Sheet number: 11

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Let’s starts by few comments regarding the root surface;

-First, the root surface is rougher than the enamel, regularly allowing plaque formation in the case of a bad oral hygiene.

-Second, the cementum covering the root surface is extremely thin, providing little resisting to caries attack.

The root surface of the tooth is covered by a thin layer of cementum covering the dentine while in the coronal part is covered by enamel, so coronally enamel is protecting dentine, whereas the thin **cementum doesn’t provide a good protection at all**.

Susceptible root surface + bacteria + fermentable carbohydrates + time are the necessary elements to start the root surface caries.

Root caries: are lesions that start in the coronal part and extend to the root (or vice versa) and at the end it is class V or root caries. They are soft progressive lesions that are found anywhere on the root surface that has lost connective tissue attachment due to gingival recession and is exposed to oral environment.

There are conflicting views about root lesions in the area of CEJ as whether the initial caries occur on the crown and extended to the root or on the root and extended to the crown.

Root caries are usually more rapid than other forms of caries so these lesions should be dected and treated early.

CEJ:

This diagram shows the relation between cementum and enamel. All these situations may present in the same tooth. Pay attention to the percentages that represent the incidence of each relation.

As we said, cementum is thin, and while scaling and polishing it might me easily removed and then the dentine is exposed. And because of the presence of cementum in the coronal region of the root

and due to the extending of scaling and root planning procedure radiculary, there is high probability that the cementum has been removed. Therefore **all root caries are dentinal caries** (caries start within the dentine).

Root caries **occur** supra-gingivally most often at or close to the CEJ within an area of 2mm.

The location of root caries has been positively associated with age and gingival recession. The root caries need an exposed root to start, normally the root is covered by gingival tissue. So **the first step for root caries to occur is gingival recession** andthis is consistent with the concept that root caries occur at location adjacent to crest of gingiva where dental plaque is easily accumulated, resulting in gingivitis and gum recession.

The doctor showed a diagram showing gum recession which might be due to more than one reason;

**1-palque induced gingivitis and then periodontitis then gum recession.**

**2-chronic fault tooth brushing or bad habits.**

**3- Iatrogenic causes, due to invasion of biological width or following perio surgery.**

-Caries process by definition: is a dynamic process, involve phases of demineralization and re-mineralization, as long as the condition is around the tooth whether in enamel or dentine or within the root, when the condition encourage demineralization (CHO and bacteria are there) then acid production and cavitations may start within enamel or dentine by this demineralization process. If we changed the condition such as removal of dental plaque, tooth brushing, fluoride or high saliva, the condition might shift toward reminirealization.

Dentine is deminiralized by acidic by-product of caries process. The layer which still has intact organic matrix is reversibly diseased and any remaining bacteria will arrest after restoration placement.

After demineralization, the tooth structure becomes affected (NOT INFECTED), and if causes of demineralization are still there, then more bacteria invade and the caries lesions become infected and this will need removal of carious lesion and making proper restoration, and the condition becomes irreversible.

The doctor showed a slide of a 2nd molar with extracted 1st molar, and there is a discoloration within the mesial proximal surface of the 2nd, and probably distal to the premolar, this discoloration shows an arrested caries, demineralization started and after extraction the area became more cleansable and more saliva is allowed to reach it, thus reminiralization occurred. This discoloration is mostly stain. If you do a longitudinal section in that area (the Dr. showed a picture), then you will see the carious lesion within the enamel is triangular in shape (the base toward tooth surface and apex toward DEJ). In more advance, the carious lesion might involve enamel and dentine with intact surface, so never use a probe to see if there is a cavitation or not because this may change the condition from affected to infected. Up to this stage (even if part of dentine is involved and seen by bitewings), as long as the surface is intact and the patient is asymptomatic, then only follow up is needed. BUT, if there is pain and the lesion is seen by BWGs reaching more than half of the dentine, then it should be restored. The same thing is applied to root caries (they also might be arrested or might be soft and break the walls, the same explanation with the same factors are applied here).

