Restorative & Preventative Materials

Dental Materials Session #2

Dr. Andrew Moshman
Prof. Anne Fiordimondo
Dr. Daniela Taranto

Dental Materials Lecture #2 Outline

- Adhesive Dentistry (Composites, Compomers, Glass Ionomers)
- Amalgams
- Microleakage
- Matrix Bands/Sectional Matrices
- Liners and Bases
- Sealants
- Polishing

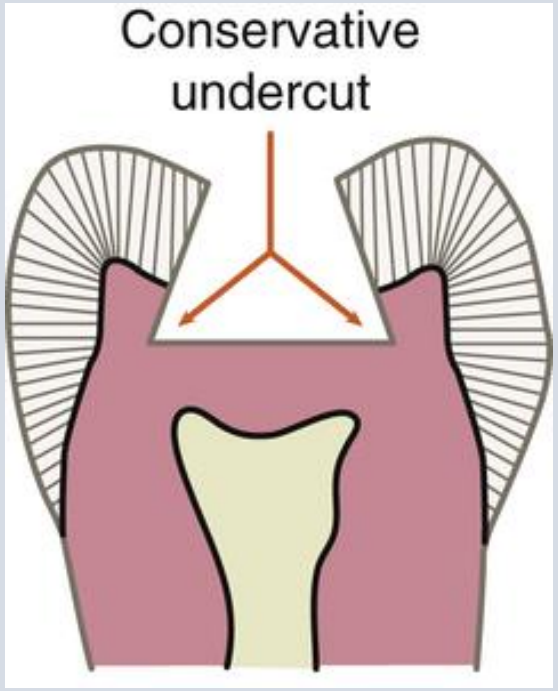
Role of Dental Hygienist

- Identify Different types of Dental Restorations
- Identify Failing Dental Restoration
- Proper Maintenance During Hygiene Visits
- Advise Patient on Best Home Care Practices

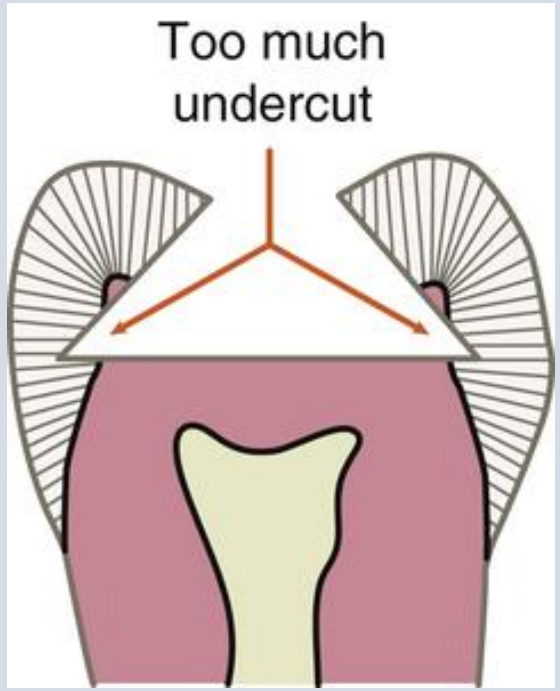
Learning Objectives

- Explain the components needed for Adhesive Dentistry
- Discuss the effects of acid etching on enamel and dentin
- Describe the various types of composite resin restorative materials
- Describe how fillers affect the properties of resin composites
- Compare and Contrast the different properties of Restorative/Preventive materials.
  (Composite vs Glass Ionomer vs Compomer vs Amalgam)
  Understand the properties of different sealants
  (Resin vs Glass Ionomer)
- Understand how to use Matrix Bands and Sectional Matrices
- Explain the function of Matrix Bands and Sectional Matrices
- Review Polishing Restorations

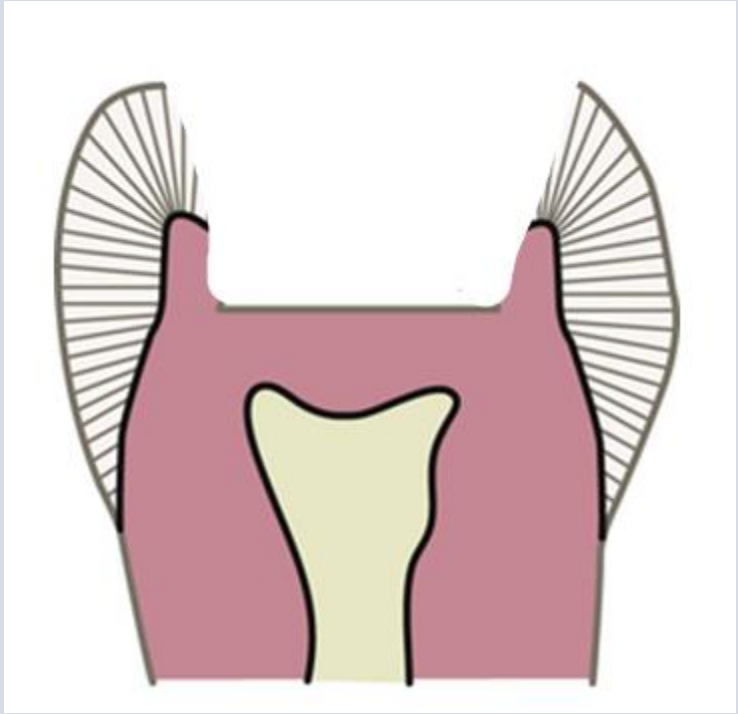
How do Fillings stay in the tooth?



Retentive Preparation



Too Retentive Preparation



Non-Retentive Preparation

From Anusavice KJ: *Quality Evaluation of Dental Restorations: Criteria for Placement and Replacement,* Chicago, 1989, Quintessence Publishing.

Adhesive Dentistry

- Adhesive dentistry deals with dental materials which allow ***bonding to*** the natural substance of teeth, mainly enamel and dentin.
- Adhesive dental materials depend on bonding properties rather than a retentive preparation to stay attached to the tooth structure.

Materials in Adhesive Dentistry:

-Resin Composites

-Glass Ionomers

-Compomers

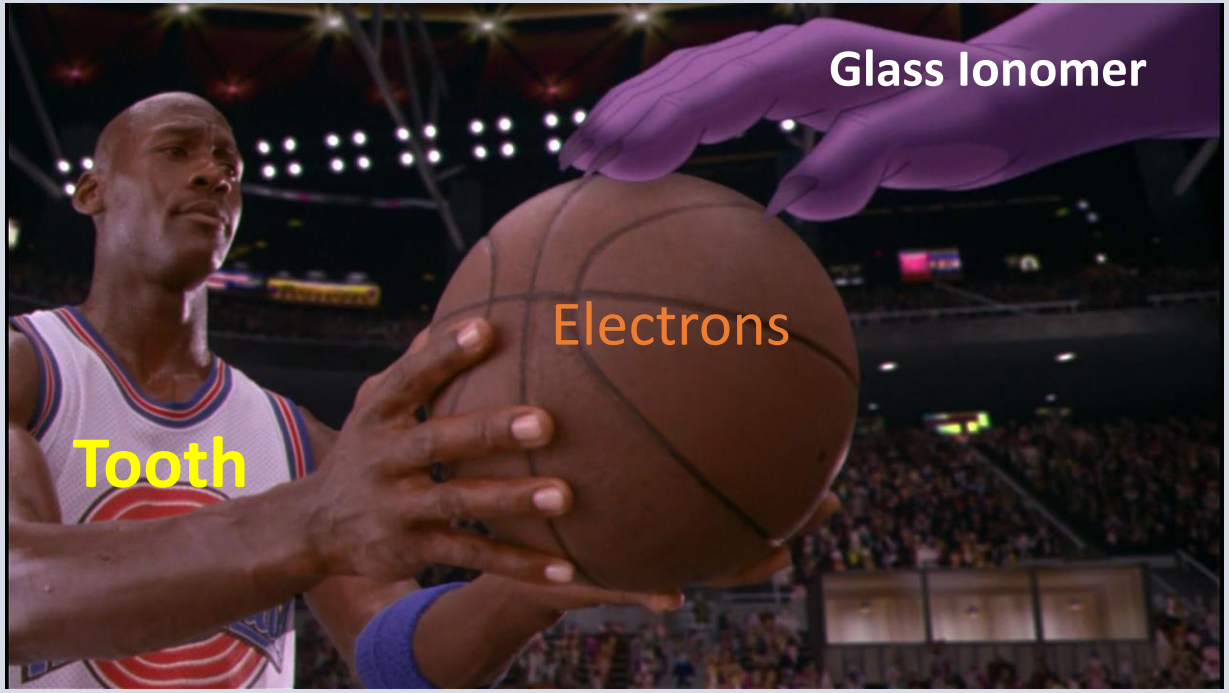
Bonding in Resin Composites vs Bonding in Glass Ionomers

<u>Resin Composites:</u>
Micromechanical Bonding
(Polymerization Reaction)

Tooth

Resin Composite

<u>Glass Ionomers:</u>
Chemical Bonding
(Acid Base Reaction)



Bonding

Cure or Polymerize

Learning the Language of Adhesive Dentistry

Etching or Conditioning

Adhesion

Bonding

Bonding: to connect/fasten/bind.

