensitivity.17

According to this theory, if the tubules can be occluded, fluid flow is prevented and a cold temperature does not induce pain. The operative factor in reducing sensitivity to thermal change thus becomes effective sealing of dentinal tubules rather than placement of an insulating material of a certain thickness.

Slide 12 :

* Liners: cement or resin ( polymers like BIS-GMA ) coating of **minimal thickness and that is the difference between liners and bases which is thicker (usually less than 0.5 mm)** usually applied only to dentin cavity walls that are near the pulp to achieve

1. a physical barrier to bacteria and their products ( most of liners have antibacterial protection ) .
2. to provide a therapeutic effect, such as an antibacterial or pulpal anodyne effect.
3. They also contribute initial electrical insulation.
4. Generate some thermal protection.

Slide 13 :

Metallic restoration not well bonded to the tooth structure because there is always a space between the restoration and the tooth structure , so using liners provide better seal .

Slide 14:

Thin film liner

* 1. m can be subdivided into:

1. Solution liners (varnishes 2-5um) : very thin layer
2. Suspension liners (20-25 um)
3. Cement liners (200-1000um) selected for pulp medication and thermal protection. (thicker)

Slide 15 :

**Solution liners (varnishes) :**

* The first type of liners
* Very thin
* There thickness 2-5 micrometers
* Composed of resin ( copal or other resin 10% of the material
* Dissolved in a volatile non-aqueous solvent (ether, alcohol and acetone)
* The resin content is a very low >> when the volatile solvent evaporate thin layer of resin will be produced on the dentine
* Most solvent loss occurs in 8-10 seconds and does not require forced air assistance
* They are flexible have no strength (can’t be used in a mechanical protection)
* We use it in amalgam filling over the smear layer
* Some moisture is present in the smear layer and varnishes are hydrophobic so a single layer is not enough to cover the dentin surface ( because the smear layer is moist and the resin is hydrophobic we can’t use just one layer >> the first layer will come in contact with the smear layer so we add another layer to give enough strength over the first one )
* Varnish has commonly been used under amalgam restorations and before cementation of indirect restorations with zinc phosphate cement.

Slide 17 :

* Note : from the table u have to know the

\*\* components :

\*solid: copal resin

\*solvent: ether, alcohol, acetone

\* setting reaction: is physical (by solvent evaporation)

\*\* Wetting: is poor with hydrophilic surfaces (we need multiple layers)

\*\* Bonding: covalently bonded with organic materials (weak) the bond is between the same compound with no chemical bonding

Slide 18:

**2. Suspension Liners:**

* Aqueous : based on water have many of the constituents suspended instead of dissolved and are called **suspension liners**
* Produce the same effect as solution liners.
* They dry more slowly and produce thicker films.
* The differences between them and the varnishes :
  + - 1. They are not dissolved they are water resist
      2. Resin is non aqueous
* Ex:

Slide 19 :

1. **Eugenol:**

\*A Parasubstituted phenolic compound that is slightly acidic. (Has OH group)

\*It produces palliative or obtundent actions on the pulp when used in low concentrations. They alleviate discomfort resulting from mild to moderate pulpal inflammation. (Has an analgesic effect in LOW concentration)

\*High concentrations can be irritating.

Slide 20 :

\* Several cements, bases and liners result from the reaction between zinc oxide and eugenol.

\* In liners small amount of eugenol is released over a period of several days. For this reason these materials were used in relatively deep preparations.

\* We always mix the eugenol with zinc oxide and we use this material as a liner > during the chemical reaction small amount of eugenol releases from the cement and this helps in reducing the pain so we use it in deep preparation

\* if the material releases large amount of eugenol >> irritation will happen so we don’t use it with zinc oxide cuz zinc oxide releases the eugenol during the chemical reaction

Slide 21:

1. **Calcium Hydroxide:**

\* They are based on the reaction between calcium ions from calcium hydroxide particles and phenolic moieties on mono-functional or multi-functional molecules.(the reaction between calcium ions and phenolic grp which is a benzene ring with OH )

\* They are formulated to undergo a chemical setting reaction but allow minor amounts of calcium hydroxide to be released from the liner surface to produce the desirable effect (reparative dentin formation). ( we have chemical reaction same as eugenol with zinc oxide and small amount of calcium hydroxide release help in repair the dentine)

\* Used in the deepest portions of the preparation or when pulp exposure is suspected.

Slide 22 :

\*the function of calcium hydroxide encouraging dentinal bridging.

\* Reparative dentin formation is assisted, rather than stimulated due to the antibacterial action of calcium hydroxide, which reduces or eliminates the inflammatory effects of bacteria and their by-products on the pulp.