A carious lesion within the dentine or root caries could be defined as a carious lesion that is confined to the root between; 1-soft irregular shaped lesion that is totally confined to the root, or 2- started within the CEJ (from the coronal part and then extended to the root) or 3-start on large area within the root, then invade enamel up and laterally as one layer, ill-defined lesion.

Again, the four factors needed for a carious lesion to start are:

1-susciptable root surface (enamel or dentine). 2-fermentable carbohydrates. 3-bacteria. 4-time.

By the time, acid is produced, demineralization starts. The PH for dentine to be dissolved and for demineralization to start is about 6.2 (critical PH). For coronal caries it’s 5.3. So demineralization of root surface through cementum and dentine is 2 times rapid than the demineralization of enamel (demineralization is faster within dentine than within the enamel, as dentine is less mineralized and has higher pH).

As demineralization continue; the collagen fiber will be exposed and cavitated lesion occur then degradation of collagen fiber happened .

**Similarities and differences between coronal and root(dentine) carious lesions;**

Coronal and root caries **share** common risk factors:

1. Microorganism: streptcoccus Mutans and lactobacilli. (main cause\factor)
2. Common predisposing factors
3. Share similar process of dentine destruction and remineralization.

**Differences:**

1. Related to pH (coronal pH = 5.3, root pH = 6.2 ) , at which demineralization begin .
2. The rule of proteolytic enzymes in the destruction of initial target tissue and rate of progression.

**Incidence of root caries:**

In HAO survey shows an increase rate of root caries in adult. As coronal caries increase 2.4 folds, the root caries increase 21.8 folds so root caries increase more than coronal caries.

old people have more gum recession and we expect more root caries.

**Diagnosis of root caries depends on**:

1. *Clinical picture:* as we said, the first thing that occurs is gum recession (exposing of the root). Clinical appearance ranges from small slightly softened and discolored area (yellow to brown) to a hard lesion. There is no reported clinical symptom of root caries although pain maybe present in advanced lesions, (no complain in the first initial lesion but if it becomes too close the pulp, pain may occur). **The most comonly used clinical signs** to describe root caries is visually (depending on the color, contour, cavitations) or tactile (surface texture, we use a probe for that when we are sure it’s a cavitation to see is it hard “sclerotic dentine” or “soft “where you have to remove the carious lesion” ).

A picture showing a canine and a PM with a brown discoloration.

-Color: carious lesions are brown to yellow in color rapidly progressive one (especially brown one)>> active lesions. Dark brown lesions usually of a slow progression.

-Contour: **well defined**: active caries lesion or **ill defined**: arrested lesion.

\*DON’T use a probe to see if there is a carious lesion or not if the surface is still hard, whether coronally or within the root, only use the probe to clean the tooth from food debris or plaque.

-Differential diagnosis of root caries:

1-Active root caries; light brown (color), soft, leathery and elastic in nature (texture).

2-Arrested; dark brown to black (color), hard , cannot be compressed (texture)

3-Just stains; dark in color (color), hard and rough texture

1. *Radiograph:* accurate radiographs can help in diagnosis of root caries**, if there is no overlap and when cervical burn out artifact is excluded.**

We said that gum recession is initially there, this mean there is **a bullous**, this is how root caries is differentiated from other artifacts. So, to tell that this radio-lucency is root caries not cervical burn out you have to see **first bone loss**. Root caries are not identical in all teeth. No enamel involvement is seen.

1. *Assessment of risk factor*:

Remember, in **general gingival recession** is more common in old people and after perio surgery.

**Xerostomia:** accompany from radio-therapy or as side effect of many medications.

**High sugar intake.**

**Improper design or\and use of removable partial denture (RPD).**

**Over hanging restoration.**

**Smoking.**

Usual locations of root caries:

**1-exposed roots:**

**Management:** Removal of caries and restore will proper restoration

**Which type of composite usually used for root caries? ( the only classification that we have for composite depend on the filler, micro ,macro filler )**

Its Glass Ionomer cement. Why? 1-we may have difficulty in isolation. 2- bond to tooth structure 3-it release fluoride “but also composite do”. (we will talk about it later)

**2- defective margins**

**Management:** removal of restoration and see whether the remaining tooth structure is restorable, and proper restoration

**3- Over hang restoration**: easy for plaque to accumulate >> root caries

The management is removal of the whole restoration and do proper cavity and removal of root caries, then proper restoration.