Bonding can be accomplished by:

- mechanical adhesion (physical interlocking)
- chemical adhesion
- combination of both mechanical/chemical

Adhesion

Adhesion: the act of sticking 2 things together

-in dentistry it is used to describe the processes of ***bonding***

or ***cementation***

- in dentistry chemical adhesion occurs when atoms or molecules, which are dissimilar, join together

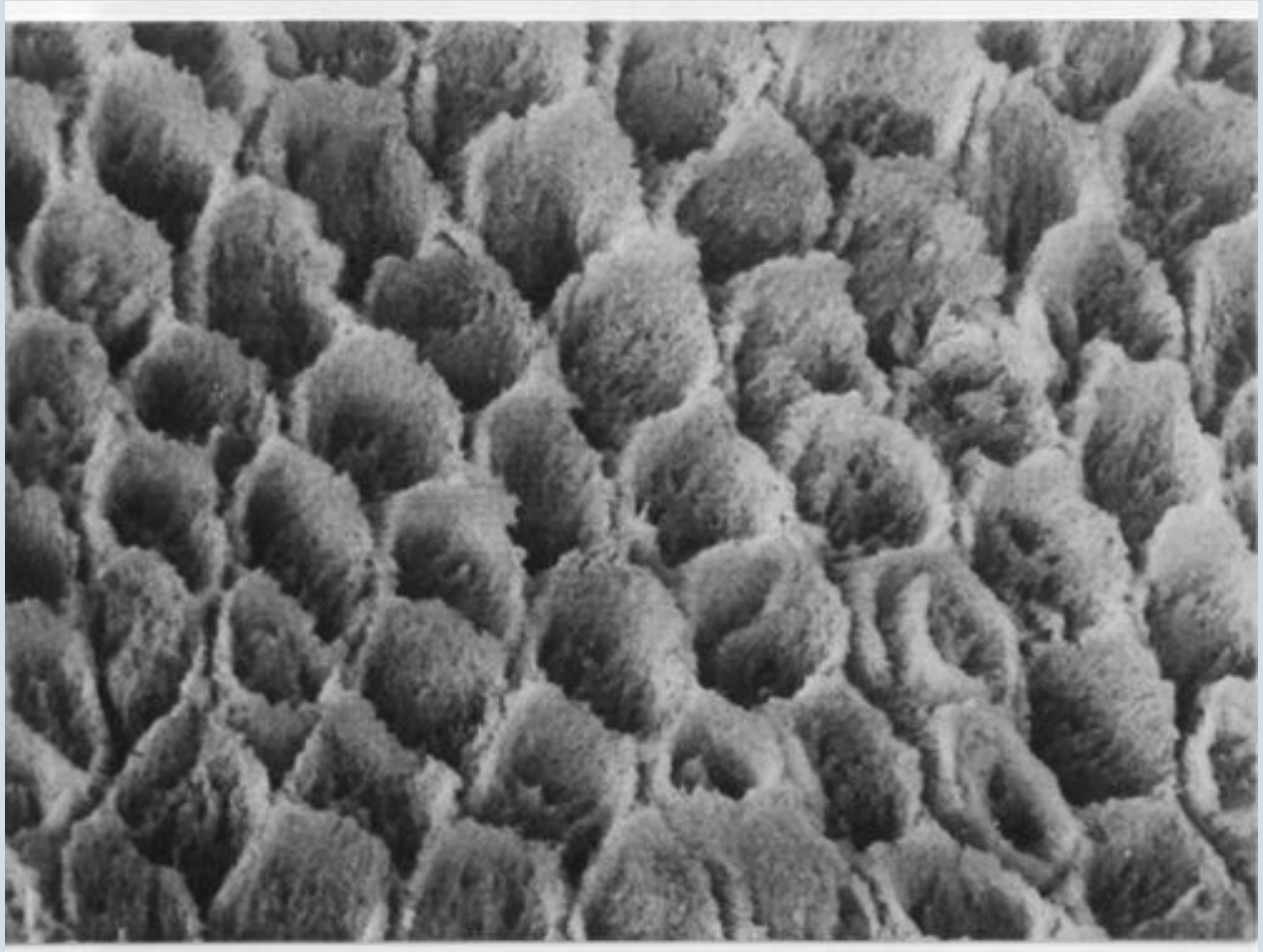
Etching or Conditioning

Etching/Conditioning: the process of preparing the tooth surface for bonding.

- the product can be in a liquid or gel form
- will roughen the surface (creating retention/enamel tags) to increase adhesion
- applying an etch causes a ***controlled erosion,*** creates rough features called "tags and tunnels" that are better able to absorb bonding resin which can chemically & physically lock it into place on the enamel and dentin surface.

Phosphoric Acid (35%) most often used as the etching agent.

Etched Enamel / Enamel Tags



Cure or Polymerization

- Cure or Polymerization is a term used to describe a reaction that links low molecular weight resin molecules (called monomers) to high molecular weight chains (called polymers) which harden or set.

***Chain of Events**:

1. An initiator breaks down the double bond
2. This forms a free radical
3. The free radical then reacts with a monomer, forming a new bond
4. Additional monomers are then added to the chain
5. The free radicals combine

Adhesive Agents

Function to:

- provide a seal between the tooth & the restoration

- seal the dentinal tubules to decrease post filling sensitivity

- enhance retention so less tooth structure has to be removed for retention

TOOTH

Resin Composite

What is in a Resin Composite?

1) Resin Matrix: Bis-GMA, UDMA, TEGDMA

2) Filler Particles (Glass, Quartz, Silica)- are added to make it stronger. The more filler particles in a composite, the stronger it will be

3) Coupling Agent: Silane (Allows Resin Matrix to Bond to the Filler Particles)

4) Photoinitiator: Camphorquinone (starts the reaction)

General Properties of Composite Resins

- Micromechanical Bond
- Polymerization Reaction
- Shrink When Setting
- High Bond Strength
- Stronger Physical Properties
- No Fluoride Release
- Very Technique Sensitive
- Poor tolerance to moisture contamination
- Sets immediately once cured with light

Resin Composites: Flowable vs. Packable

Flowable Composite

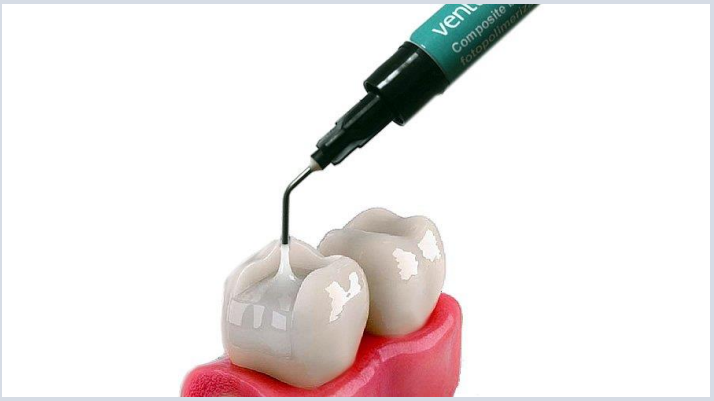
-More Resin Matrix, less Filler

-Less Viscous, More “Flowy”

-Shrinks More On Setting

-Less Strong

-Class V Preparations &
Bottom Layer of Class I and II



Packable Composite

-Less Resin Matrix, More Filler Particles

-More Viscous, Less “Flowy”

-Shrinks Less On Setting

-Stronger

-Class I and II Preparations

Composites are Classified by Filler Size

- Macrofilled
- Microfilled
- Hybrid Composites
- Microhybrids
- Nanohybrids
- Nanocomposites

Macrofilled Composites

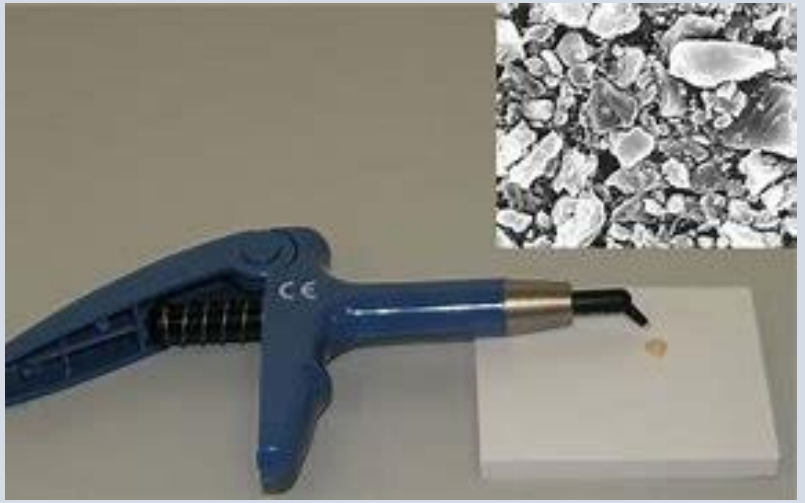
- Relatively large particle fillers 10-100 microns
- Difficult to polish
- Wear more rapidly
- Stronger than composites with smaller particles
- No longer widely used.