\* Calcium hydroxide may release growth factors from dentin that can assist in pulpal healing.

Slide 23 :

**\*\* The problem with calcium hydroxide is**:

* + - * 1. They may degrade severely over a long period of time so that they no longer provide the mechanical support for the overlying restoration.
        2. Unfavorable physical properties restrict calcium hydroxide use to application over the smallest area that would suffice to aid in the formation

of reparative dentin when a known or suspected pulp exposure exists.

Slide 24 :

\*\* in the table there is comparison between different liners:

* + - * 1. Calcium hydroxide :
        2. Reinforced ZOE
        3. Traditional glass ionomer cement

All these are used as a liners

Tables are for you to read about them but the DR will ask about the differences between the glass ionomer and calcium hydroxide >> mainly the differences in the composition or mechanical properties or thermal conductivity.

Slide 25 :

**Current status:**

Newer liners place less emphasis on pulpal medication and more on chemical protection by sealing, adhesion and mechanical protection.

Sealing is the most important property.

Ceramic and or polymeric materials provide excellent thermal insulation.

Newer compositions rely on mechanically strong acrylic resin matrix and this makes the release of eugenol or calcium hydroxide ions almost impossible.

We talked about the physical properties of GI and ZIE is very weak >> so we add resin and now its called resin modified ionomer

More resin >> more reaction >> less release of the material >> less release of eugenol and calcium hydroxide

Slide 26 :

**Bases:**

Materials to replace missing dentin, used for bulk buildup and/or for blocking out undercuts in preparations for indirect restorations. Cement bases typically 1-2mm.**(thicker than liners)**

They are used to:

1. Provide thermal protection for the pulp.
2. Supplement mechanical support for the restoration by distributing the stresses from the restoration across the underlying dentin surface.

This mechanical support provides resistance against disruption of the thin dentin layer over the pulp during condensation of amalgam or cementation of indirect restorations.

Slide 27 :

* First they used **Zinc phosphate cement and resin reinforced zinc oxide eugenol** were widely used for bases in the 1960
* then **poly carboxylate cements** became popular.
* Later they started using **glass ionomer cements**. Highly modified forms of glass ionomers provide chemical adhesion, good mechanical strength, and rapid achievement of strength.
* Slide 28 the dr skipped it !! and didn’t say anything about it !!

**Slide 29 :**

The table :

* + - 1. **Zinc phosphate >> the compressive strength 70**
      2. **Polycarboxylate >> the compressive strength 100**
      3. **Glass ionomer >> the compressive strength 120**
      4. **Modified glass ionomer >>the compressive strength 200**

**\*\* they change the material according to their properties :**

**Same structure**

**Same thermal and electrical**

**The difference in strength**

**They modified the mechanical properties**

**Slide 30 :**

**Clinical considerations:**

* + 1. The need for specific types of liners and bases depends on:
       - 1. the remaining dentin thickness.
         2. Consideration of the adhesive material.
         3. Type of restorative material being used.
    2. Various liners and bases may be combined in a single preparation and the dimension between the pulp and the restoration may be a combination between natural dentin, liner, and base.

Slide 31 :

* In a shallow tooth excavation:
  + - 1. there is no need for pulpal protection, other than in terms of chemical protection.
      2. For an amalgam restoration dentin is coated with two thin layers of varnish, a single coat of dentin sealer, or a dentin bonding system.
      3. For a composite restoration the prep is treated with the bonding system.

Slide 32 :

* In a moderately deep tooth excavation:
  + - 1. For an amalgam restoration that includes some extension towards the pulp we apply zinc oxide eugenol (provides some thermal insulation and releases some amount of eugenol that is obtundent to the pulp) or calcium hydroxide to provide pulpal medication.
      2. For a composite tooth preparation eugenol is not used as it has some potential of inhibiting polymerization of layers of bonding agent or composite that are in contact with it. So calcium hydroxide is used if a liner is indicated.
* The dr summarized these points by :
  + - * 1. For Shallow tooth excavation there is no need for liner or bases we may use sealer which is varnish to the amalgam
        2. Moderate deep tooth excavation : we need liner (calcium hydroxide)
        3. Deep : we need liner and bases

Slide 34 :

* The pic is in our book :
  + 1. In shallow >> we don’t use anything
    2. In moderate >> we use liners like : ZIO or calcium hydroxide
    3. In deep >> bases and liners are used and varnish as sealer for amalgam
* Read the table
* The last two slides the dr didn’t mention anything about them (skipped them!)