**4- Root caries distal to lower 2nd molar, with impacted 3rd molar (food impaction, plaque accumulation)**

**Treatment:** is first by doing extraction of wisdom , then proper access for doing proper restoration

Root caries are more common in males than females, most commonly they are seen in **mandibular** molars followed by PM , canine, and incisors, **this order is reversed in maxilla** (incisor, canine, PM, and then molars) .facial and proximal surfaces are more susceptible than palatal and lingual surfaces.

**Classification:** regarding 1- carries activity: Active and inactive

2- tissue involved: dentin or cementum

3- color: yellow, light brown, dark brown, black

4- texture: soft, leathery or hard

5- presence of cavitation

6- Location: confined “primary” ,or scattered and extended “secondary”

**Treatment:** different ways to remove caries and do cavity preparation

Rotary instrument, chemo mechanical, laser, ozone, air abrasion, sonic preparation

**Rotary instrument:**

\*Always remember that the best bur to remove any caries specially root caries is large round bur with slow speed hand piece (small round bur is more time consuming and more possibility of pulp exposure), we choose large round bur that is suitable with the size of the cavity and not larger than the cavity or carious lesion

The dr. showed a pic and he Saied that: the first thing that you will think about when you see this carious lesion is that this tooth is indicated for endo treatment, you have to depend on clinical findings “signs and symptoms”, regardless of the size of the caries. So do proper examination, is the patient tender to percussion, history of acute pain, if no signs and symptoms then start removing the caries. And even if the tooth is indicated for endo, you have to do first proper clean “remove the carious lesion”, and do proper restoration, then do endo treatment. because 1- I will never be able to do proper isolation using rubber dam or any other technique and do proper endo. 2- you can’t do instrumentation when the cavity is carious because I want to reach a sterile canal

Start removing caries in any cavity within the walls **(clean walls first)** with large round bur , don’t start toward the pulp. When you finish cleaning caries from the whole walls (it will take less than 1 min) , you then clean the cavity

Remember that the shape of the carious lesion is cone shape, whether in class 1 or class 5 and even in class 3

**Restorative materials could be used as restoration for root caries:**

1-resin modified glass ionomer

2-conventional glass ionomer

3-compomers

4-composite

5-amalgam

The main differences between these materials is: first, **esthetic** , **bonding to the tooth structure, fluoride release** (fluoride **inhibit** rather than prevent the carious lesion)

Note that the first four materials **bond** to the tooth structure, **colored** restoration. While amalgam mechanically stay in the cavity and not esthetic restoration.

**Conventional GIC :**

**Advantages:** fluoride release, esthetic, bond to the tooth structure

**Disadvantages:** typical handling, typical finishing, water contamination during placement leads to weak and opaque restoration, dehydration causing crack of the restoration (so you need to apply protective layer or cauting agent)

GIC available as powder/liquid or in capsules.

How fluoride released from conventional GI and resin modified GI ? they both set by acid-base reaction, fluoride released as byproduct of setting reaction

The dr. showed a diagram how GIC bond to tooth structure?

remember that the powder of GI composed of aluminum fluoride and silicate powder, and the acid is polyacrylic acid, so the acid will attack the powder and we will see calcium ions, aluminum ions , and carboxyl group (coo - ). Acid will react with calcium and aluminum and the material will start to set, at the same time the carboxyl group will bond to calcium and phosphate within enamel and dentin (this is the chemical bonding of GIC).

 **\*powder is flouro aluminum silicate, and the acid is polyacrylic acid.**

acid attack the powder>> Ca and Al will be released>**>** the act by carboxyl group from the poly acrylic>> polymer matrix & at the same time bond to tooth structure

**clinical tips:**

don’t over finish the margin of GI restoration, because GI develop strength slowly, and finishing should be done with light pressure and less abrasive disks.