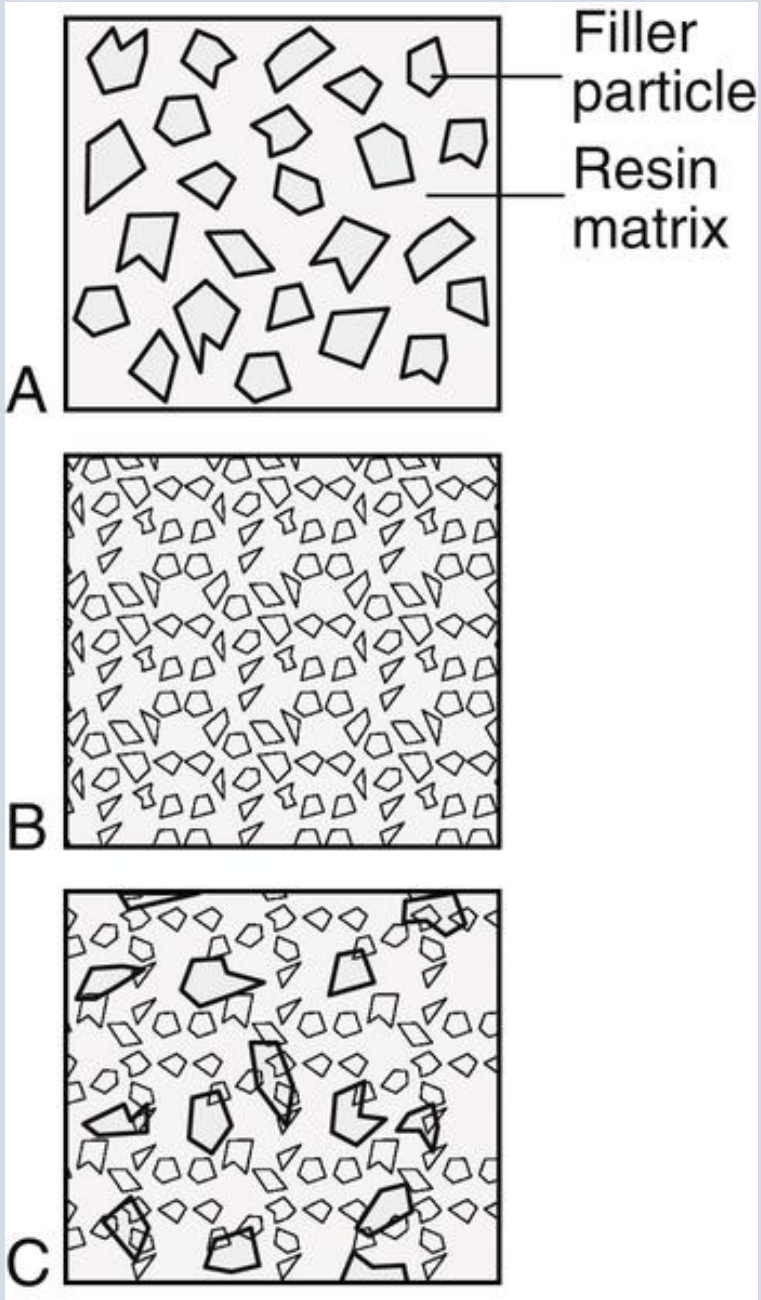
Microfilled Composites

- Developed to overcome problems with large filler size of macrofilled
- Filler particles are 0.03-0.5 microns in diameter
- Weaker
- Higher polymerization shrinkage
- Less wear resistant
- Good polish
- Poor physical properties
- Not suitable for stress bearing sites (Class I,II, IV restorations)

Hybrid Composites

- Contain both large fillers (2-4 microns) and microfine fillers (0.04-0.2 microns)
- The combination of two filler sizes: large particles provide strength and smaller particles allow for a smooth, polished finish.
- The **Hybrid Composites** are called **universal composites** because they are esthetic, wear resistant, and strong. This allows them to be used in both anterior and posterior of mouth.
- * **Best choice** for an occlusal restoration.





Macrofilled vs Microfilled vs Hybrid

A- Macrofilled;
B- microfilled;
C- hybrid—a combination of micro fillers (about 0.4 µm) and small fillers (about 1-4 µm).

Microhybrid Composites

- Contain a mixture of small particles (0.04-1 micron) and microfine particles (0.01-0.1 microns)
- High Filler Content by Volume

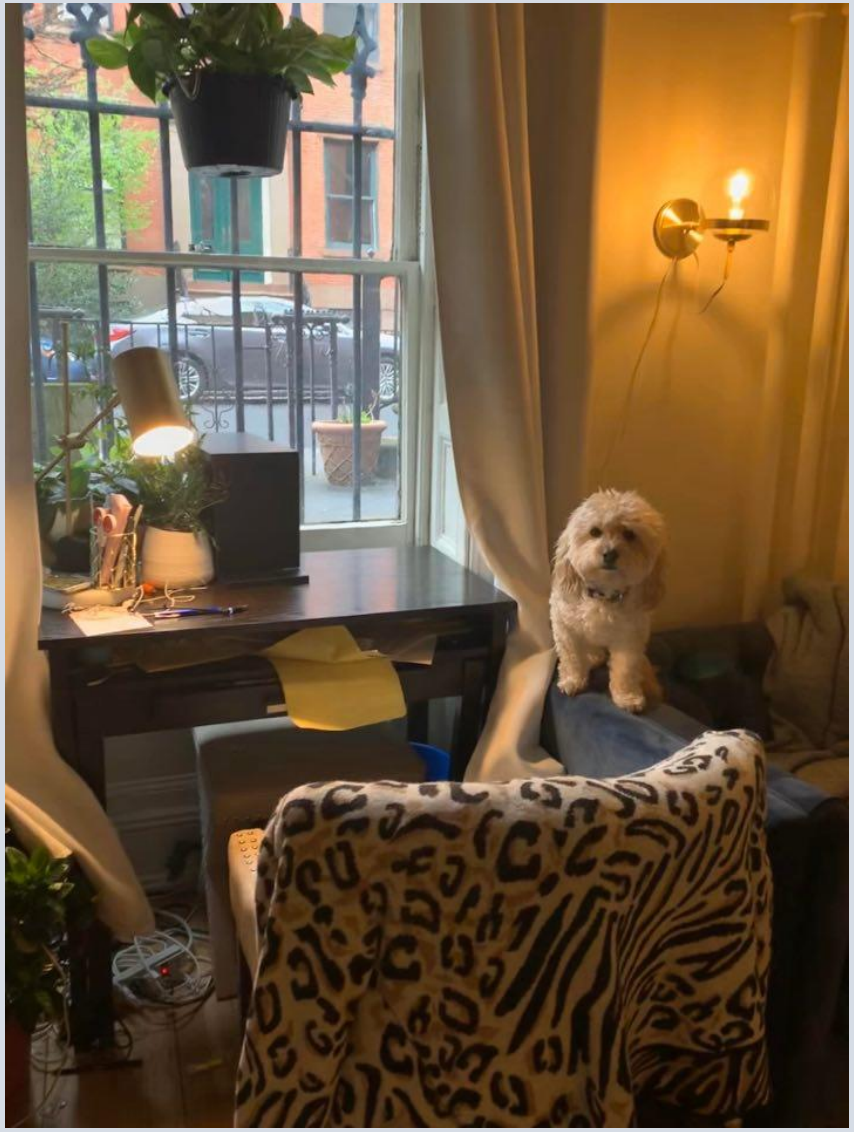
Nanohybrids

- Nanohybrids are microhybrids with nanosized particles added
- Their particle sizes range from 0.005 microns to 0.020 microns
- Using smaller filler particles allows the composite to have increased numbers of filler particles and decreased amount of resin
- Because of less resin, less polymerization shrinkage than microhybrids
- Strong material
- Polish to high shine
- Retain shine better than previous composites

