DENTAL MATERIALS

Terminal Learning Objective

Identify the basic facts and principles relating to dental materials and mercury hygiene with 70% accuracy.

Enabling Learning Objectives

a. Identify the basic facts and principles of chemistry relating to dental materials with 70% accuracy.

b. Identify the basic facts and principles of bases and liners relating to dental materials with 70% accuracy.

c. Identify the basic facts and principles of temporary sedative filling materials and cements with 70% accuracy.

d. Identify the basic facts and principles of glass ionomer products relating to dental materials with 70% accuracy.

e. Identify the basic facts and principles of impression materials, restorative resins, and amalgam relating to dental materials with 70% accuracy.

f. Identify the basic facts and principles of material safety relating to dental materials and mercury hygiene with 70% accuracy.

g. Identify the facts and principles of the precious metals recovery program with 70% accuracy.
INTRODUCTION

In the dental clinic you may work with many materials that you have never heard of before. The oral health of your patient and the success of the treatment depends largely on your knowledge of those materials. If mixed and placed correctly, these materials will last a long time.

The amalgam restoration is made possible only because of the unique characteristics of mercury. It is this metal that provides the plastic like mass which can be inserted in the tooth preparation and finished. Dental restorations have been around for a very long time. Amalgam's first reported use was in 659 A.D. in the People's Republic of China. It is still one of the most commonly used restoration materials.

CHEMISTRY IN DENTAL MATERIALS

Chemistry is a science that deals with the composition of matter and the changes in composition that the matter may undergo. The base is the supporting ingredient in a material. The catalyst is the substance that initiates a chemical reaction.

The composition of matter is as follows:

- A mixture is two or more substances not chemically combined.
- A solution is a homogenous mixture that is uniform in consistency.
A solute is a substance that is dissolved, for example sugar in water.

**Solubility** is how well something dissolves. This would be influenced by the solvent, solute, temperature, and pressure.

A compound is two or more elements combined in definite proportions.

**pH** is a measurement of how basic or acidic a solution is based on a scale of 0-14. Bases are solutions measuring above 7 on the pH scale. The higher the pH number, the more basic the solution. Acids are solutions measuring below 7 on the pH scale. The lower the pH, the more acidic the solution. Neutral solutions such as water have a pH of 7.

**BASES AND LINERS**

Two types of bases that are commonly used are calcium hydroxide (Dycal) and Zinc oxide and Eugenol (Cavitec).

There are two types of calcium hydroxide, self-curing which is chemical cured and light cured. A self-curing material hardens because of a chemical interaction of materials being mixed together. A light-cured material does not harden until it is exposed to a curing light. A light cured formula is more resistant to the acid-etching process. Calcium hydroxide is a protective base that soothes the pulp and promotes the formation of reparative dentin. It is put directly over the pulpal floor of the restoration. It is mixed according to the manufacturer's instructions. Apply calcium hydroxide to a dry cavity preparation.

Zinc oxide and Eugenol are sedative bases that are placed to soothe the pulp. It is placed directly over the pulpal area of the tooth. It is used in deep cavity preps and provides some thermal insulation. It is mixed according to the manufacturer's
instructions. It is applied to a dry cavity prep and is not used under composite restorative material.

Before the placement of a restoration, **Liners** *(Copalite, Plastodent, Amalgambond, All-Bond II)* are placed as a barrier that seals the exposed surfaces of a prepared tooth.

**Varnishes** are liners that are used primarily to protect pulpal tissues. They seal dentinal tubules (microscopic canals). They control the initial leakage between the restoration and the tooth structure (microleakage). They cannot be used under composite restorative material. Make sure to cap the bottle after it is used to prevent evaporation. Maintain the proper concentration by adding solvent when needed. To maintain infection control, do not re-dip the cotton into the varnish.

**Dentin bonding agents** are primarily used to seal dentinal tubules that are cut during tooth preparation. They control the transmission of fluids and microorganisms to the pulp of the tooth by sealing the dentinal tubules.

**TEMPORARY SEDATIVE FILLING MATERIALS AND CEMENTS**

**Intermediate Restorative Material (IRM)** is a reinforced zinc oxide-eugenol composition that is used for intermediate restoration that last up to 1 year. They can be used as a base or temporary cement. They are not used under composite restorative material. You mix IRM in accordance with the manufacturer's instructions.