Rechargeability of fluoride in GIC is higher than composite, however avoid using acidic topical fluoride to prevent erosion of GI

The dr. showed a diagram how fluoride initially released to the tooth structure to enamel and dentin make them less susceptible to acid attack, and then fluoride start to release into the oral cavity and hence decrease the amount of microorganism and act as anticariogenic.

**2- resin modified GIC, which is conventional GIC plus some amount of resin**

It sets by **2 setting reactions**: 1- conventional acid-base reaction

2-light cure free radical polymerization of resin content

**Main advantages:** higher early strength, easier finishing and polishing

\*remember that after acid etching technique, we need to do washing and drying, remember to follow the instructions that come with the material, don’t do over drying, gentle drying is needed, many bonding agents and composite need moist or wet cavity (over drying may be the reason why the restoration will fall a day after filling). This is because over drying will cause collapse of collagen fibers within dentin and it will not bond to composite.

The most important tool to do proper class 5 restoration is to use **cervical matrix.**

Advantages of cervical matrix: 1- **contouring**,

2-smooth surface (**best smoothness** u can get is from Mylar strip or cervical matrix, you can’t reach such smoothness with the finishing burs, so be careful to put the proper amount of the restoration,

3- **adaptation** {remember that part of the bonding in composite and GIC is chemical + blue light, so in order to be able to bond we have to bring the materials together}. So proper content and proper adaptation you will get proper final restoration,

4- to get **proper polymerization** reaction of the composite you have to isolate the composite “or the last layer at least” from the atmosphere (note that when you do curing of the composite without mylar strip/cervical matrix, you will notice that the composite is still sticky, because the polymerization not yet completed.)

Over time resin modified GIC tend to expand, therefore it requires trimming in later appointments, expansion is more severe when the materials are not adequately mixed or contaminated with water during placement.

**3- Compomers**

Compomers or polyacids modified composite used mainly for restoration in **low stress bearing area**.

It’s mainly **composite with some amount of GIC.**

Some compomers have modified monomers that provide additional fluoride release.

Setting occur primarily by light cure polymerization, but an acid-base reaction also occur as compomers absorb water after treatment and upon contact with saliva.

**4- Composite**

**Microfill** composite is the recommended one, because it has low modulus of elasticity (class 5 here is within the root, and the tooth may flex, so if the material we have has high modulus of elasticity the restoration will fall)

**Low modulus of elasticity** means that when the tooth flex, the restoration flexes as well, its flexible restoration material that flex with teeth during function.

Here also we need to have **moist dentin.**

You have to apply a layering technique, even in class 5 or root caries you have to apply the restorative material “composite” **incrementally**.

**Main advantages:** esthetic, bond to the tooth structure.

**Main disadvantage:** polymerization shrinkage

Fluoride releasing composite: some branch of composite resin are modified to release fluoride from their filler particles, radio-opaque agent or resin matrix. However they are nor rechargeable, neither release fluoride as other restorative material such as resin modified GI, therefore these materials can’t be used to restore root caries in patients with high risk caries.

**5- amalgam**

**Main disadvantages:** esthetic, poor fluoride release, lack of adhesion, disposal and safety concern

**Main advantage:** technique insensitive, self-sealing margin, wear resistance

\*The recommended material for **high caries risk patient is resin modified GI** (bond to tooth structure, release fluoride, esthetic and fluoride rechargeability and stronger than conventional GI )

\*For **high esthetic demand composite** is recommended

\***amalgam** can be used in case of **difficulty to do proper isolation**, and **esthetic is not critical.**

whether you are using composite or GIC when you are doing finishing and polishing, don’t start directly with polishing disks, remember that its two steps: it is **finishing** (where you have to use the diamond bur to remove excess material) **and then polishing** (using polishing disks).

We have more difficulty in restoring root caries that are **subgingivally**, here we use **retraction cords**, or **proper rubber dam** using special clamp “212 clamp” to get proper isolation of the cavity during restoration of root caries, **surgical technique** “forget it”

The next lecture is about other problems during root restorations .

Sorry for any mistake,

Good Luck ☺