Nanocomposites

- Filler particles that range from 5-75 nanometers
- Have a combination of individual spheroidal particles and clusters of these particles
- The spaces between the particles in the cluster are filled with silane (coupling agent), which helps bind the clusters to the resin matrix
- Nanoclusters range from 0.6-1.4 microns
- Even higher overall filler content further reduces polymerization shrinkage and increases strength and toughness.
- Excellent polishability, improved wear resistance, will retain luster long term.
- Have handling characteristics and physical/mechanical properties similar to microhybrids and nanohybrids.
- More translucent (small particle let more light through)
- Blends in with tooth better

Break Slide



Packable Composite vs. Flowable Composite

What is in a Glass Ionomer

1) Calciumaluminofluorosilicate

2) Polyacrylic Acid

3) Bioactive Composite

Glass Ionomer Properties

- Chemical Bond
- Acid Base Reaction
- Releases Fluoride
- Fluoride is absorbed from saliva and released to help prevent recurrent decay.
- Fluoride Release makes GI an excellent restorative material in Pediatric and Geriatric Patients
- Lower Bond Strength than Resin Composite
- Not as strong as a Resin Composite
- Doesn’t polish as nicely as a Resin Composite
- Less Technique sensitive
- More forgiving of moisture contamination
- Sets 1-2 minutes after placement

Fuji IX Glass Ionomer

Compomers

- A Mix of Properties between Resin Composite and Glass Ionomer
- Some Fluoride Release, but not as much as a Glass Ionomer
- Some Micromechanical bonding, but not as much as Resin Composite
- Some Chemical bonding, but not as much as a Glass Ionomer
- Leaky
- Poor Performance
- Not widely used due to poor performance

Things to Consider

- **Hue-** The color of the tooth and may include mixtures of colors, such as yellow-brown.
- **Chroma-** The amount or intensity of color present. This is what creates the hue.
- **Value-** The amount of lightness or darkness of the tooth (sometimes described as the grayness of the tooth).
- **Translucency-** The ability of the material to allow light to pass through.

Overview of Steps for Resin vs Glass Ionomer Filling

Resin Composite Technique Sequence

1- Condition tooth with Acid Etch
(and then rinse)

2- Place Bonding Agent
(and then light cure)

3- Place Resin Composite
(and then light cure)

Glass Ionomer

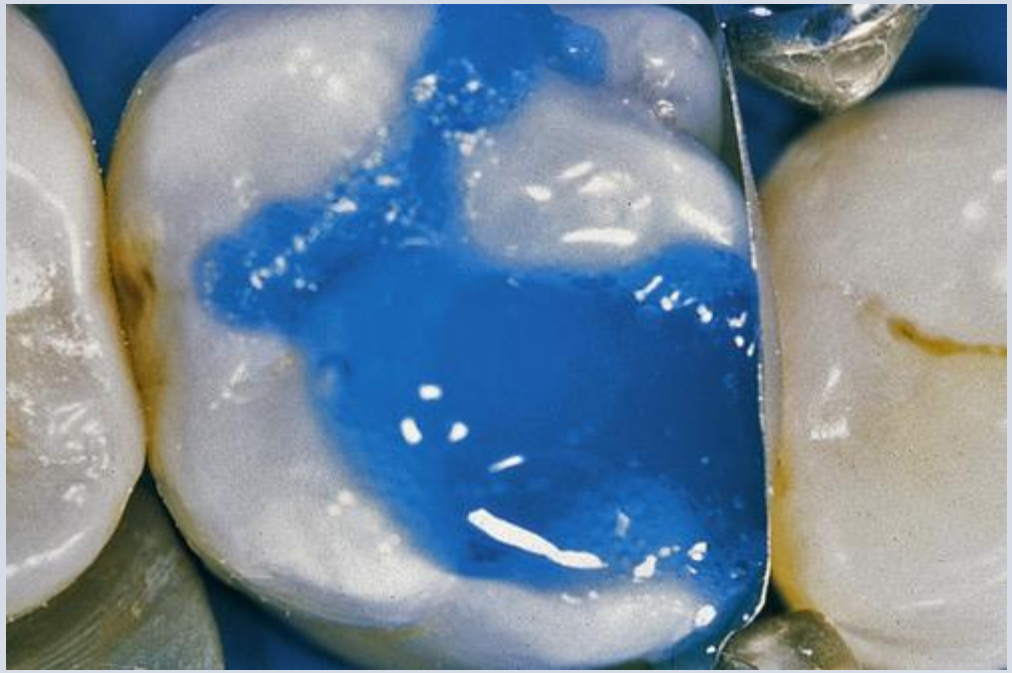
1- Place Glass Ionomer
(and wait for it to set)

Resin Composites

Step 1: Phosphoric Acid Etch Enamel and Dentin (and rinse)

- **The Phosphoric Acid Etch “opens” the enamel rods and dentinal tubules creating “tags and tunnels”, which increase the surface area for the sealant material.**

- **The gel is left on the tooth's surface for about 15 to 30 seconds, and this controlled erosion it creates gives the smooth enamel surface a frosty appearance.**



Steps for Resin Composite Placement

1) **Etch**
2) Bond
3) Composite

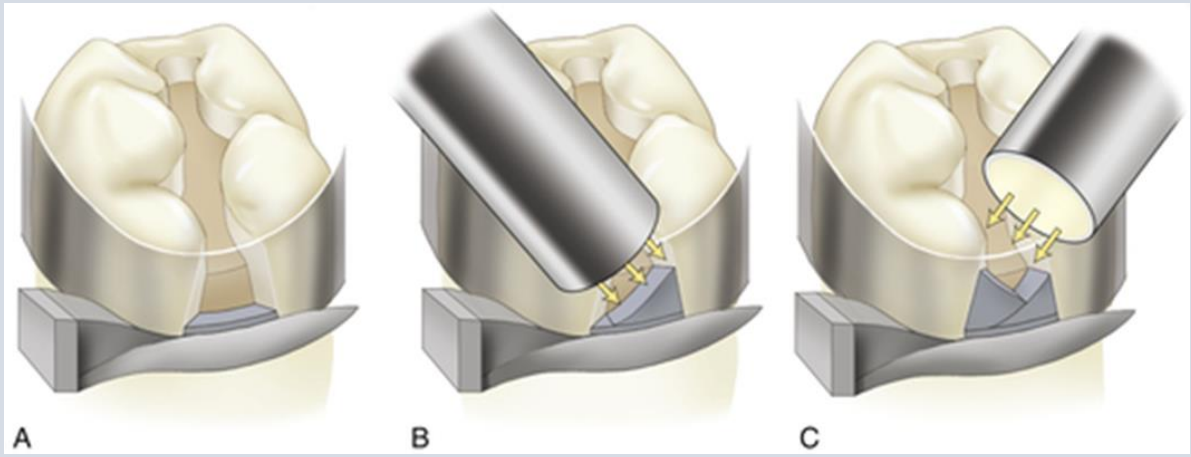
Etching “opens up” the enamel rods and dentinal tubules so that resin can flow into them and form a micromechanical bond

Step 2: Apply Bonding Agent (and light cure)

The Bonding Agent is an <u>adhesive</u> or "glue" that holds the tooth and the resin composite together

Step 3: Place the Composite (and light cure)

Build up the Composite (and cure) in Small Layers



Glass Ionomer Restoration

Step 1: Place GI Material.

(Wait for It to Set)

Bioactive Composites

KEY FEATURES:

-Natural esthetics – Highly polishable

-Tough, resilient, wear and fracture resistant

-Releases and recharges calcium, phosphate and fluoride

-Chemically bonds – Seals against microleakage

-Stimulates remineralization and apatite formation

-Moisture friendly – Simplified technique

-Mimics a natural tooth

Bioactive Composite

Review Slide

-What is a Resin Composite?

-What are the properties of a Resin Composite?

-Flowable Composite and Packable Composite?

-What are the steps to place a Composite?

-What is a Glass Ionomer?

-What are the Properties of a Glass Ionomer?

-What is the step to place a Glass Ionomer?

Clinical Considerations

Phosphoric Acid Etch
-Very corrosive. If it gets on soft tissue (gums/mucosa), rinse off immediately
-tastes terrible, avoid getting etch on tongue, especially when rinsing

Light Cure
-We no longer use UV light in Dentistry. We use visible spectrum light.
-Can still damage your eyes. Look away when curing material.

Resin Composites and Resin Sealants:
-Very technique sensitive. Will fail if tooth is contaminated with moisture.
-Must use appropriate isolation (Cotton Roll, DryShield, Rubber Dam, etc.)

Glass Ionomer and Amalgam
-Less sensitive to moisture contamination.
-Adequate isolation still recommended.