**Zinc Phosphate Cement (Zinc oxide and Phosphoric Acid)** is a cementing agent for crowns and fixed partial dentures (FPDs). It is also used for temporary restorations and as an insulating base. It produces heat when mixing. It is prepared according to the manufacturer's instruction. Mix it over a large area on a glass slab to dissipate heat (heat accelerate setting time).

**GLASS IONOMER PRODUCTS**
Glass ionomer cement bonds to enamel, dentin, and metals. It is used as a cementing agent for crowns and FPDs, temporary fillings, and lining material. It releases fluoride ions. It is mixed in accordance with the manufacturer's instructions. The teeth should be clean and slightly moist when it is applied. The cement should appear glossy. A dull appearance means the setting reaction has occurred.

Base - light cured glass ionomer bonds well to tooth structure. It contains fluoride and is used under restorative material. It is prepared in accordance with the manufacturer's instructions. The mixture should have a smooth consistency and a glossy appearance. Apply the mixture to a slightly moist cavity prep. Light cure it for 30 seconds. Avoid any contact with soft tissue.

Glass ionomer restorative material (Ketac-fil) is an excellent match with the tooth color. It releases fluoride ions. It is mixed in accordance with the manufacturer's instructions. The mixing time affects the setting time. Avoid any contact with the soft tissues and apply it to a clean, slightly moist cavity prep.

IMPRESSION MATERIALS

Alginate impression material is not as accurate as other impression materials. It is used for preliminary impression and study casts and is usually not used for final impressions. It is easy to mix and use and requires little equipment. It is cheaper than other impression materials. It is an irreversible hydrocolloid that means that it cannot return to a solution after it becomes a gel. Do not inhale the powder. Regular set alginate has a working time of 2 minutes and a setting time of 4 1/2 minutes. Fast set alginate has a working time of 1 minute and a setting time of 2 minutes. The setting time is directly affected by the temperature of the water and the patient's mouth.

Vinylpolysiloxane impression material (Reprosil) is an extremely accurate impression material used for final
impressions. It is used to take crown and bridge impressions and precise duplication of models (diagnostic casts) in the dental laboratory. There are four types. A light body (low viscosity) that is used in a syringe or tray. A regular body (medium viscosity) that is used in a syringe or tray. A heavy body (high viscosity) that is used in a tray. A putty that is used in a tray.

Sterilize instruments used in treatment (amalgam carrier, impression trays, etc.). Disinfect impression material prior to sending it to the lab. Rinse everything thoroughly, spray with disinfectant solution, and play in a sealed plastic bag and give it to the lab.

RESTORATIVE RESIN MATERIALS

**Acid etch** (35 - 50% solution of phosphoric acid) increases the bond between tooth enamel and resin. It provides an added source of retention and marginal seal. The procedures for acid etching of an enamel surface are as follows:

- Dry the cavity prep thoroughly.

- Apply the etch to the enamel walls; leave it on in accordance with the manufacturer's instructions.

- Rinse/dry thoroughly.

- The treated tooth will appear chalky.

- If the prep becomes contaminated with saliva, repeat the procedure.

Avoid contact with the soft tissue and rinse thoroughly if contaminated; protect the pulp.

The purpose of a **bonding agent** is to chemically bond composite filling material to tooth structure. If using the
light cured method, no mixing is required. The procedures for applying a bonding agent are as follows:

- Apply the bond to the etched tooth surface (use of a dentin primer prior to bonding is optional).
- Light cure in accordance with the manufacturer's instructions (20 - 30 seconds average time).

CAUTION: Proper use of the protective light shield when curing bonding agent eliminates the potential eye hazards to the provider and the patient.

Light cure composite resin (Primsa) is a restorative material that is used primarily for anterior teeth, and it matches natural tooth color. It is applied using the following procedures:

- Apply the base.
- Etch the tooth in accordance with the manufacturer's instructions.
- Apply the bonding agent and light cure.
- Place the resin material and light cure for 20 - 40 seconds per layer (time varies dependent upon shade).
- Finish and polish the restoration.

CAUTION: Ensure the proper use of the light shield and dispense materials prior to use.