Amalgam Restoration

- Much stronger than Resin or GI
- Not Esthetic
- Alloy of Silver (67-74%), Tin (25-28%), and Copper (6%), Mercury (3%)
- Mercury is inert in set amalgam
- The purpose of the Mercury is to add strength and durability of the amalgam.
- No bond between tooth and amalgam
- Relies on Retentive Preparation
- Unethical to remove silver filling and replace with composite just because dentist or patient wants to, or for asthethics.
- Acceptable to remove amalgam filling due failing restoration.
- After Placement, Takes Several Hours to Set

Temporary/Intermediate Filling Material

Cavit

- Slight expansion of the filling material ensures a well-sealed margin
- Pre-mixed, self-cured **temporary** sealing compound for the temporary restoration of cavities.
- **Often placed in between root canal appointments**

IRM (Intermediate Restorative Material)

- polymer-reinforced **zinc oxide-eugenol**
- Mix powder (zinc oxide) + liquid (eugenol)
- Intermediate restorative filling material
- IRM restorative may also be used as a base under restorative materials and cements that do not contain resin components.

Liners and Bases

- Bases and liners are ‘sandwiched’ between the cavity preparation and the restorative material of the operator’s choice

- A **dental liner** is a material that is usually placed in a thin layer over exposed dentin, within a cavity preparation. Its functions are dentinal sealing, pulpal protection, thermal insulation and stimulation of tertiary dentin. (ex- Dycal)

- A **dental base** is a material that is placed on the floor of the cavity preparation in a relatively thick layer. Its purpose is to protect the pulp by providing thermal insulation due to temperature changes and absorbing occlusal forces. (ex- IRM)

- A liner can be used underneath a base, but a base cannot be used underneath a liner

Resin Modified Glass Ionomer

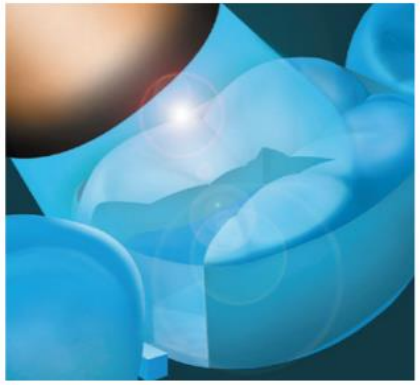
1

Preparation
- Isolate tooth. Remove caries.

Mixing
- Dispense 1 level powder scoop.
- Hold liquid vial vertically and dispense 1 drop.
- Mix within 10-15 seconds.
- Minimum working time is 160 seconds.

2

Placement
- Apply in thin layer (1/2 mm or less) covering dentin.



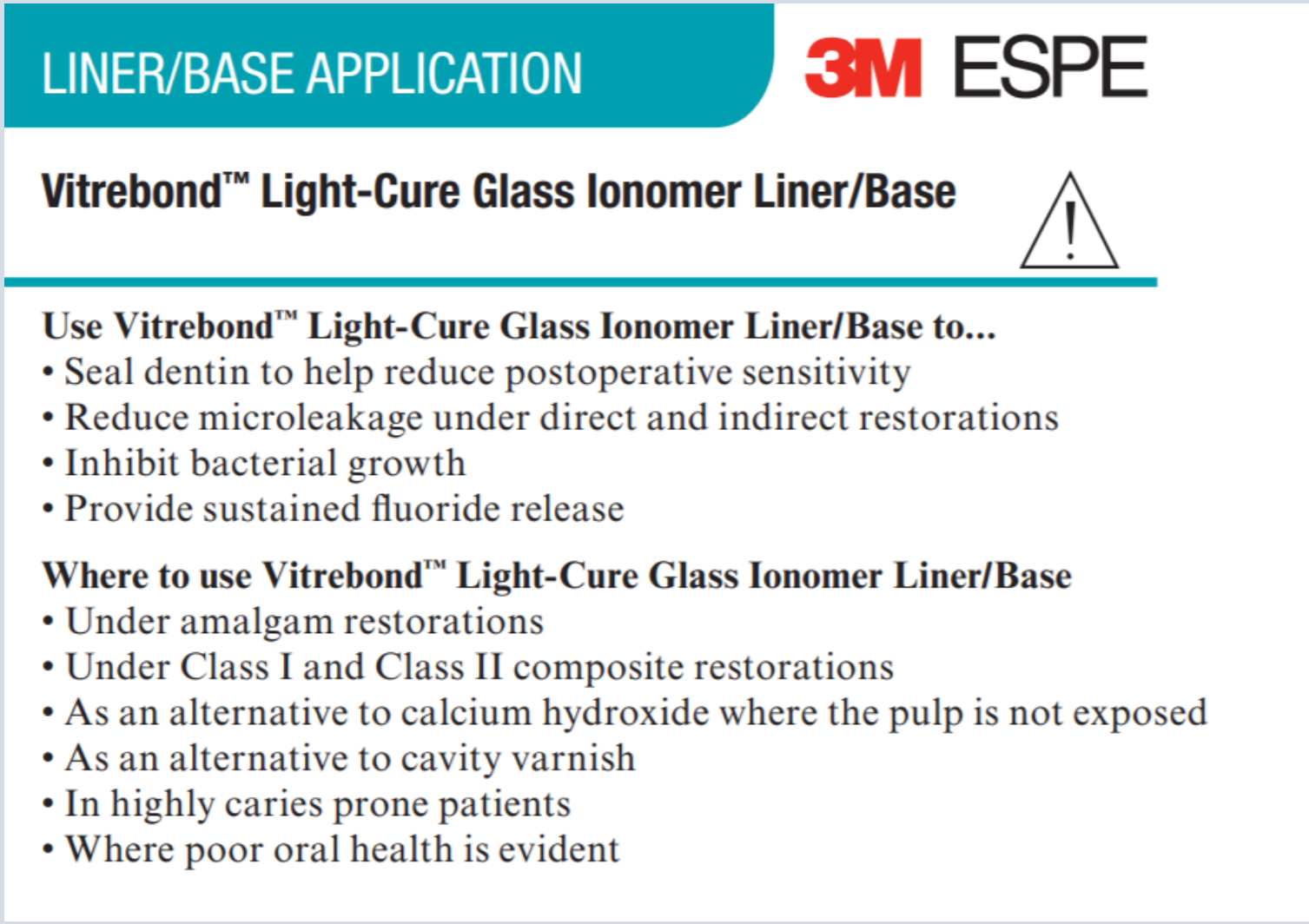
3

Curing
- Light-cure for 30 seconds.
- If needed, a second layer up to 2mm may then be placed and cured.
- Continue with the restorative procedure.

Example of RMGI (Compomer)

Vitrebond Application

Example of RMGI: Vitrebond Application



LINER/BASE APPLICATION

3M ESPE

Vitrebond™ Light-Cure Glass Ionomer Liner/Base

Use Vitrebond™ Light-Cure Glass Ionomer Liner/Base to...

- Seal dentin to help reduce postoperative sensitivity
- Reduce microleakage under direct and indirect restorations
- Inhibit bacterial growth
- Provide sustained fluoride release

Where to use Vitrebond™ Light-Cure Glass Ionomer Liner/Base

- Under amalgam restorations
- Under Class I and Class II composite restorations
- As an alternative to calcium hydroxide where the pulp is not exposed
- As an alternative to cavity varnish
- In highly caries prone patients
- Where poor oral health is evident

Example: RMGI (Vitrebond) Placement

Deep Caries Excavation

Liner Placed

Light Cure

Vitrebond Set

Now the permanent restoration will be placed on top.

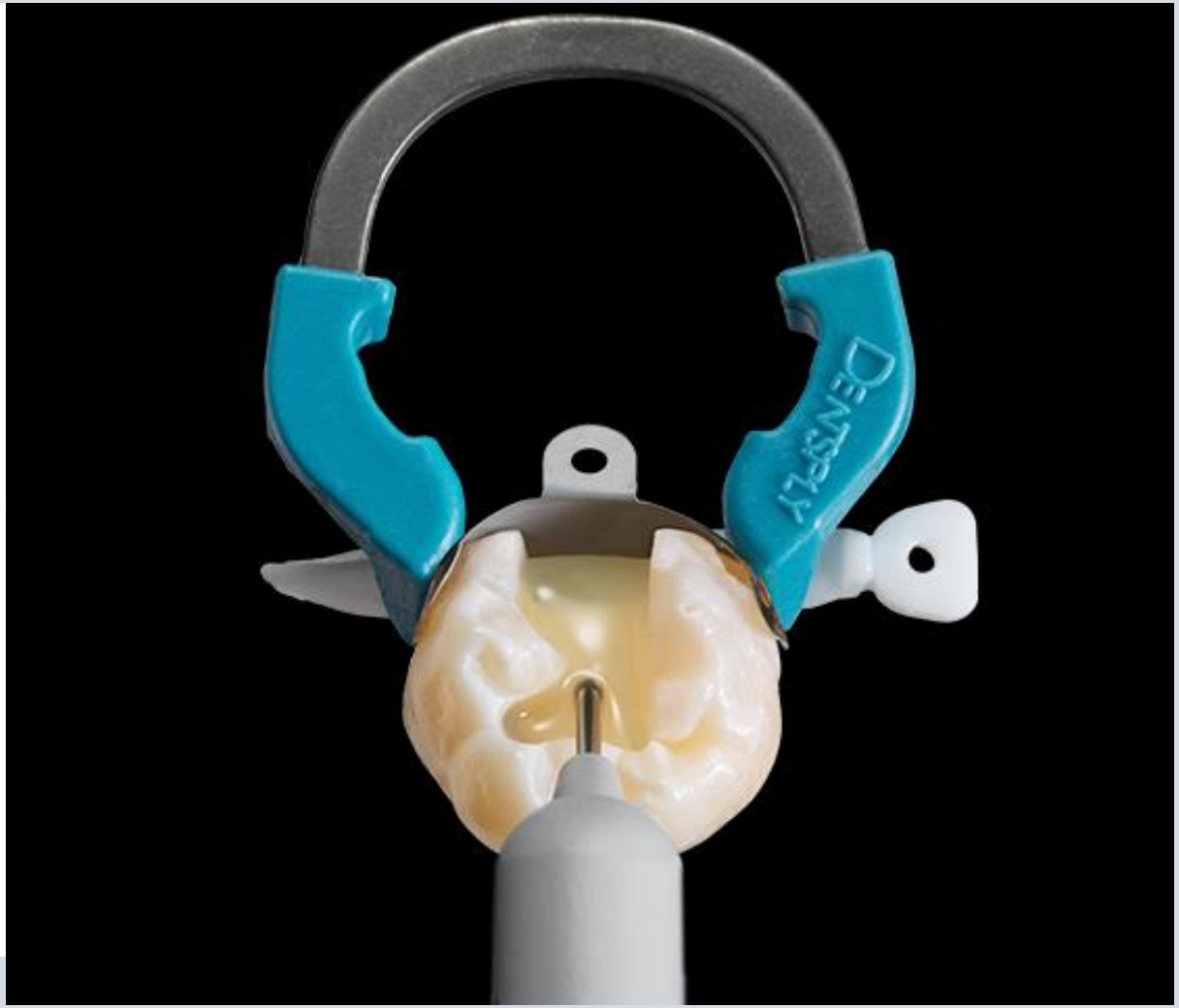
Review Slide

- Class I and Class II restorations can be placed using Resin Composite, Glass Ionomer or Amalgam restorative Materials
- Best Material depends on Clinical/Patient Considerations
- Very often more than one material is appropriate
- Bases and liners are ‘sandwiched’ between the cavity preparation and the restorative material of the operator’s choice

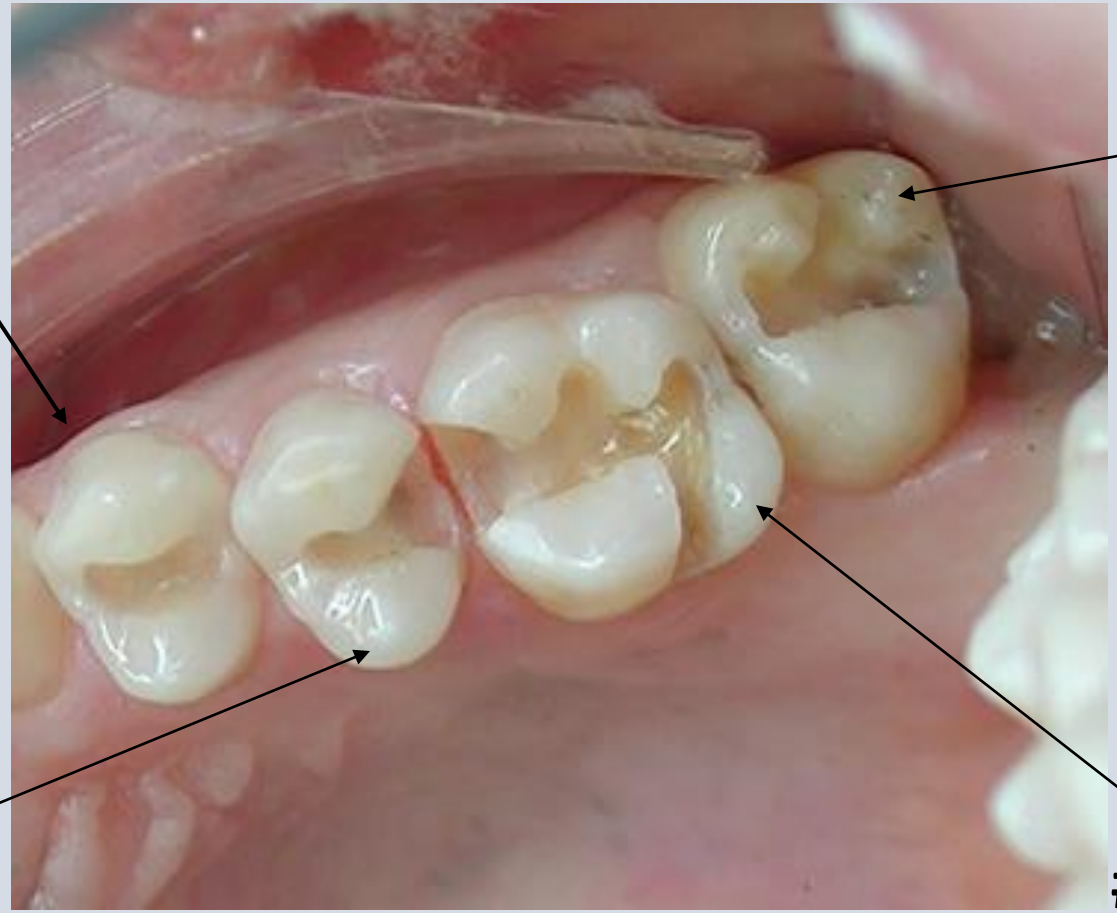
Class II, III, IV Direct Restorations Require a Matrix System

- Class II fillings start on the occlusal and extend interproximal (mesial and/or distal)
- Matrix Band or Sectional Matrix Band
- Wedges