**AMALGAM**

Amalgam is an alloy containing a mixture of silver, tin, copper, mercury, and zinc. Newer amalgams are made without mercury (Gallium Alloys). Amalgam is supplied in pre-capculated
form. Amalgam restorations are primarily used on posterior teeth, but they can be used to restore all surfaces. Amalgam is soft, pliable, and easily shaped when it is freshly mixed. Once it has hardened, it forms a strong restoration that can withstand biting forces. Amalgam is not esthetic because the silver color does not match the natural tooth color. Microleakage and recurrent decay may occur if it does not bond directly to the tooth. Although amalgam contains mercury, a long history of its safe usage exists.

MATERIAL SAFETY

Material Safety Data Sheets (MSDS's) contain information about chemical and physical hazards in the workplace. The MSDS's should be centrally located within the clinic. This allows easy access for all clinic personnel. Misuse of chemicals can cause injury to you or to a patient (chemical burns, skin, and eye irritation) and they can ruin clothing.

Hazardous materials used in patient treatment should be properly stored. In the dental treatment room there normally should be a 1 to 2 week supply. This is usually established by local clinic policy. The bulk of hazardous materials should be stored centrally located in a flame proof cabinet.

MERCURY HYGIENE

Mercury can be absorbed by dental personnel in three ways. It can be absorbed though the skin by direct contact when handling mercury or mercury containing compounds. Vapors from mercury or mercury containing substances can be inhaled. Exposure to contaminated office spaces can be caused by accidental spills, vaporization of mercury from contaminated instruments placed in sterilizers, amalgam condensation (especially with ultrasonic compactors), scrap amalgam improperly stored, and contaminated amalgamators.

Mercury absorbed through the skin or by exposure to contaminated office space can easily be prevented by avoiding spills, cleaning spills carefully, and by not directly handling mercury or newly mixed amalgam for any reason.
Mercury vapors are a more serious threat; therefore, a well ventilated work area should be maintained. Without preventive measures and ways to monitor these vapors, we would never know what sort of danger exits. Mercury vapors have no scent, they are invisible, and they cannot be felt. This makes them extremely dangerous.

Mercury collects within the body faster than the body can get rid of it. A small amount of mercury poisoning every day could cause serious illness or possibly death over a long period of time. Bio-environmental engineering uses "mercury sniffers" to check mercury vapors on an annual or as needed basis.

Mercury poisoning has bizarre symptoms that can easily be misdiagnosed. They include the following:

- A fine tremor observable in handwriting or other fine movements, eventually progressing to convulsions.
- Loss of appetite.
- Nausea and diarrhea.
- Headache.
- Insomnia, depression, fatigue, increased irritability, and pneumonia.
- Swollen glands and tongue.
- Allergic manifestations (contact dermatitis).
- Dark pigmentation of the marginal gingiva.
- Loosening of the teeth.
- Possibly death.

Minimize vapors and avoid storing or using mercury around heated areas such as sterilizers and sunny areas. The heat causes vaporization.
Use the following work place practices when handling mercury:

- Avoid touching your hair or face after handling mercury.
- Wash hands thoroughly.
- Never wear jewelry (mercury combines readily with silver and gold).
- Store scrap amalgam in a dry, tightly sealed, unbreakable container.
- Work over a rimmed metal tray to contain possible spills or droplets from contaminating the floor, work area, patient, provider, or self.
- Avoid unnecessary contact to the skin and inhalation of mercury vapors.
- Use pre-capsulated amalgam.
- Run vacu-cleanse through vacuum lines prior to removing amalgam trap.
- Capsules which contain separate bladders for mercury should be disposed with scrap amalgam. The capsule itself can be disposed with normal trash.
- Use water spray and high volume evacuation when cutting and polishing amalgam to minimize mercury vapors.
- Recap used amalgam capsules immediately after dispensing the contents.
- Report mercury spill to your immediate supervisor and bio-environmental engineering office as soon as possible so that the spilled mercury can be picked up by a special suction system.

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PRECIOUS METALS RECOVERY PROGRAM

The precious metals recovery program is designed to save money and conserve our natural resources. Comply with local policies for the retention and turn-in of precious metals. These items would include silver bearings scraps such as scrap amalgam, scrap dental x-ray film (exposed/unexposed), and x-ray fixer solution (used).

REFERENCE