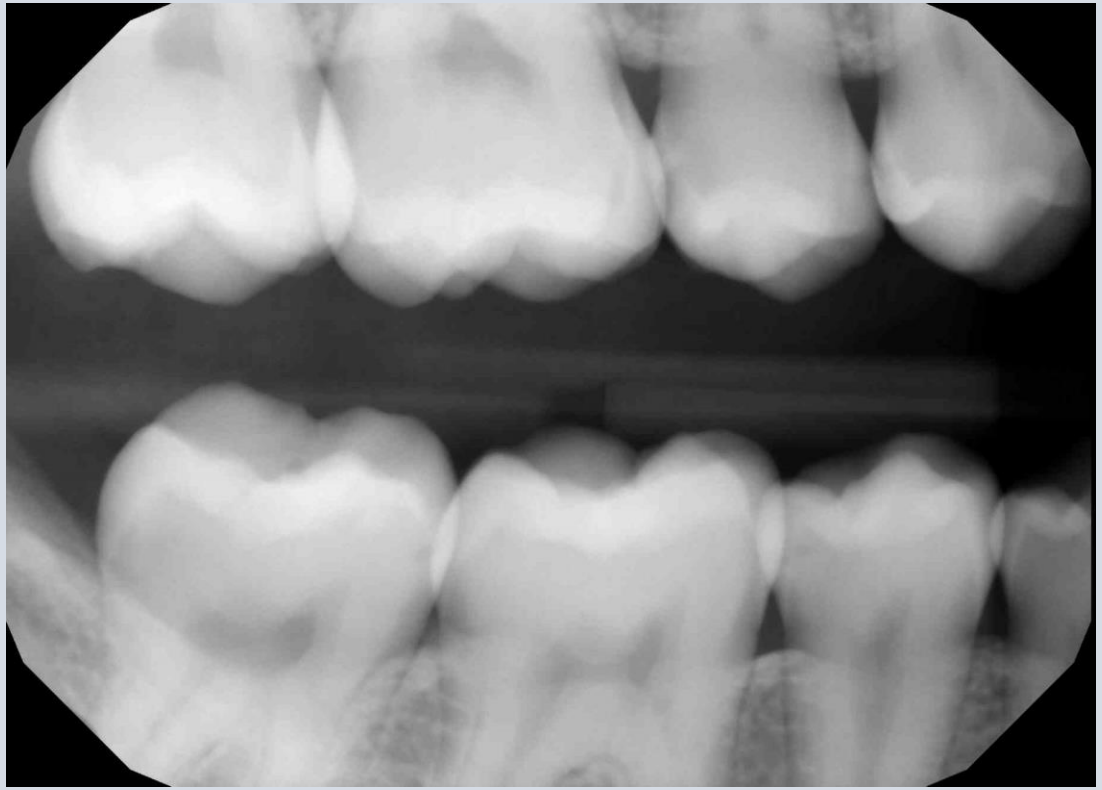
Sectional Matrix and Plastic Wedge



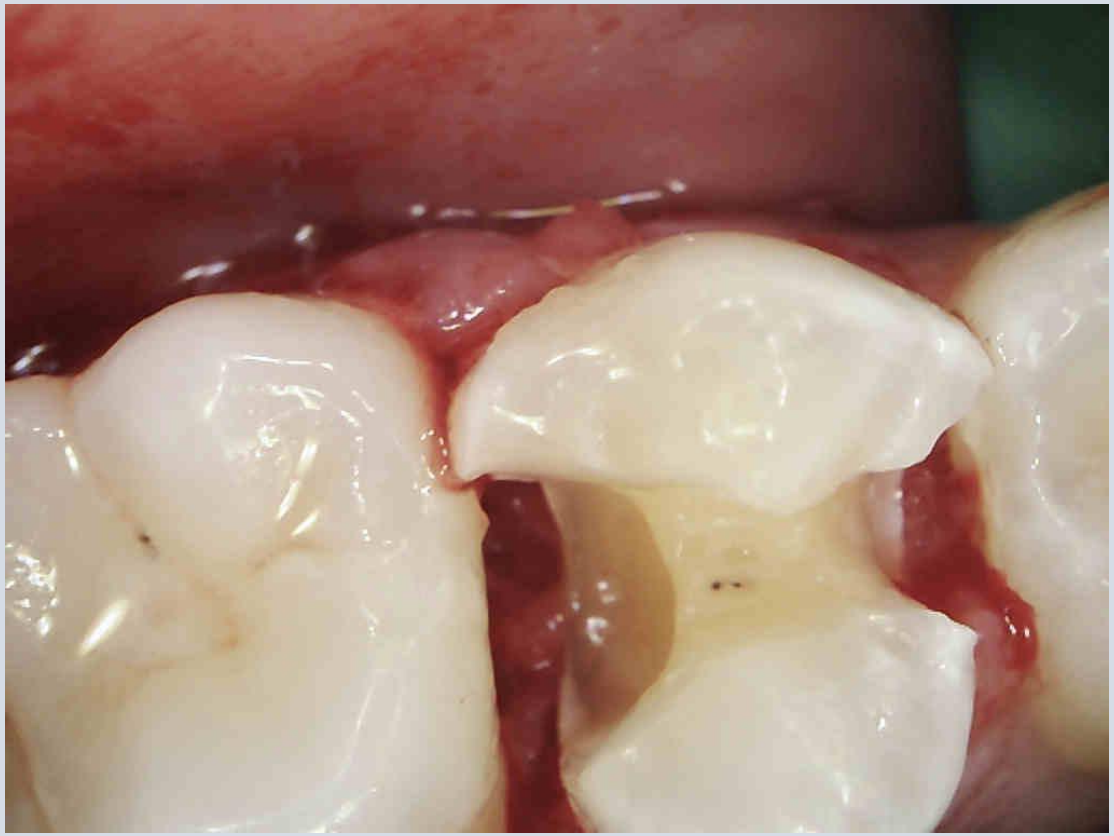
Examples of Class I and Class II Preparations



Clinical Case: #4 MOD Composite

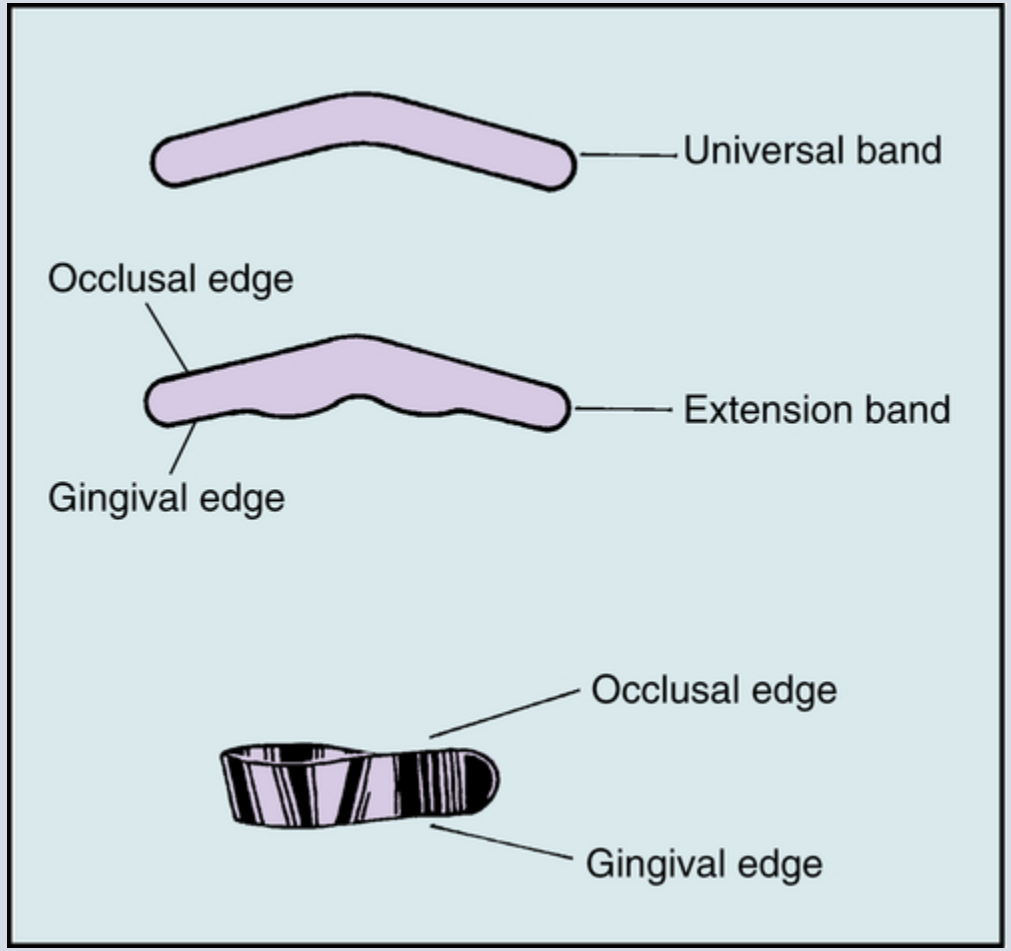


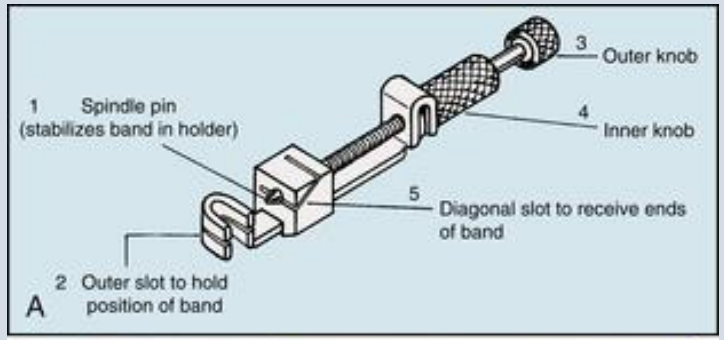
Clinical Case: #4 MOD Composite



Clinical Case: #4 MOD Composite

Tofflemire & Matrix Band





Tofflemire + Matrix Band + Wooden Wedge

Overhanging Restorations

- Food Trap
- Bone Loss
- Decay
- Tissue Irritation
- Sensitivity
- Difficult to Floss
- Difficult to Clean
- Difficult to scale during hygiene visit

Margination- process of mechanically removing excess restorative material in order to produce a smooth surface which stimulates normal tooth contours. -during margination, the contours of the restoration are blended to the normal contours of the tooth to restore the functional anatomy and provide a healthy environment for the periodontium. *Should only be performed when the overhang is small.

Break Slide

Dental Sealants

A dental sealant “seals” or covers anatomical pits and fissures on the smooth surfaces of teeth (occlusal/buccal/lingual) in order to keep out biofilm and prevent decay.

- Indications
- Isolation
- Sealant Materials
- Steps

Magnification of Sealant and Occlusal Surface

Cross Section of Fissure

Sealant Indications

Indications

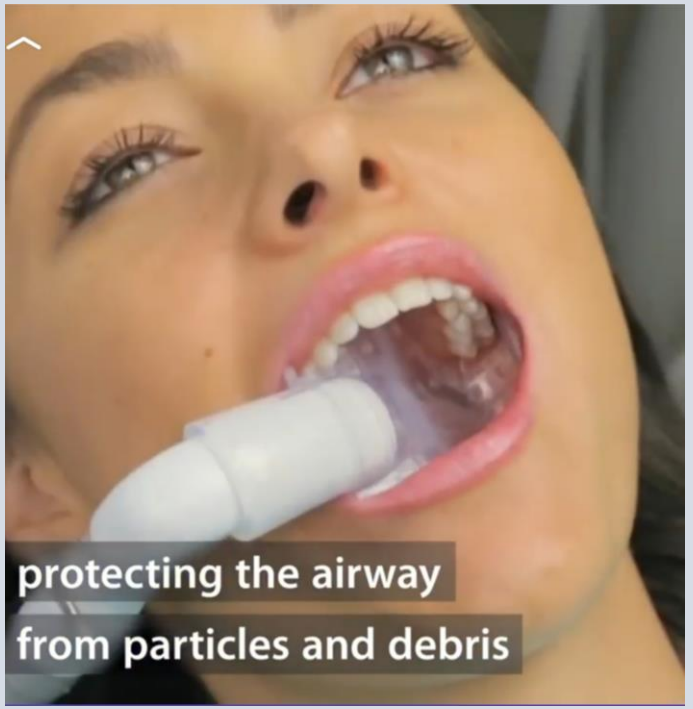
- Deep pits and fissures
- Moderate/High caries risk
- Newly Erupted Teeth
- Preventative
- Incipient/Non-cavitated lesions

Contraindications

- Uncooperative Patient
- Cavitated Active Decay
- Unable to adequately isolate
- Parents object
- Existing Restoration on tooth surface.
- The most common reasons for sealant failure are inadequate isolation and subsequent contamination.

Isolation

- Cotton Roll/Dri-Angle Isolation
- Isolight or DryShield Isolation
- Rubber Dam Isolation
- **The ADA recommends the use of two operators to maintain a dry field during sealant placement, allowing one clinician to focus on moisture control.**



Types of Sealants

Resin Sealant (Sealant of Choice)

-Similar to a Flowable Composite

-High Resin/very low Filler content

-Better Bond to Tooth

-No Fluoride Release

-Must Etch Tooth First

-Light Cure

-Will Fail if Moisture Contamination

Glass Ionomer Sealant

-Weaker Bond to Tooth

-Fluoride Release

-Self Cure (takes longer to set)

-More Tolerant of Moisture Contamination (Moisture Friendly)

-Soft Food Diet to Follow

Sealant Classifications

- C**olor**: Clear, tinted, or opaque.
- **Content**- Filled, unfilled, or glass ionomer
- **Method of Polymerization**- Autopolymerization (Self Cure) or Photopolymerization (Light Cure)

Process of Resin Sealant- Light Cured

- Isolation (Rubber Dam / Cotton Roll w/ Dry Angles)
- Pumice
- Rinse
- Etch
- Dry Tooth (Chalky White / Matte)
- Place Sealant
- Light Cure
- Check for Retention
- Check Bite

* Air bubbles should not be present. If one should occur, re-etch, wash, dry, and apply additional sealant material.

Isolation

Pumice

Etch

35% phosphoric acid

Place Resin Sealant (and light cure)

- After dispensing sealant onto tooth, while it is still in liquid phase, run your explorer through all of the grooves to make sure that the sealant flows into all the deep fissures that we want to seal.

- This also helps to eliminate voids.

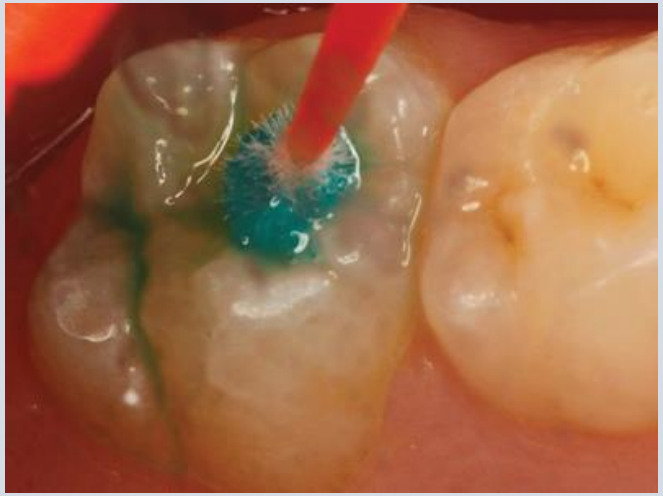
Placed Sealant

Process of Glass Ionomer Sealant- Self Cured

- Isolate with cotton rolls (Moisture Friendly)
- Pumice
- Rinse & Dry
- Condition 20 secs
- Rinse & Dry- (Tooth does not get “Chalky White”)
- Place GI Sealant (has to be triturated first)
- Check for Retention
- Check Bite

Pumice

Condition



20% PolyAcrylic Acid

Place Glass Ionomer

Video of Glass Ionomer Sealant Application

Do not disappoint Dr. Archer

Note: The application of the sealant material is in the base of the deep grooves on the occlusal surface not on the incline planes of the cusps

Dental Sealant

- Google image: https://rubashdental.wordpress.com/2011/11/

Sealant/Resin Composite Considerations

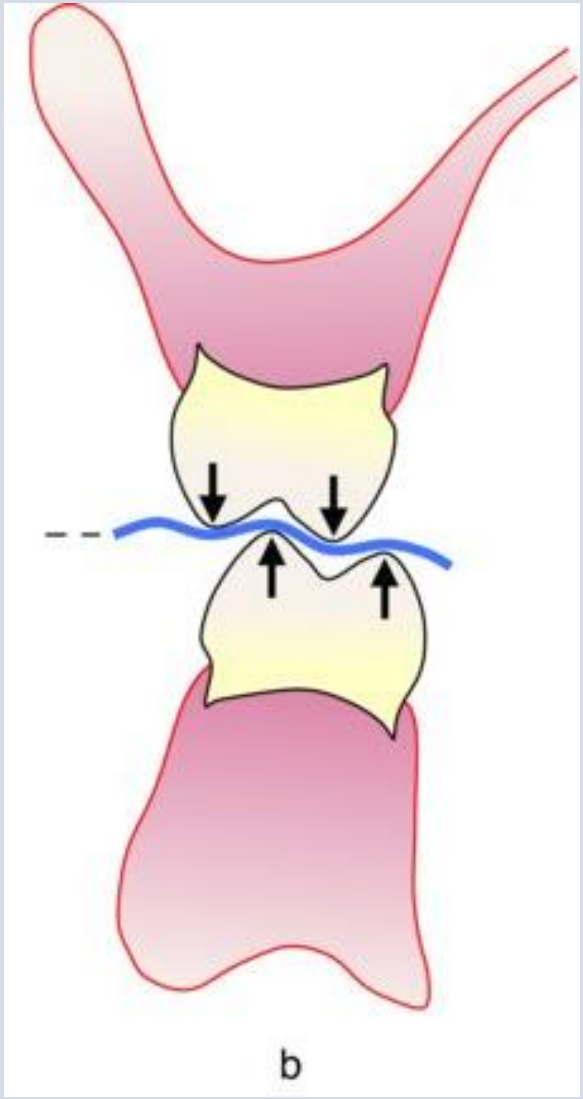
- Fluoride Inhibits Bonding between Resin and tooth structure
- DO NOT use products with Fluoride prior to Resin Sealants/Restorations

→This includes Fluoride Varnish and Prophy Paste

- **DO NOT engine polish with prophy paste before placing a sealant.**

Adjusting High Sealants and Composites

- Check with articulating paper to find the high spot
- Use a low speed handpiece or hand scaler to adjust
- Usually done with white stone, diamond or finishing carbide



Failing Restorations

Beautiful Sealant

Failing Composite

Maintenance During Hygiene Appointments

- Sometimes restorations (fillings) are very sensitive around the cavosurface margins
- If the patient is experiencing discomfort, either lower the power on the ultrasonic or switch to hand scalers
- If there is an overhang, you may have to alter flossing technique and pull the floss out sideways after inserting it. Otherwise it will shred
- Be careful when scaling overhangs that your instrument does not get stuck. Additionally, no matter how much you scale, an overhang will not become smooth. ***AVOID scaling overhanging restorations in our clinic.**
- Sealants and Fillings can all be engine polished with a fine prophy paste as needed.

The End